



**875-0376-0**

User Guide  
Revision: A4  
October 1, 2021

**Vector™ V500  
GNSS Smart Antenna**

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## Device Compliance, License and Patents

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### Device Compliance

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

This device may not cause harmful interference, and

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](https://hemispheregnss.com/about-us/quality-commitment).

E-Mark Statement: This product is not to be used for driverless/autonomous driving.

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Patents			
6111549	6876920	7400956	8000381
6397147	7142956	7429952	8018376
6469663	7162348	7437230	8085196
6501346	7277792	7460942	8102325
6539303	7292185	7689354	8138970
6549091	7292186	7808428	8140223
6711501	7373231	7835832	8174437
6744404	7388539	7885745	8184050
6865465	7400294	7948769	8190337
8214111	8217833	8265826	8271194
8307535	8311696	8334804	RE41358

Australia Patents	
2002244539	2002325645
2004320401	

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## V500 Terms & Definitions, Continued

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**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@HGNS.COM](mailto:PRECISION@HGNS.COM)  
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Hemisphere GNSS, Inc.  
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**Documentation  
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[HTTPS://HEMISPHERE.ATLASSIAN.NET/SERVICEDESK/CUSTOMER/PORTAL/2/USER/LOGIN?DESTINATION=PORTAL%2F2](https://hemisphere.atlassian.net/servicedesk/customer/portal/2/user/login?destination=portal%2F2)

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## V500 Terms & Definitions

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

### V500 terms & definitions

Term	Definition
1PPS	1 pulse-per-second is a pulse output by the receiver precisely once per second and is used for hardware synchronization.
Activation	Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see <a href="#">Subscription</a> .
Atlas	Atlas is a subscription-based service provided by Hemisphere that enables the V500 to achieve sub-decimeter accuracy without a base station or datalink.
Base Station	The Base Station is a receiver placed over a familiar point, provides real-time observations, and sends those observations to nearby RTK rovers via the internet.
BeiDou	BeiDou is a Chinese satellite-based navigation system.
CAN	Controller Area Network
DGPS/DGNSS	Differential GPS/GNSS refers to a receiver using Differential Corrections.
Differential Corrections	A method of improving precision of a GNSS rover. Two GNSS receivers placed in a nearby area will have similar error. A base station is placed over a known point.

*Continued on next page*

## V500 Terms & Definitions, Continued

V500 terms & definitions, continued

Term	Definition
Elevation Mask	Elevation Mask is the minimum angle between a satellite and the horizon for the receiver to use that satellite in the solution.
EMC	Electromagnetic compatibility (EMC) is the ability of electrical equipment and systems to function in their electromagnetic environment, by limiting the unintentional generation, propagation and reception of electromagnetic energy which may cause unwanted effects such as electromagnetic interference (EMI) or even physical damage in operational equipment.
Firmware	Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.
GALILEO	Galileo is a global navigation satellite system implemented by the European Union and European Space Agency.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System deployed and maintained by Russia.
GNSS	Global Navigation Satellite System (GNSS) is a system that provides autonomous 3D position (latitude, longitude, and altitude) and accurate timing globally by using satellites. Current GNSS providers are: GPS, GLONASS and Galileo.
GPS	Global Positioning System (GPS) is a global navigation satellite system implemented by the United States.
Heading	Heading is the angle between true north and the vector calculated from the primary to secondary antenna.
Heading Bias	Heading Bias is an offset applied to the heading value calculated by the receiver.

*Continued on next page*

## V500 Terms & Definitions, Continued

V500 terms & definitions, continued

Term	Definition
IRNSS	The Indian Regional Navigation Satellite System, an autonomous regional satellite navigation system that provides accurate real-time positioning and timing services.
mFreq	Multi-frequency
Multipath	Multipath occurs when the GNSS signal reaches the antenna by two or more paths. This causes incorrect pseudo-range measurements and leads to less precise GNSS solutions.
NMEA	National Marine Electronics Association (NMEA) is a marine electronics organization that sets standards for communication between marine electronics.
ppm	Pulse per minute
QZSS	Quasi-Zenith Satellite System, a four-satellite regional time transfer system and a satellite-based augmentation system developed by Japan
ROX	ROX is a Hemisphere GNSS propriety RTK message format that can be used as an alternative to RTCM3 when both the base and rover are Hemisphere branded.
RTK	Real-Time-Kinematic (RTK) is a real-time differential GPS method that provides better accuracy than differential corrections.
SBAS	Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.
SNR	Signal-to-noise ratio is a measure used in science and engineering that compares the level of a desired signal to the level of background noise.
Subscription	A subscription is a feature that is enabled for a limited time. Once the end-date of the subscription has been reached, the feature will turn off until the subscription is renewed.

*Continued on next page*



## V500 Terms & Definitions, Continued

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V500 terms & definitions, continued

Term	Definition
UHF	Ultra-high frequency is the ITU designation for radio frequencies in the range between 300 megahertz (MHz) and 3 gigahertz (GHz), also known as the decimetre band as the wavelengths range from one meter to one tenth of a meter (one decimeter).
WAAS	Wide Area Augmentation System (WAAS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of North America.

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# Chapter 1: Introduction

## Overview

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**Introduction** This User Guide provides information to help you quickly set up your Vector V500 GNSS Smart Antenna™. You can download this manual from the Hemisphere GNSS website at [www.hgnss.com](http://www.hgnss.com).

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## Product Overview

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### Product overview

Based on Eclipse Vector™ GNSS technology, the V500 (Figure 1-1) is designed for marine applications that require precise heading and RTK position performance.

The V500 is designed to withstand the stringent Marine EMC and Environmental requirements. It offers support for BT/Wi-Fi, Ethernet, CAN, RS-422, and RS-232. An optional external UHF radio can be connected.

Featuring an all-in-one Hemisphere GNSS Eclipse Vector-based receiver and two integrally separated antennas, with a baseline of 50 cm, the V500 achieves heading accuracy of up to 0.2° RMS (depending on environmental conditions) and offers robust positioning performance.



**Figure 1-1 V500 Smart Antenna**

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*Continued on next page*

## Product Overview, Continued

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, continued

The V500 provides accurate and reliable heading and position information at high update rates by using a high performance GNSS receiver and two antennas for GNSS signal processing.

One antenna is designated as the primary GNSS antenna, and the other antenna is the secondary GNSS antenna. Positions computed by the V500 are referenced to the phase center of the primary GNSS antenna. Heading data references the Vector formed from the primary GNSS antenna phase center to the secondary GNSS antenna phase center.

The standard model V500 tracks GPS, GLONASS, Galileo, BeiDou, and QZSS satellites.

The V500 can be upgraded via activations or subscriptions to support:

- Multi-frequency
  - Athena RTK
  - Atlas L-band
- 

### Athena RTK

Athena RTK (Real Time Kinematic) technology is available on Eclipse-based GNSS receivers. This is Hemisphere's most advanced RTK software and can be added to the V500 as an activation.

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
- 

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## Product Overview, Continued

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### Atlas L-band

Atlas L-band is Hemisphere's industry leading correction service, which can be added to the V500 as a subscription. Atlas L-band has the following benefits:

- **Positioning accuracy** - Competitive positioning accuracies down to 4 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 4 cm to 50 cm range
  - **Convergence time** - Industry-leading convergence times of 10-40 minutes
- 

### For more information

For more information about Athena RTK, see:  
[HTTP://HEMISPHEREGNSS.COM/TECHNOLOGY](http://HEMISPHEREGNSS.COM/TECHNOLOGY)

For more information about Atlas L-band, see:  
[HTTP://HEMISPHEREGNSS.COM/ATLAS](http://HEMISPHEREGNSS.COM/ATLAS)

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## Key Features

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### V500 key features

Key features of the V500 include:

- Simple all-in-one RTK-capable
  - Multi-frequency GPS/GLONASS/BeiDou/Galileo/QZSS/IRNSS
  - Athena™ RTK and Atlas® L-band capable
  - Supports Ethernet, CAN, Serial, Bluetooth, and Wi-Fi
  - Powerful WebUI accessed via Wi-Fi
  - Fully rugged solution for the harshest environments
  - Standard output rate 20 Hz
-

## What's Included in Your Kit

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### V500 kit

Table 1-1 lists the parts included with your V500. The V500 GNSS Smart Antenna and the power/data cable (accessory item) are the only two required components.

**Note:** The V500's parts comply with IEC 60945 Section 4.4: "Exposed to the weather."

### V500 Parts list

**Table 1-1 V500 Parts list**

Part No.	Description
752-0027-10	Vector V500 GNSS Compass
940-3119-10	Vector V500 GNSS Compass kit
150-0056-10	BT/Wi-Fi antenna

All the following items are available for purchase separately from your V500 receiver:

Part No.	Description
051-0421-10	15m V500 multi-function serial cable
051-0421-20	30m V500 multi-function serial cable
051-0422-10	15m ethernet cable
051-0422-20	30m ethernet cable
710-0152-10	22-Pin to 18-Pin adapter kit
150-0056-10	BT/Wi-Fi antenna
163-1004-000	Eclipse mFreq activation
163-1045-0	Athena RTK activations
Multiple	Atlas subscriptions

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## Firmware Upgrades

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### Overview

Periodically, Hemisphere GNSS releases firmware upgrades to improve performance, fix bugs, or add new features to a product. To update the firmware on the V500, choose from one of two options:

1. Download the latest version of Hemisphere GNSS RightArm from the following link:

[HTTPS://HEMISPHEREGNSS.COM/RESOURCES-SUPPORT/SOFTWARE](https://hemispheregnss.com/resources-support/software)

2. Use the internal WebUI.
- 

### RightArm Updates

Connect the V500 to a computer over serial. Firmware can be loaded over serial port. Set the baud rate of the serial port you are using to 19200.

Launch RightArm.

Click the **Connect** button or navigate to Receiver -> Connect.



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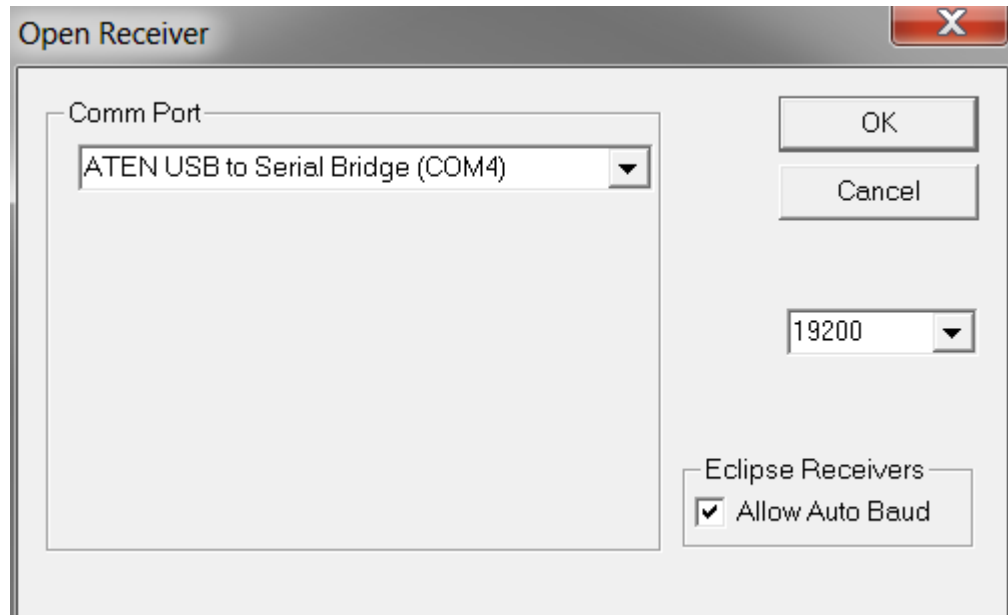


## Firmware Upgrades, Continued

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**RightArm  
Updates,  
continued**

Choose the COM port connected to the V500 and click **OK**.



**Note:** The baud rate of the serial port should be set to 19200 bps. Select **Allow Auto Baud** to change the baud rate during the firmware upgrade for a faster update.

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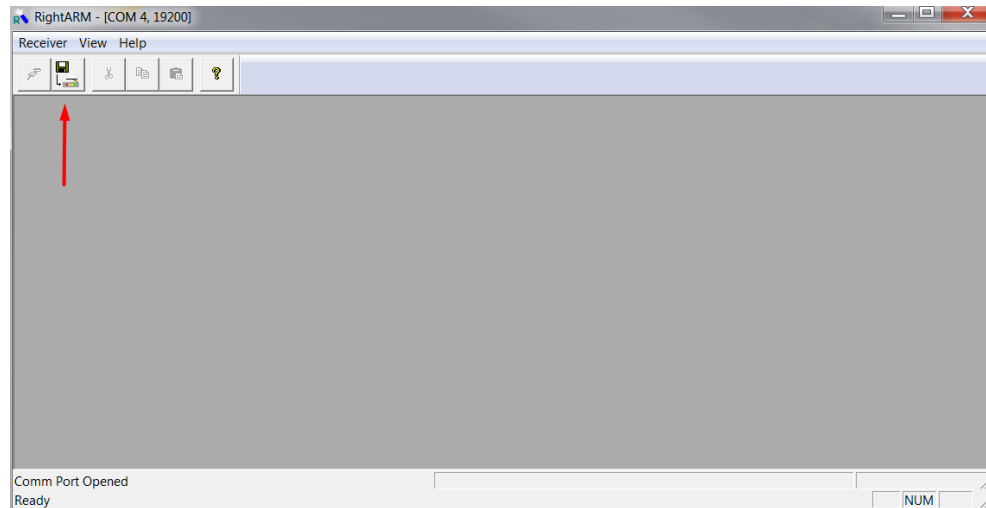
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## Firmware Upgrades, Continued

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RightArm  
Updates,  
continued

Click the **Programming** button.



Select a **Program Type**.

The V500 has two firmware applications, allowing two different versions of GNSS firmware. Hemisphere GNSS suggests loading the new firmware onto both applications.

After the firmware update is completed, check the current GNSS firmware.

If the current firmware is different from the newly loaded firmware, the V500 could be using the other application. You can switch applications by sending the following command:

```
$JAPP,OTHER.
```

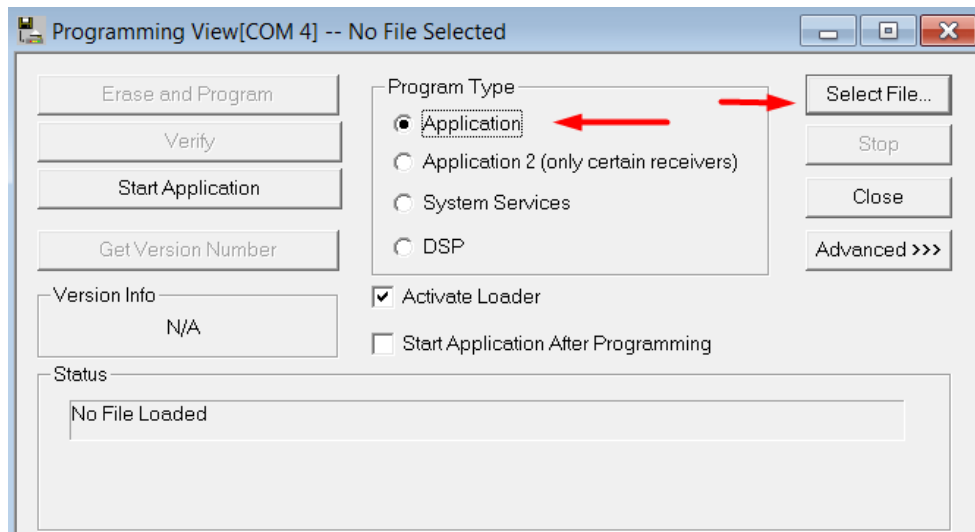
Choose the Application, and press **Select File** to select the firmware file.

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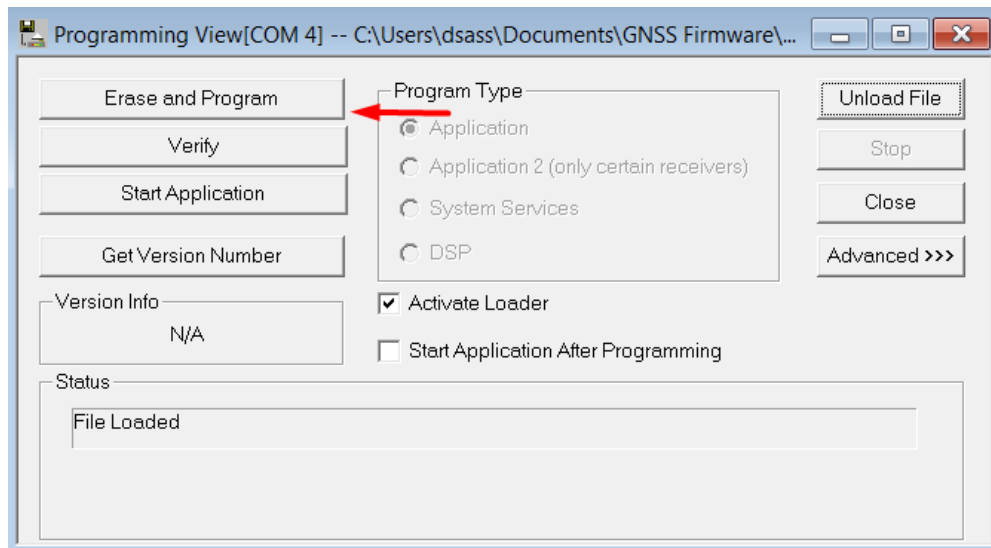
## Firmware Upgrades, Continued

RightArm  
Updates,  
continued



Choose the firmware, and click **Erase and Program**.

The **Activate Loader** checkbox in the Programming View window is selected. After pressing the Erase and Program button, this checkbox will de-select, and the **Status** field indicates the receiver is in loader mode (ready to receive the new firmware file).



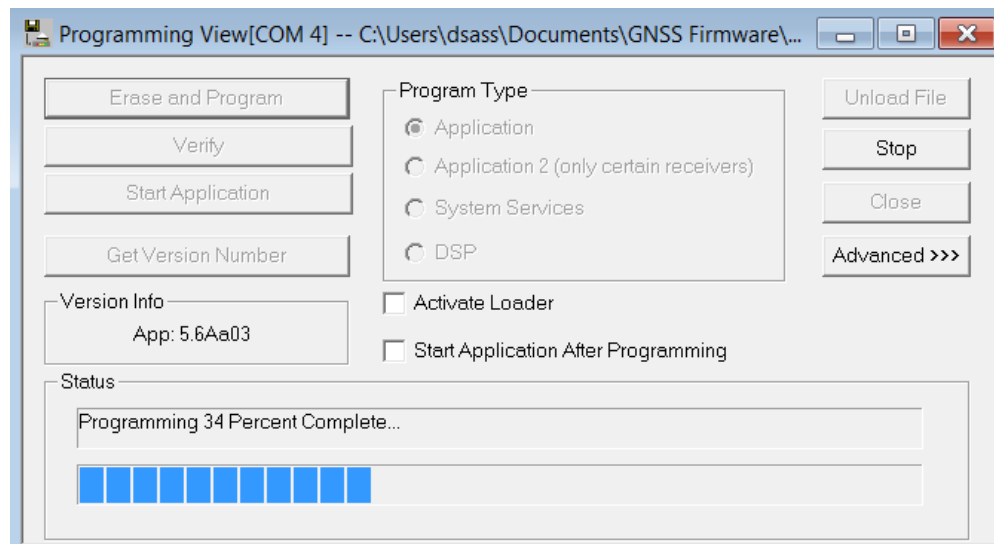
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## Firmware Upgrades, Continued

**RightArm Updates,**  
continued

**Note:** If the Activate Loader check box remains selected, power the receiver off and on. When the receiver powers back on, the Activate Loader box should be de-selected.

**⚠ WARNING:** Do not to interrupt the power supply to the receiver, and do not interrupt the communication link between the PC and the receiver until programming is complete. Failure to do so may cause the receiver to become inoperable and will require factory repair.



**Note:** After completing the firmware update, Hemisphere GNSS suggests repeating this process for the other application.

## Chapter 2: Installing the V500

### Overview

---

**Introduction** This chapter provides instructions on how to mount and install your V500 receiver.

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## Mounting the V500

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**Introduction** This section provides information on mounting the V500 in the optimal location, orientation considerations, environmental considerations, and other mounting options.

---

**GNSS satellite reception** When considering where to mount the V500, consider the following satellite reception recommendations:

- Ensure there is a clear view of the sky available to the V500 so the GNSS and L-band satellites are not masked by obstructions that may reduce system performance
- Mount the V500 in a position in respect to the primary GNSS antenna (located on the end opposite the recessed arrow on the underside of the enclosure)
- Locate any transmitting antennas away from the V500 by at least a few meters to ensure tracking performance is not compromised
- Ensure cable length is adequate to route into the machine to reach a breakout box or terminal strip
- Do not locate the antenna where environmental conditions exceed those specified in Appendix B, Technical Specifications of this document.



**Figure 2-1: Recessed arrow**

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## Mounting the V500, Continued

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- Environmental considerations** Hemisphere Vector Smart Antennas are designed to withstand harsh environmental conditions; however, adhere to the following limits when storing and using the V500:
- Operating temperature: -40°C to +70°C (-40°F to +158°F)
  - Storage temperature: -40°C to +85°C (-40°F to +185°F)
  - Humidity: IEC 16750-4:2010 Section 5.6 Humid heat, cyclic test
- 

**Mounting orientation** The V500 outputs heading, pitch, and roll readings regardless of the orientation of the antennas. The relation of the antennas to the machine's axis determines if you need to enter a heading, pitch, or roll bias.

The primary antenna is used for positioning and the primary and secondary antennas, working in conjunction, output heading, pitch, and roll values.

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- Parallel orientation** Parallel installation orients the V500 parallel to, and along the centerline of, the axis of the machine. **This provides a true heading.** In this orientation:
- If you use a gyrocompass and there is a need to align the Vector smart antenna, you can enter a heading bias in the V500 to calibrate the physical heading to the true heading of the machine.
  - You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.
- 

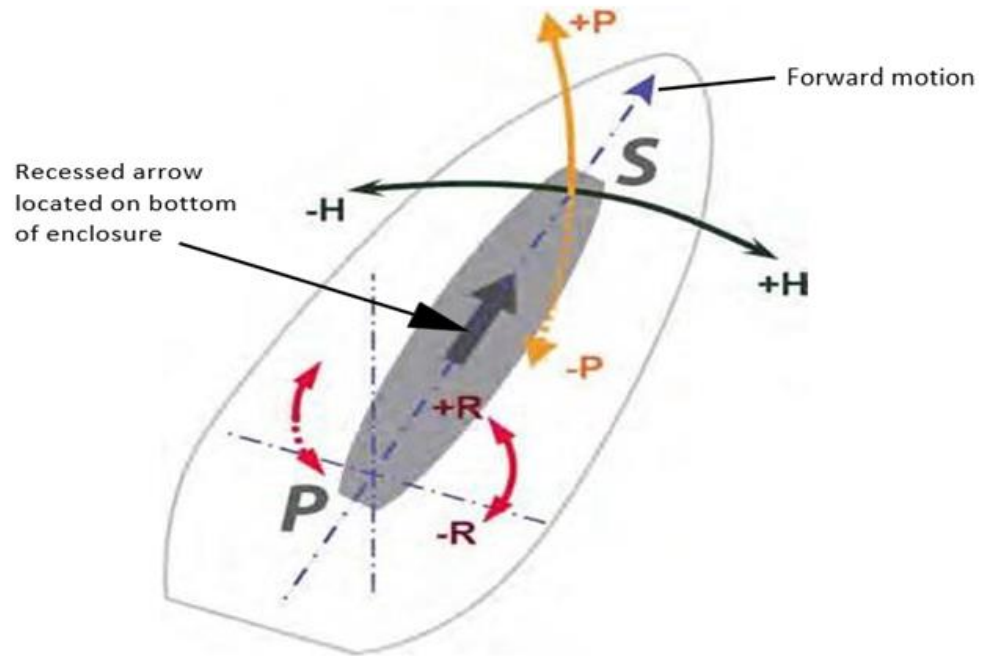
- Perpendicular orientation** You can also install the antennas, so they are oriented perpendicular to the centerline of the machine's axis. In this orientation:
- Enter a heading bias of +90° if the primary antenna is on the right side of the machine and -90° if the primary antenna is on the left side of the machine.
  - Configure the receiver to specify the GNSS smart antenna is measuring the roll axis using the V500 WebUI.
  - Enter a roll bias to properly output the pitch and roll values.
  - You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.
- 

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## Mounting the V500, Continued

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Mounting  
orientation  
example



**Figure 2-2: Recommended orientation and resulting signs of HPR values**

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## Mounting the V500, Continued

Mounting orientation example, continued

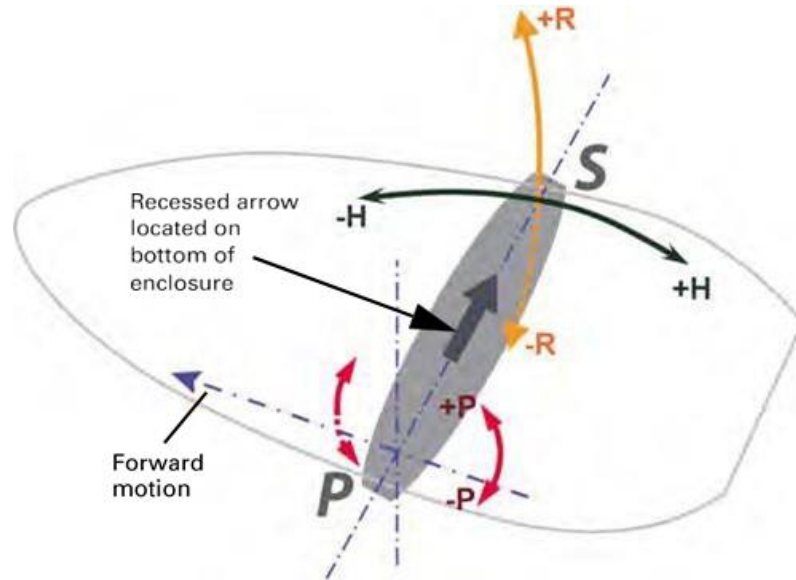


Figure 2-3: Alternate orientation and resulting signs of HPR values

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## Mounting the V500, Continued

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### Mounting alignment

The top of the V500 enclosure incorporates sight design features to help you align the enclosure on your machine.

To use the sights, center the small post on the opposite side of the enclosure from you, within the channel made in the medallion located in the center of the enclosure top as shown in Figure 2-4 and Figure 2-5.

The long sight alignment accuracy (Figure 2-4) is approximately  $\pm 1^\circ$ . Short sight alignment accuracy (Figure 2-5) is approximately  $\pm 2.5^\circ$ .

---

### Mounting options

The V500 allows for two different mounting options: flush-mount and pole-mount.

1. **Flush-mount**-The bottom of the V500 contains eight M8-1.25 holes for flush mounting the unit to a flat surface (see Figure 2-5). The eight holes comprise two sets of four holes. Flush mounting does not provide any additional dampening to the receiver. The V500 can be mounted using an optional mounting bracket. See Table 1-1 for bracket part information.
2. **Pole-mount**-The V500 can be mounted using a mounting pole.

<p><b>Note:</b> Hemisphere GNSS does not supply mounting surface hardware or a mounting pole. You must supply the appropriate mounting hardware required to complete V500 installation.</p>
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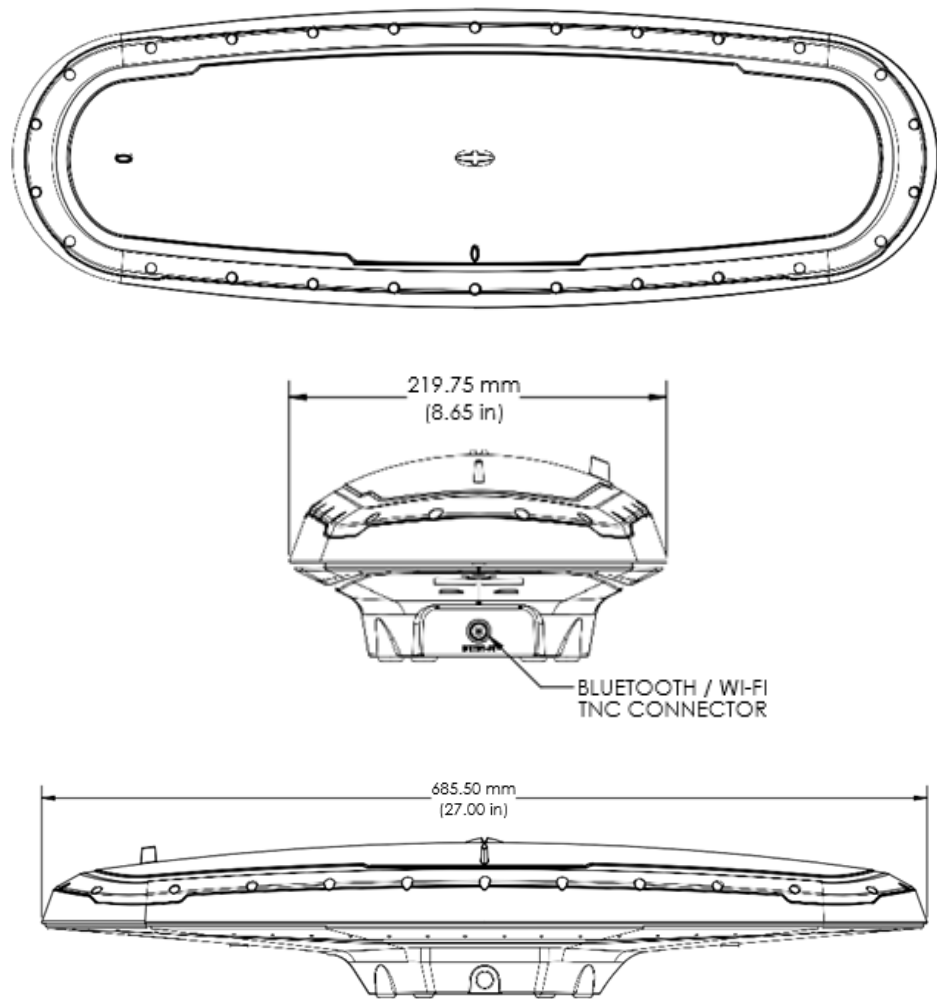
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## Mounting the V500, Continued

### V500 dimensions

Figure 2-4 illustrates the physical dimensions of the V500.



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## Mounting the V500, Continued

V500  
dimensions,  
continued

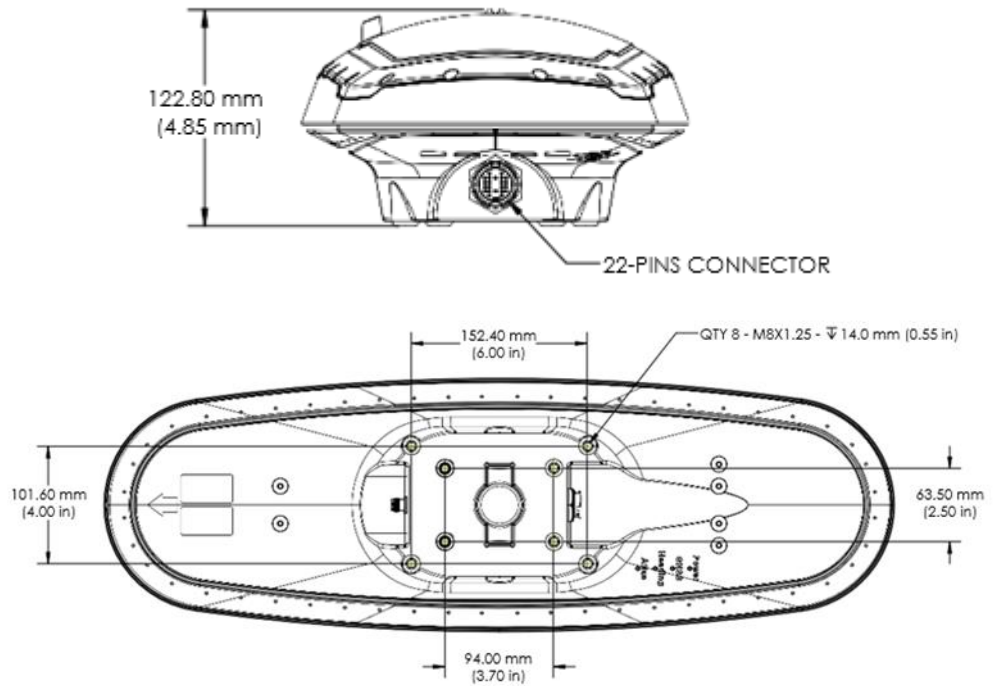


Figure 2-4: V500 Physical dimensions drawing

*Continued on next page*

## Mounting the V500, Continued

### Power/Data cable considerations

Before mounting the V500, consider the following regarding power/data cable routing:

Do	Do not
Ensure cable reaches appropriate power source	Run cables in areas of excessive heat
Keep cable away from corrosive chemicals	Run cables through a door or window jams
Connect to a data storage device, computer, or other device that accepts GNSS data	Crimp or excessively bend the cable
Keep cable away from rotating machinery	Place tension on the cable
Remove unwanted slack from the cable at the V500 end	
Secure along the cable route using plastic wrapping	

**⚠ WARNING:** Improperly installed cable near machinery can be dangerous.

### Connecting the Serial Power/Data cable

1. Align the cable connector key-way with the V500 connector key.
2. Rotate the cable ring clockwise until it locks. The locking action is firm; you will feel a positive “click” when it has locked.
3. Attach the power/data cable to the cable clamp.
4. Fasten the clamp to the bottom of the V500 using the screw and washer.

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## Mounting the V500, Continued

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**Flush-mounting the V500** The bottom of the V500 contains eight holes (two sets of four holes) for flush-mounting the unit to a flat surface (Figure 2-5).



**Figure 2-5: Flush-mounting holes on bottom of V500**

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## Mounting the V500, Continued

Assembly  
drawing

Figure 2-6 shows the V500 assembly.

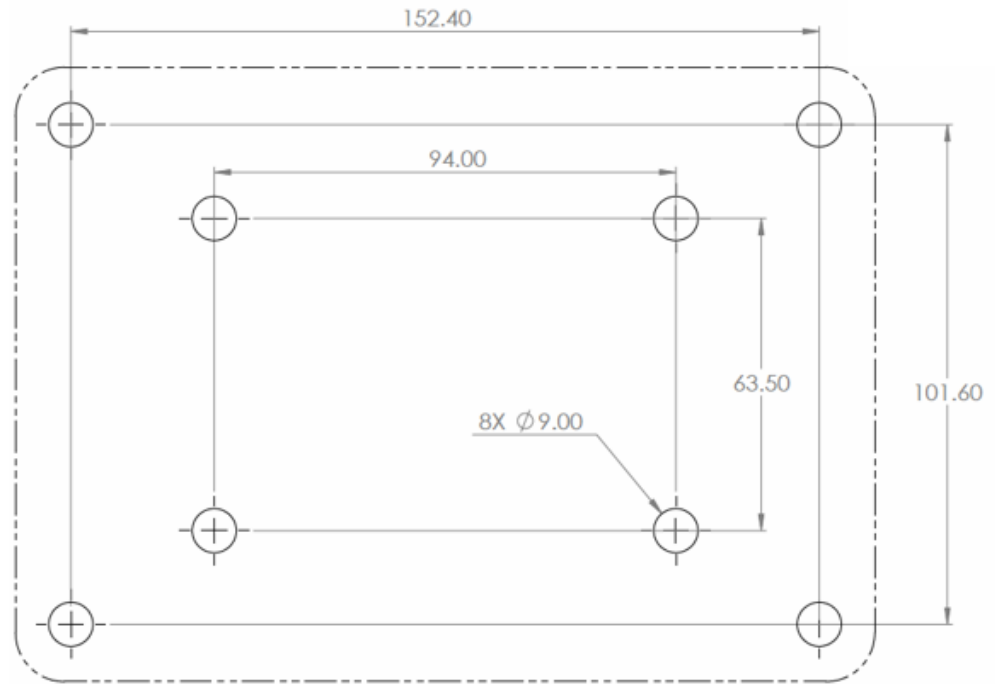


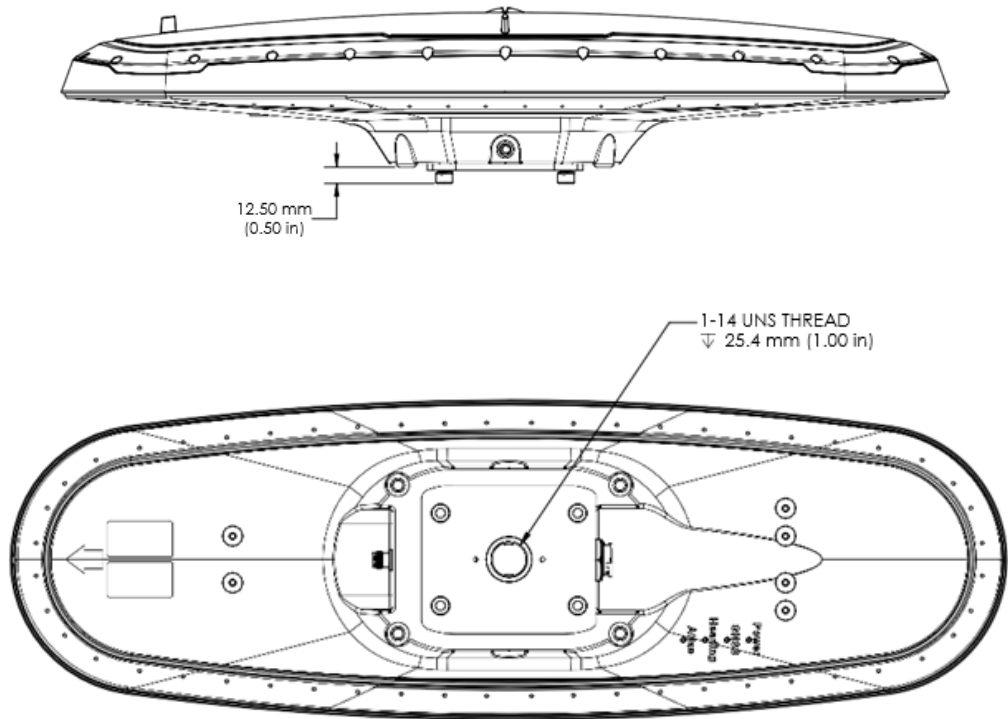
Figure 2-6: Assembly drawing

*Continued on next page*

## Mounting the V500, Continued

### Pole-mounting the V500

Figure 2-7 shows the specifications for pole-mounting the V500 antenna.



**Figure 2-7: Pole-mounting specifications**

*Continued on next page*



## Ports

---

**Overview** The V500 offers serial port, CAN, and Ethernet port functionality.

---

**Serial ports** The V500 has two serial ports:

- Port A can be both full-duplex RS-232 and half-duplex RS-422 (transmit only)
- Port B is full-duplex RS-232 or RS-422 (default)

Use the WebUI or one of the following commands (\$JRELAY,PORTC,\$JPORTB,RS232 or \$JRELAY,PORTC,\$JPORTB,RS422) to switch Port B between RS-232 and RS-422.

You can receive external differential corrections via either Port A (full-duplex RS-232) or Port B (full-duplex RS-232 or full-duplex RS-422). You can connect up to three devices at one time using two ports.

One device can receive data via Port A (RS-422 transmit only) while two devices can transmit and receive data via Ports A and B (one connected to Port A RS-232 and one connected to Port B).

You can update firmware via Port A (RS-232) or Port B.

**Note:** The V500 has maximum baud rate of 115200.

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*Continued on next page*

## Ports, Continued

---

### Serial port configuration

You may configure Port A or Port B of the GNSS receiver to output any combination of data.

Port A can have a different configuration from Port B in data message output, data rates, and the baud rate of the port, and configure the ports independently based upon your needs. Both RS-232 and RS-422 output signals may be used simultaneously.

The RS-232 Port A and RS-422 Port A output the same data messages at the same baud rate. If the baud rate or messages for the RS-422 port need to be changed, this needs to be commanded through the RS-232 port.

**Note:** For successful communications, use the 8-N-1 protocol and set the baud rate of the V500's serial ports to match that of the devices to which they are connected. Flow control is not supported.

---

## Selecting Baud Rates and Message Types

---

### **Baud Rates & Message Types**

When selecting your baud rate and message types, use the following formula to calculate the bits/sec for each message and sum the results to determine the baud rate for your required data throughput.

Message output rate \* Message length (bytes) \* bits in byte = Bits/second  
(1 character = 1 byte, 8 bits = 1 byte, use 10 bits/byte to account for overhead).

For information on message output rates refer to the [Hemisphere GNSS Technical Reference Manual](#).

---

## Connecting the V500 to External Devices

---

### **Recommendations for connecting to other devices**

When interfacing to other devices, ensure the transmit data output and the signal grounds from the V500 is connected to the data input of the other device.

The RS-422 is a balanced signal with positive and negative signals referenced to ground; ensure you maintain the correct polarity.

When connecting the transmit data output positive signal to the receive line of the other device, it should be connected to the receive positive terminal.

The negative transmit data signal from the V500 is then connected to the receive data negative input of the other device.

For a list of Hemisphere GNSS commands, please refer to the [Hemisphere GNSS Technical Reference Manual](#). To configure the unit through the WebUI, please refer to [Configuring the V500 using WebUI](#).

---

*Continued on next page*

## Connecting the V500 to External Devices, Continued

---

### **Power/Data cable considerations**

The V500 uses a single 3m, or 15m (optional) cable for power and data input/ output.

The receiver end of the cable is terminated with an environmentally-sealed 22-Pin connection while the opposite end is unterminated and requires field stripping and tinning.

Depending on the application and installation needs, you may need to shorten this cable. However, if you require a longer cable run than 15m, you can bring the cable into a break-out box that incorporates terminal strips, within the machine.

When lengthening the cable keep the following in mind:

- When lengthening the power input leads to the V500, ensure the additional voltage drop is small enough that your power system can continue to power the system above the minimum voltage of the system. A wire of 18-gauge or larger should also be used.
- Minimize RS-232 cable length to ensure reliable communication.

---

*Continued on next page*

## Connecting the V500 to External Devices, Continued

---

V500 with 22 to 18 pins adapter

Use the 22-Pin to 18-Pin adapter if you want to use a V320 cable.

**Note:** Using the adapter will cause you to lose ethernet capability.

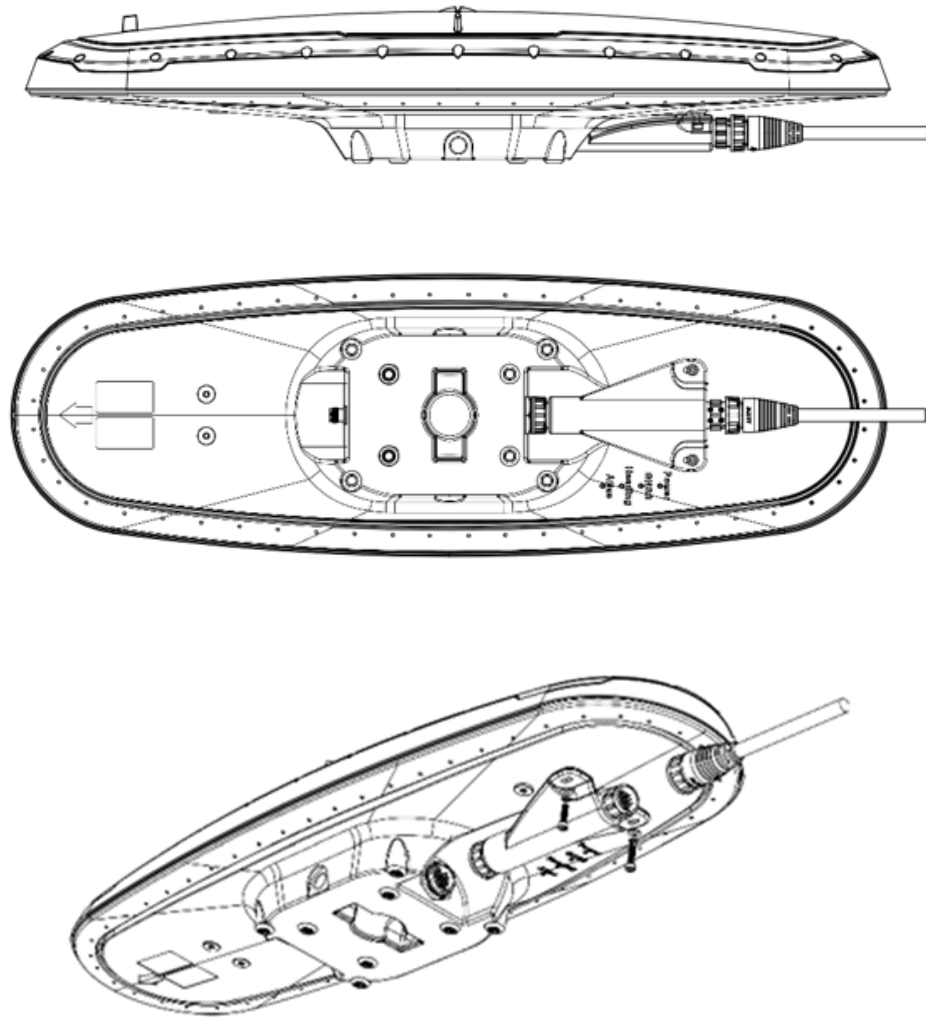


Figure 2-8: V500 with 22-Pin to 18-Pin adapter

*Continued on next page*

## Connecting the V500 to External Devices, Continued

---

### Power/data cable pin-out assignments

Figure 2-9 shows the power/data cable pin-out assignments.

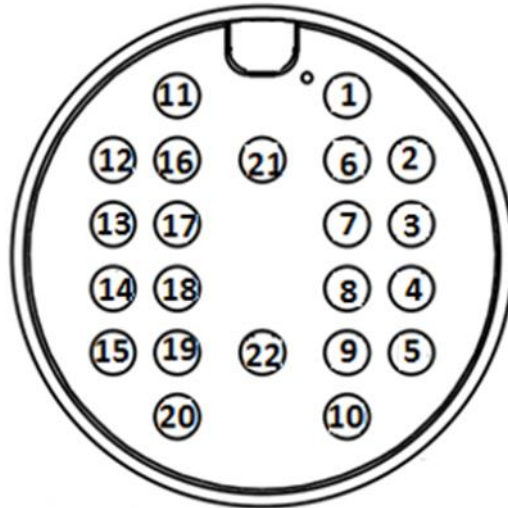


Figure 2-9: V500 pin-out assignments

---

*Continued on next page*

## Connecting the V500 to External Devices, Continued

### Power/data cable pin-out specifications

Table 2-1 shows the cable pin-out specifications for the multi-function serial cable, and Table 2-2 shows the V500 ethernet cable pin-out specifications.

**Table 2-1: V500 multi-function cable pin-out specifications**

Pin	Function	Color
1	POWER+	Short to Pin 21 (Red)
2	CAN1 H	Orange-Black
3	CAN1 L	Yellow-Black
4	B RS-232 RX / RS-422 A	Orange
5	B RS-232 TX / RS-422 Z	Yellow
6	CAN2 H	Green
7	CAN2 L	Blue
8	B RS-422 B	Purple
9	B RS-422 Y	Grey
10	1PPS	White
11	A RS-232 RX	Pink
12	A RS-232 TX	Black-Green
13	SIGNAL GROUND	Black-White, Brown
16	HDG	Orange-White
17	SPEED	Green-White
20	MARK	Red-Black
21	POWER+	Red
22	POWER-	Black

**Table 2-2: V500 ethernet cable specifications**

Pin	Function	Wire Color
1	POWER+	Short to Pin 21 (Red)
13	SIGNAL GROUND	Black-White, Brown
14	ETHERNET TD+	Green-White
15	ETHERNET TD-	Green
18	ETHERNET RD+	Orange-White
19	ETHERNET RD-	Orange
21	POWER+	Red
22	POWER-	Black



## Chapter 3: Understanding the V500

### Overview

---

#### Introduction

The GNSS receiver begins tracking satellites when it powers up and an antenna has connected to the antenna port on the receiver. Position and heading accuracy vary depending upon location and environment. Position performance can be improved with RTK or DGNSS.

The following sections provide the steps to configure your V500 to use Atlas, SBAS, or RTK.

**Note:** Differential source and RTK status impact only positioning and heave. There is no impact to heading, pitch, or roll.

---

#### Contents

Topic	See Page
Differential and RTK Operation	42
SBAS Tracking	43
Athena RTK	44
Atlas L-band	45
Supported Constellations	46
Supplemental Sensors	47
Time Constants	50

---

## Differential and RTK Operation

---

### **Differential (DGNSS) and RTK operation**

The purpose of differential GNSS (DGNSS) and RTK is to remove the effects of atmospheric errors, timing errors and satellite orbit errors, while enhancing system integrity.

Autonomous positioning capabilities of the V500 will result in positioning accuracies of 2.5m 95% of the time.

To improve positioning quality, the V500 can receive DGNSS corrections over SBAS, L-band corrections with Hemisphere GNSS' Atlas L-band technology, or RTK corrections over serial.

For more information on the differential services and the associated commands refer to the [Hemisphere GNSS Technical Reference Manual](#).

---

## SBAS Tracking

---

**SBAS tracking** SBAS is a standard feature on the V500 and does not require an activation or subscription code.

The V500 automatically scans and tracks SBAS signals without the need to tune the receiver.

The V500 features two-channel tracking that provides an enhanced ability to maintain a lock on an SBAS satellite when more than one satellite is in view.

This redundant tracking approach results in more consistent tracking of an SBAS signal in areas where signal blockage of a satellite is possible.

**Note:** The V500 moving base station algorithm uses only GNSS to calculate heading. Differential and RTK corrections are not used in this calculation and will not affect heading accuracy.

---

## Athena RTK

---

### Athena RTK

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 V500 can use RTK through either serial port. The receiver uses any RTK message coming in over a serial port if the RTK message type is included in the list of available differential sources.

If you do not know which RTK message type is being sent by the base station, you can include RTCM3, ROX, and CMR.

Including extra differential sources will not affect the receiver if those differential sources are not being received.

After setting the differential source configure the baud rate of the serial port receiving the RTK corrections. Ensure that the serial port configuration of the external device (such as modem) is 8 bits/byte, 1 stop bit, no parity and no flow control.

Connect the external device to the serial port of the V500. Some cables may require the use of a gender changer and/or null modem adapter.

---

## Atlas L-band

---

### **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.

The V500 can calculate a position with 4 cm RMS (horizontal) accuracy in an industry-leading time of 20 minutes.

To configure the receiver to use Atlas L-band, a subscription must be purchased.

---

## Supported Constellations

---

**GLONASS,  
Galileo &  
BeiDou**

V500 is available in its base form as L1 GPS, G1 GLONASS, E1 Galileo, and B1 BeiDou.

By adding multi-frequency GPS, GLONASS, Galileo, and BeiDou, the number of available signals increases, improving the ability to obtain and maintain a heading solution.

For a heading calculation, GPS, GLONASS, Galileo and BeiDou satellites are used interchangeably, as intersystem biases cancel inside the V500—this translates into being able to work in more obstructed areas and maintain a GNSS heading solution.

---

## Supplemental Sensors

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### Overview

The V500 has an integrated gyro and two tilt sensors, which are enabled by default. Each supplemental sensor may be individually enabled or disabled. Both supplemental sensors are mounted on the printed circuit board inside the V500.

The sensors act to reduce the RTK search volume, which improves heading startup and reacquisition times. This improves the reliability and accuracy of selecting the correct heading solution by eliminating other possible, erroneous solutions.

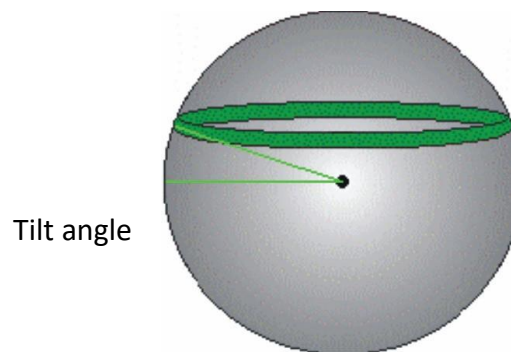
The [Hemisphere GNSS Technical Reference Manual](#) describes the commands and methodology required to recalibrate, query, or change the sensor status.

---

### Tilt Aiding

The V500's accelerometers (internal tilt sensors) are factory calibrated and enabled by default and constrains the RTK heading solution beyond the volume associated with a fixed antenna separation.

The V500 knows the approximate inclination of the secondary antenna with respect to the primary antenna. The search space defined by the tilt sensor is reduced to a horizontal ring on the sphere's surface by reducing the search volume and decreases startup and reacquisition times (see Figure 3-1).



**Figure 3-1: V500 tilt aiding**

*Continued on next page*

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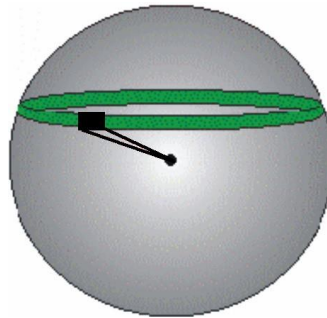
## Supplemental Sensors, Continued

---

### Gyro aiding

The V500's internal gyro reduces the sensor volume for an RTK solution and shortens reacquisition times when a GNSS heading is lost due to blocked satellite signals.

The gyro provides a relative change in angle since the last computed heading, and, when used in conjunction with the tilt sensor, defines the search space as a wedge-shaped location (see Figure 3-2).



**Figure 3-2: V500 gyro aiding**

The gyro aiding accurately smooths the heading output and the rate of turn and provides an accurate substitute heading for a brief period depending on the roll and pitch of the machine (ideally seeing the system through to reacquisition).

The gyro provides an alternate source of heading, accurate to within 1° per minute for up to three minutes, in times of GNSS loss for either antenna. If the outage lasts longer than three minutes, the gyro will have drifted too far and the V500 begins outputting null fields in the heading output messages. There is no user control over the timeout period of the gyro.

The gyro initializes itself at power up and during initialization, or you can calibrate it as outlined in the [Hemisphere GNSS Technical Reference Manual](#).

For optimal performance, when the gyro is first initializing, the dynamics the gyro experiences during this warm-up period are similar to the regular operating dynamics.

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*Continued on next page*



## Supplemental Sensors, Continued

---

### **Gyro aiding,** continued

With the gyro enabled, it is used to update the post HTAU smoothed heading output from the moving base station RTK GNSS heading computation.

If the HTAU value is increased while gyro aiding is enabled, there will be little to no lag in heading output due to vehicle manoeuvres.

The [Hemisphere GNSS Technical Reference Manual](#) includes information on setting an appropriate HTAU value for the application.

---

## Time Constants

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### Overview

The V500 incorporates user-configurable time constants that can provide a degree of smoothing to the heading, pitch, Rate-of-Turn (ROT), Course-over-Ground (COG), and speed measurements.

You can adjust these parameters depending on the expected dynamics of the machine. For example, increasing the time is reasonable if the machine is very large and is not able to turn quickly or would not pitch quickly. The resulting values would have reduced “noise,” resulting in consistent values with time. If the machine is quick and nimble, increasing this value can create a lag in measurements.

Formulas for determining the level of smoothing are located in the [Hemisphere GNSS Technical Reference Manual](#). If you are unsure how to set this value, it is best to be conservative and leave it at the default setting.

---

*Continued on next page*

## Time Constants, Continued

---

### Heading

Use the \$JATT,HTAU command to adjust the level of responsiveness of the true heading measurement provided in the \$GPHDT message. The default value of this constant is 0.1 seconds of smoothing when the gyro is enabled. The gyro is enabled by default but can be disabled.

By disabling the gyro, the equivalent default value of the heading time constant would be 0.5 seconds of smoothing. This is not automatic, and therefore it must be manually entered.

Increasing the time constant increases, the level of heading smoothing and increases lag.

---

### Pitch

Use the \$JATT,PTAU command to adjust the level of responsiveness of the pitch measurement provided in the \$PSAT,HPR message. The default value of this constant is 0.5 seconds of smoothing.

Increasing the time constant increases the level of pitch smoothing and increases lag.

---

### Rate-of-Turn (ROT)

Use the \$JATT,HRTAU command to adjust the level of responsiveness of the ROT measurement provided in the \$GPROT message. The default value of this constant is 2.0 seconds of smoothing.

Increasing the time constant increases the level of ROT smoothing.

---

*Continued on next page*

## Time Constants, Continued

---

### **Course-Over-Ground (COG)**

Use the \$JATT,COGTAU command to adjust the level of responsiveness of the COG measurement provided in the \$GPVTG message. The default value of this constant is 0.0 seconds of smoothing.

Increasing the time constant increases the level of COG smoothing.

COG is computed using only the primary GNSS antenna and its accuracy depends upon the speed of the machine (noise is proportional to 1/speed).

This value is invalid when the machine is stationary.

---

### **Speed**

Use the \$JATT,SPDTAU command to adjust the level of responsiveness of the speed measurement provided in the \$GPVTG message. The default value of this parameter is 0.0 seconds of smoothing.

Increasing the time constant increases the level of speed measurement smoothing.

---

## Chapter 4: Operating the V500

### Overview

---

**Introduction** The chapter includes information about powering and configuring your V500 receiver.

---

### Contents

Topic	See Page
Powering the Receiver On/Off	54
LED Indicators	55
Configuring the V500 Using the WebUI	56

---

## Powering the Receiver On/Off

---

### Power the receiver on/off

To power on the V500, connect the ends of the V500 power cable to a clean power source providing 9 to 32 VDC, and hold the soft power switch until the screen illuminates.

The V500 accepts an input voltage of 9 to 32 VDC via the power cable. The supplied power should be continuous and clean for best performance. Refer to [Appendix B](#) for the power specifications of the V500.

**⚠ WARNING:**

**Do not apply a voltage higher than 32 VDC. This will damage the receiver and void the warranty. A 3 Amp power fuse is recommended for the protection of personnel and the system.**

The V500 features reverse polarity protection to prevent damage if the power leads are accidentally reversed. Although the V500 proceeds through an internal startup sequence when you apply power, it will be ready to communicate immediately.

Initial startup may take 5 to 15 minutes depending on the location. Subsequent startups will output a valid position within 1 to 5 minutes depending on the location and time since the last startup.

The V500 may take up to 5 minutes to receive a full ionospheric map from SBAS. Optimum accuracy is obtained once the V500 is processing corrected positions using complete ionospheric information.

**Note:** Hemisphere GNSS recommends using a weather-tight connection and connector if the connection is located outside.

---

## LED Indicators

### Overview

The V500 has four LED lights located bottom of the unit. Table 4-1 below describes each LED indicator.



**Figure 4-1: V500 LED Display**

**Table 4-1: LED indicators**

<b>Indicator</b>	<b>Description/Function</b>
Power	Solid red indicates receiver is powered on
GNSS	Solid green indicates RTK fixed Flashing green indicates DGPS/Float
Heading	Solid green indicates 2D GNSS heading Solid red indicates 2D sensor heading
Atlas	Solid green indicates Atlas locked Solid red indicates Atlas activated, but not locked

## Configuring the V500 Using the WebUI

---

### Overview

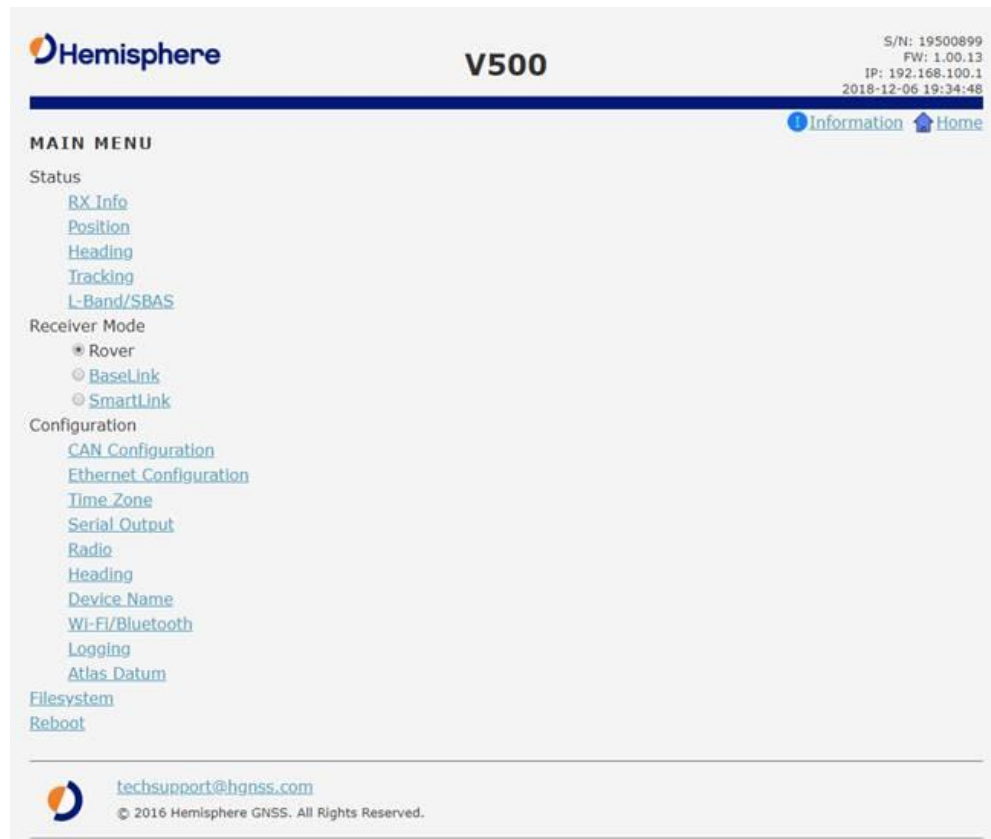
The V500 is equipped with an onboard WebUI.

First, connect the Bluetooth/WiFi antenna to the connector. The receiver displays as an available Wi-Fi device in your available networks. Connect the tablet or PC to the V500's WiFi.

To log in use the password: hgnss1234

Open a web browser window and type the following IP address:  
192.168.100.1

The V500 Main Menu displays.



The screenshot shows the Hemisphere V500 WebUI Main Menu. At the top left is the Hemisphere logo. In the top center, it says "V500". On the top right, there is a status bar with the following information: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and 2018-12-06 19:34:48. Below the status bar, there are two links: "Information" and "Home". The main menu is titled "MAIN MENU" and contains several sections of links:

- Status
  - [RX Info](#)
  - [Position](#)
  - [Heading](#)
  - [Tracking](#)
  - [L-Band/SBAS](#)
- Receiver Mode
  - Rover
  - BaseLink
  - SmartLink
- Configuration
  - [CAN Configuration](#)
  - [Ethernet Configuration](#)
  - [Time Zone](#)
  - [Serial Output](#)
  - [Radio](#)
  - [Heading](#)
  - [Device Name](#)
  - [Wi-Fi/Bluetooth](#)
  - [Logging](#)
  - [Atlas Datum](#)
- [Filesystem](#)
- [Reboot](#)

At the bottom left, there is a Hemisphere logo and the email address [techsupport@hgnss.com](mailto:techsupport@hgnss.com). At the bottom center, it says "© 2016 Hemisphere GNSS. All Rights Reserved."

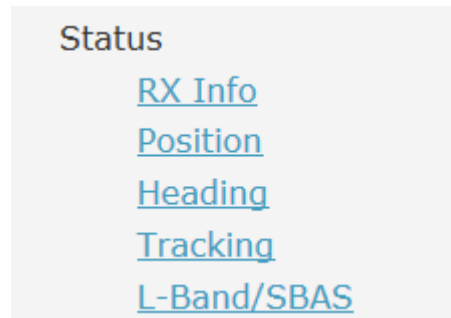
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## Configuring the V500 Using the WebUI, Continued

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**Status** You can configure RX Info, Position, Heading, Tracking, L-band and SBAS.



**Table 4-2: Status links**

<b>Link</b>	<b>Description</b>
RX Info	Serial number of the board, firmware versions, and subscriptions
Position	Position, accuracy, HDOP, number of satellites used, and differential/RTK status
Heading	Heading, COG, the offset between heading and COG, ROT, yaw, pitch, roll, heave and speed
Tracking	Sky plot and SNRs of signals tracked
L-band/SBAS	Manually tune the antenna to track a specific L-band satellite or to set the receiver up to automatically select the correct SBAS satellite

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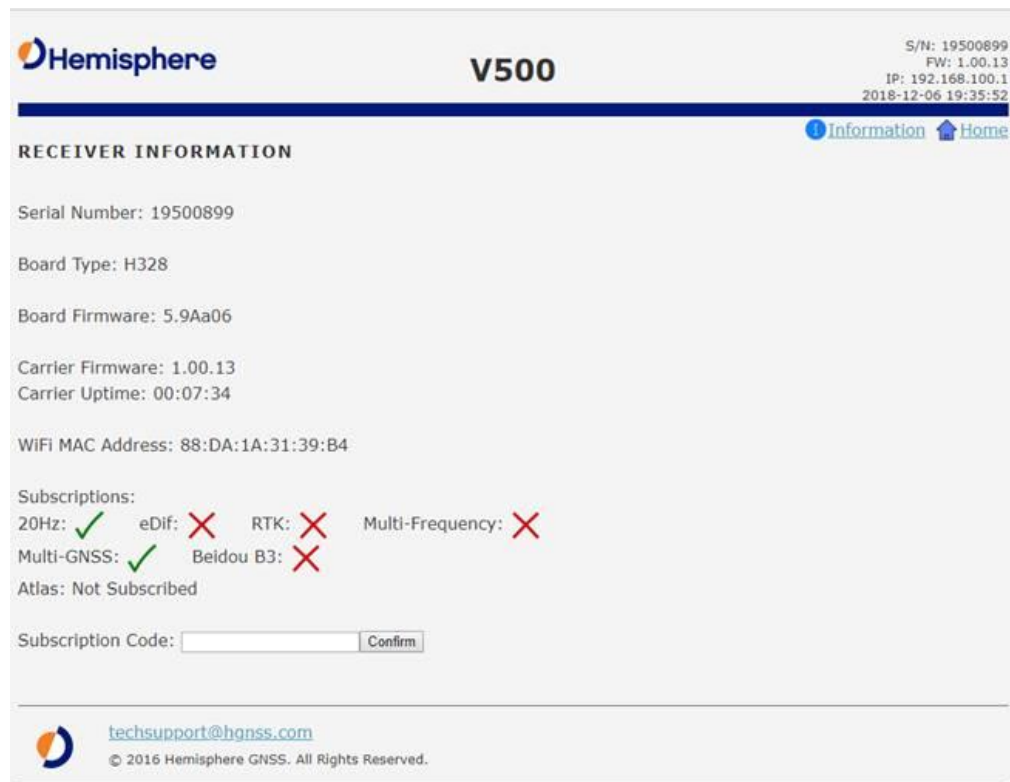
## Configuring the V500 Using the WebUI, Continued

### RX info

The Serial Number, Board Type, Carrier Firmware (for both GNSS and carrier board), Carrier Uptime, WiFi MAC Address, and your Subscriptions are displayed.

Activated items have a green check mark.

**Important:** If you have purchased an activation or subscription, use the field at the bottom of the screen to type the Subscription Code, and click **Confirm**.



The screenshot shows the Hemisphere V500 WebUI interface. At the top right, it displays system information: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and a timestamp of 2018-12-06 19:35:52. Below this is a navigation bar with 'Information' and 'Home' links. The main section is titled 'RECEIVER INFORMATION' and lists the following details: Serial Number: 19500899, Board Type: H328, Board Firmware: 5.9Aa06, Carrier Firmware: 1.00.13, Carrier Uptime: 00:07:34, and WiFi MAC Address: 88:DA:1A:31:39:B4. A 'Subscriptions' section shows the status of various features: 20Hz (checked), eDif (unchecked), RTK (unchecked), Multi-Frequency (unchecked), Multi-GNSS (checked), and Beidou B3 (unchecked). Below this, it states 'Atlas: Not Subscribed'. At the bottom of the subscriptions section, there is a 'Subscription Code' input field and a 'Confirm' button. The footer includes the Hemisphere logo, the email address techsupport@hgns.com, and the copyright notice © 2016 Hemisphere GNSS. All Rights Reserved.

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## Configuring the V500 Using the WebUI, Continued

### Position

Position and time are displayed at the top of the screen. In the example below, the Time Zone is set to UTC-10, Honolulu time.

To change the Time Zone, go to the main page and click **Time Zone**. Please note this does not affect UTC time in NMEA output.

An estimate of your 3D (and 2D) position accuracy is given in both RMS and 2DRMS.


**HDOP**-Horizontal Dilution of Precision

**Satellites Used**-Number of satellites used

**Solution Type**-Fixed, Float, etc.

**Differential Source**-Atlas, RTK, etc.

**Age of Differential**-RTK latency



The screenshot displays the Hemisphere V500 WebUI interface. At the top left is the Hemisphere logo, and at the top center is the model name "V500". On the top right, system information is shown: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and the current time: 2018-12-06 19:36:49. Below this is a navigation bar with "Information" and "Home" links. The main content area is titled "POSITION INFORMATION" and contains the following data:

- 2018-12-06 19:36:49 UTC
- Time Zone: Phoenix - USA(UTC-7)
- 2018-12-06 12:36:49 Local
- 33° 38' 35.93177" N
- 111° 53' 43.48839" W
- 455.521 m
- 3D Accuracy: 28.1 cm 1 $\sigma$  (56.2 cm 2 $\sigma$ )
- 2D Accuracy: 14.1 cm 1 $\sigma$  (28.2 cm 2 $\sigma$ )
- HDOP: 0.5
- Satellites Used: 20
- Solution Type: 3D Diff
- Differential Source: SBAS
- Age of Differential: 6 seconds

At the bottom left is a contact email: [techsupport@hgns.com](mailto:techsupport@hgns.com). At the bottom center is the copyright notice: © 2016 Hemisphere GNSS. All Rights Reserved.

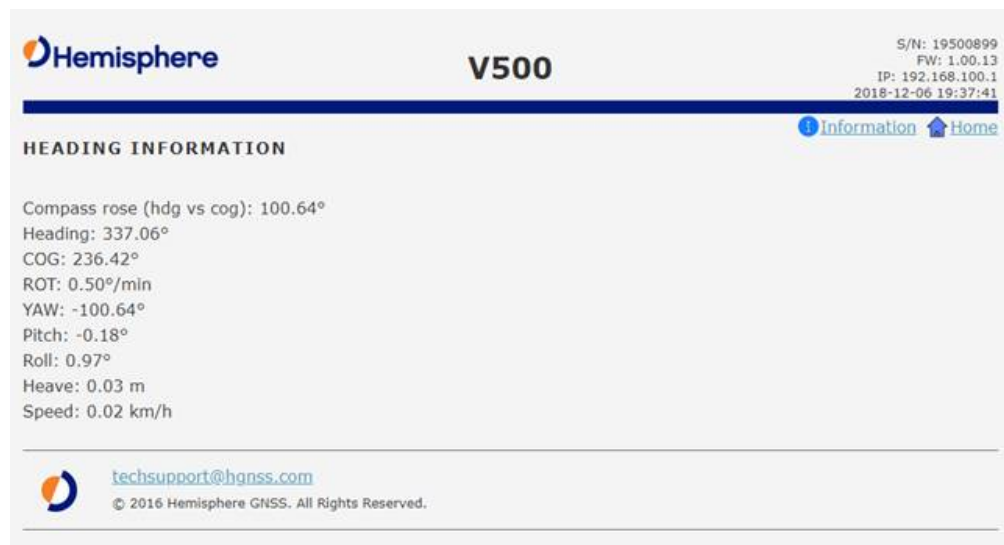
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## Configuring the V500 Using the WebUI, Continued

### Heading

The **Heading Information** screen displays the following data:

Term	Definition
Compass rose	the difference between heading and COG
Heading	the direction of the vector created from the primary to secondary antenna. Heading is measured using true north
COG	the direction the machine is moving
YAW	the difference between COG and heading
Pitch	angle between the front and back of the machine
Roll	angle between the left and right side of the machine
Heave	the upward movement of the ground
Speed	speed of machine in km/h



The screenshot shows the Hemisphere V500 WebUI interface. At the top left is the Hemisphere logo. In the top center, it says "V500". On the top right, there is a status bar with the following information: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and 2018-12-06 19:37:41. Below the status bar, there are two links: "Information" and "Home". The main heading is "HEADING INFORMATION". The data displayed is as follows:

- Compass rose (hdg vs cog): 100.64°
- Heading: 337.06°
- COG: 236.42°
- ROT: 0.50°/min
- YAW: -100.64°
- Pitch: -0.18°
- Roll: 0.97°
- Heave: 0.03 m
- Speed: 0.02 km/h

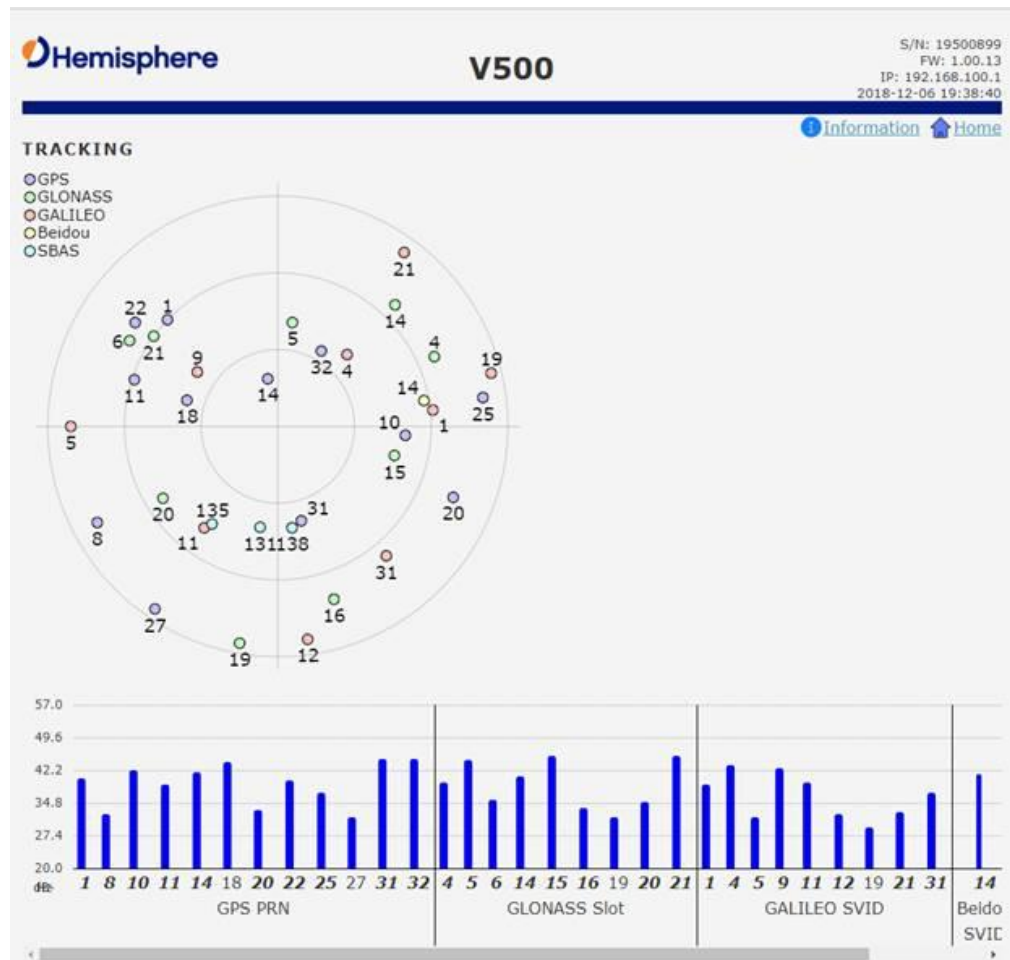
At the bottom left, there is a contact link: [techsupport@hgns.com](mailto:techsupport@hgns.com). At the bottom center, there is a copyright notice: © 2016 Hemisphere GNSS. All Rights Reserved.

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## Configuring the V500 Using the WebUI, Continued

### Tracking

The Sky Plot shows the elevation, azimuth, and SNR values of all tracked satellites.



*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

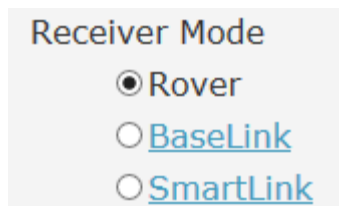
### L-band/SBAS

You can manually configure the frequency and bandwidth of the L-band satellite you wish to track, or simply click the **Auto** button and let the receiver track automatically.



### Receiver mode overview

Use the **Receiver Mode** menu to configure the V500 as a standard GNSS receiver, or as a SmartLink receiver.



**Table 4-3: Receiver mode**

Link	Description
Rover	Configure the V500 as a standard GNSS receiver
SmartLink	Uses Atlas as a correction source and outputs the correction over serial as a standard RTCM3 message

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

---

**Rover** If you are using this as a Rover receiver, select **Rover Receiver Mode**. To use in the **SmartLink** receiver mode, select **Change Mode** and select the appropriate mode.

---

**SmartLink** SmartLink allows the V500 to use Atlas as a correction source and then output the correction over serial as a standard RTCM 3 messages.

Click the **SmartLink** hyperlink. Configure the RTCM3 format (such as MSM4) using the **Correction Output** dropdown menu.

Set the baud rate of the serial port that will output the correction. Set a target accuracy. Once the Atlas solution has converged to below this threshold, RTCM3 messages begin to output over the serial port.

---

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

---

### Configuration overview

You can configure the following using the V500 WebUI:

- CANbus
  - Ethernet
  - Time zone
  - Serial port baud rate and output
  - Heading constants
  - Device name
  - WiFi Bluetooth settings
  - Logging options
  - Data (used by Atlas corrections)
- 

### CAN

Turn ON/OFF CAN and select the baud rate (250 kbps or 500 kbps).



The screenshot shows the Hemisphere V500 WebUI interface. At the top, the Hemisphere logo and 'V500' are displayed. On the right, system information is shown: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and a timestamp of 2018-12-06 19:40:58. Below this is a navigation bar with 'Information' and 'Home' links. The main section is titled 'CAN CONFIGURATION' and contains a table for CAN 1 and CAN 2 settings. Both are currently set to 'On' status, '0x10' address, and '500K' baud rate. 'Change' and 'Undo' buttons are located below the table. The footer includes the Hemisphere logo, the email 'techsupport@bgns.com', and the copyright notice '© 2016 Hemisphere GNSS. All Rights Reserved.'

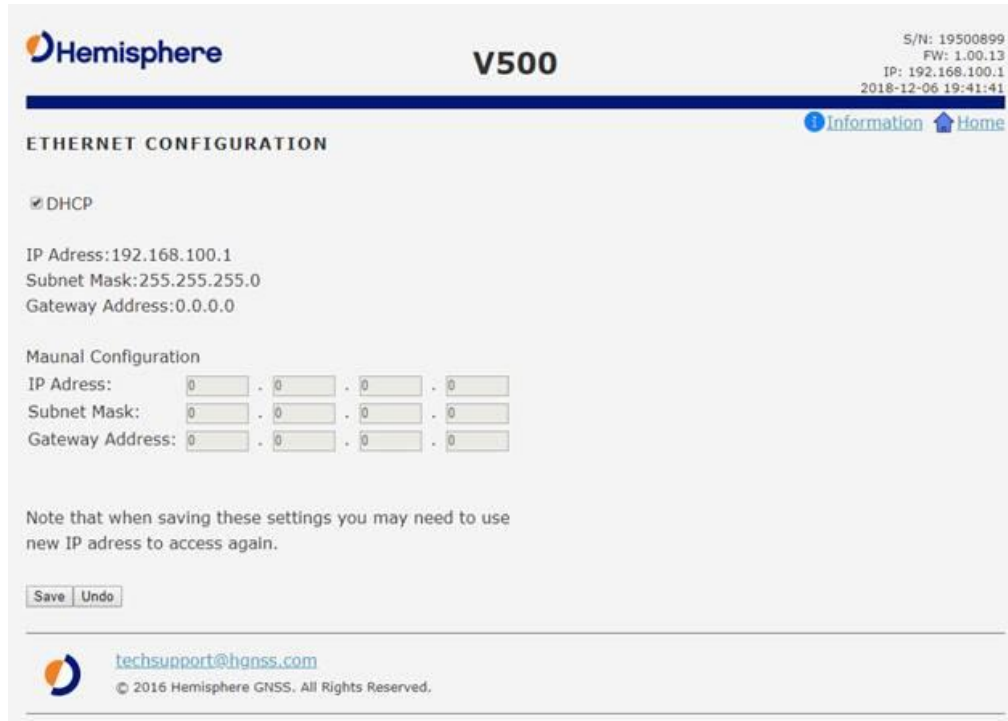
*Continued on next page*



## Configuring the V500 Using the WebUI, Continued

### Ethernet

Use the V500 WebUI to configure the Ethernet connection.



The screenshot shows the Ethernet Configuration page of the Hemisphere V500 WebUI. The page header includes the Hemisphere logo, the model name 'V500', and system information: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and a timestamp of 2018-12-06 19:41:41. There are links for 'Information' and 'Home'. The main section is titled 'ETHERNET CONFIGURATION' and features a checked 'DHCP' option. Below this, the current settings are listed: IP Address: 192.168.100.1, Subnet Mask: 255.255.255.0, and Gateway Address: 0.0.0.0. A 'Manual Configuration' section provides input fields for IP Address, Subnet Mask, and Gateway Address, each with four individual digit boxes. A note states: 'Note that when saving these settings you may need to use new IP address to access again.' At the bottom of the configuration area are 'Save' and 'Undo' buttons. The footer contains the email 'techsupport@hgns.com' and the copyright notice '© 2016 Hemisphere GNSS. All Rights Reserved.'

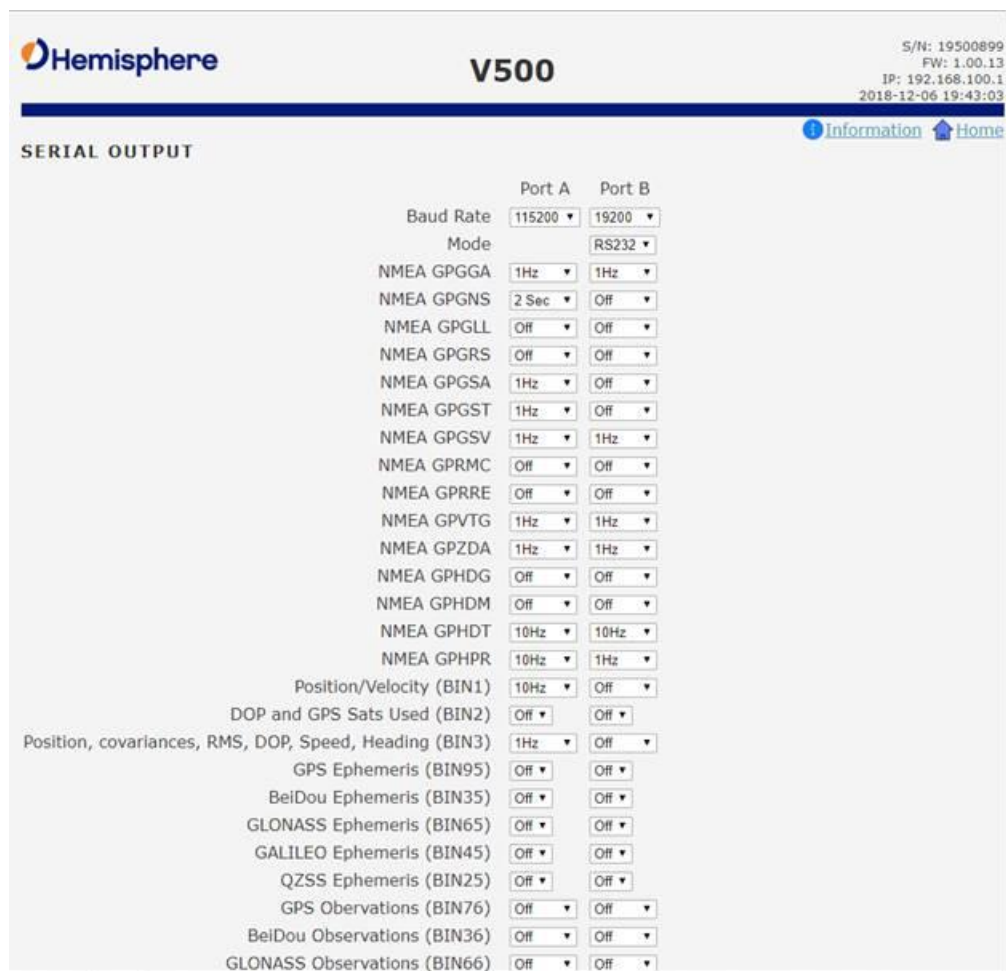
*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

**Serial Output** Use Serial Output to configure the baud rate of each serial port (PortA and PortB) and turn off/on specific NMEA 0183 messages and proprietary Hemisphere BIN messages.

You can also change Port B from RS-232 to RS-422 and RS-422 to RS-232 reciprocally.

Configure the baud rates of the serial ports and click **Change**.



**Hemisphere V500** S/N: 19500899  
FW: 1.00.13  
IP: 192.168.100.1  
2018-12-06 19:43:03

[Information](#) [Home](#)

### SERIAL OUTPUT

	Port A	Port B
Baud Rate	115200	19200
Mode		RS232
NMEA GPGGA	1Hz	1Hz
NMEA GPGNS	2 Sec	Off
NMEA GPGLL	Off	Off
NMEA GPGRS	Off	Off
NMEA GPGSA	1Hz	Off
NMEA GPGST	1Hz	Off
NMEA GPGSV	1Hz	1Hz
NMEA GPRMC	Off	Off
NMEA GPRRE	Off	Off
NMEA GPVTG	1Hz	1Hz
NMEA GPZDA	1Hz	1Hz
NMEA GPHDG	Off	Off
NMEA GPHDM	Off	Off
NMEA GPHDT	10Hz	10Hz
NMEA GPHPR	10Hz	1Hz
Position/Velocity (BIN1)	10Hz	Off
DOP and GPS Sats Used (BIN2)	Off	Off
Position, covariances, RMS, DOP, Speed, Heading (BIN3)	1Hz	Off
GPS Ephemeris (BIN95)	Off	Off
BeiDou Ephemeris (BIN35)	Off	Off
GLONASS Ephemeris (BIN65)	Off	Off
GALILEO Ephemeris (BIN45)	Off	Off
QZSS Ephemeris (BIN25)	Off	Off
GPS Observations (BIN76)	Off	Off
BeiDou Observations (BIN36)	Off	Off
GLONASS Observations (BIN66)	Off	Off

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

### Heading

Authorized users may change the Heading configuration.

Under the **Configuration** menu, click **Heading**. If you are an authorized user, type the Hemisphere GNSS provided password, and click **Login**.



The screenshot shows the Hemisphere V500 web interface. At the top, the Hemisphere logo and 'V500' are displayed. On the right, system information is shown: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and the date/time: 2018-12-06 19:44:13. Below this is a navigation bar with 'Information' and 'Home' links. The main content area is titled 'AUTHORITY CHECK' and contains the text 'Please input password to continue:' followed by a 'Password:' input field and 'Login' and 'Cancel' buttons. At the bottom, there is a footer with the email 'techsupport@hgnss.com' and the copyright notice '© 2016 Hemisphere GNSS. All Rights Reserved.'

### Heading, continued

**Note:** Default settings can be changed to set the time constants to smooth heading, Course-over-Ground (COG), and speed measurements. Various heading settings can also be configured.

Click the box of the desired setting and type the configuration setting values.



The screenshot shows the Hemisphere V500 web interface with the 'HEADING CONFIGURATION' screen. The system information at the top right is updated to 2018-12-06 19:45:09. The configuration settings are as follows:

- Heading Bias:
- Pitch Bias:
- Gyro Aiding:
- Negative Tilt:
- Tilt Aiding:
- Flip Board:
- Level Operation:
- Pitch/Roll Mode:
- Heading TAU:  s
- Heading Rate TAU:  s
- COG TAU:  s
- Speed TAU:  s
- MSEP:  m
- CSEP:  m

At the bottom left, there are 'Change' and 'Undo' buttons.

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

Heading,  
continued

**Table 4-4: Heading configurations**

<b>Time Constant</b>	<b>Description</b>
Heading Bias	Add a bias to the heading value the receiver outputs.  Range: -180 – +180
Pitch Bias	Add a bias to the pitch value the receiver outputs.  If the receiver is in “roll” mode, this will add a bias to the roll instead.  Range: -15 – +15
Gyro Aiding	Gyro aiding enables the use of the internal gyro sensor and allows for the continuous output of heading for up to three minutes during a GNSS outage. Gyro aiding improves the reacquisition time when GNSS heading is lost because of an obstruction in GNSS signal.
Negative Tilt	Change the sign of the pitch/roll measurement.
Tilt Aiding	Turn OFF or ON tilt aiding. When on, the sensors are used to reduce the RTK search volume – improving heading startup and reacquisition times.
Flip Board	N/A
Pitch/Roll Mode	If the antennas are mounted such that they model pitch, set to PITCH.  If the antennas are mounted such that they model roll), set this to ROLL.  <b>Note:</b> If your HBIAS is -90 or +90, this will be set to ROLL. If your HBIAS is 0 or 180, set this to PITCH.

*Continued on next page*

## Configuring the V500 Using the WebUI

### Configuring the V500 Using the WebUI, Continued

Heading,  
continued

**Table 4-4: Heading configurations (continued)**

Time Constant	Description
HTAU (Heading)	<p>Adjust the responsiveness to true heading.</p> <p>If the machine is large and unable to turn quickly, increase this value.</p> <p>For longer baselines (10 m) HTAU should be between 0.1 and 0.5 since the gyro introduces noise.</p> <p><b>Default value:</b> 0.1 s with gyro enabled Range: 0.0 to 60 s</p> <p><b>Formula:</b> <math>htau (s) = 40 / \text{max rate of turn } (^\circ/s)</math> with gyro ON  <math>htau (s) = 10 / \text{max rate of turn } (^\circ/s)</math> with gyro OFF</p>
HRTAU (Rate of Turn)	<p>Adjust the responsiveness to the rate of heading change.</p> <p>If the machine is large and unable to turn quickly, increase this value.</p> <p><b>Default value:</b> 2.0 s with gyro enabled Range: 0.0 to 60 s</p> <p><b>Formula:</b> <math>hrtau (s) = 10 / \text{max rate of the rate of turn } (^\circ/s^2)</math></p>

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

Heading,  
continued

**Table 4-4: Heading configurations (continued)**

Time Constant	Description
COGTAU (Course Over Ground)	<p>Adjust the responsiveness to the course over ground measurement.</p> <p>If the machine is small and dynamic, leave this value at 0.0 s to be conservative.</p> <p>If the machine is large and resistant to motion, increase this value.</p> <p><b>Default value:</b> 0.0 s Range: 0.0 to 60 s  <b>Formula:</b> cogtau (s) = 10 / max rate of change of course (°/sec)</p>
SPDTAU (Speed)	<p>Adjust the responsiveness to speed.</p> <p>If the machine is small and dynamic, leave this value at 0.0 s to be conservative.</p> <p>If the machine is large and resistant to motion, increase this value.</p> <p><b>Default value:</b> 0.0 s Range: 0.0 to 60 s  <b>Formula:</b> spdtau (s) = 10 / max acceleration (m/s<sup>2</sup>)</p>
CSEP	<p>This is the antenna separation calculated by the receiver. Ensure the CSEP value is within 0.2 of 0.5 (within two cm of 50 cm).</p> <div style="border: 1px solid black; padding: 5px;"> <p><b>Note:</b> If CSEP value is “0” the receiver is unable to calculate the separation between the primary and secondary antennas.</p> </div>

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

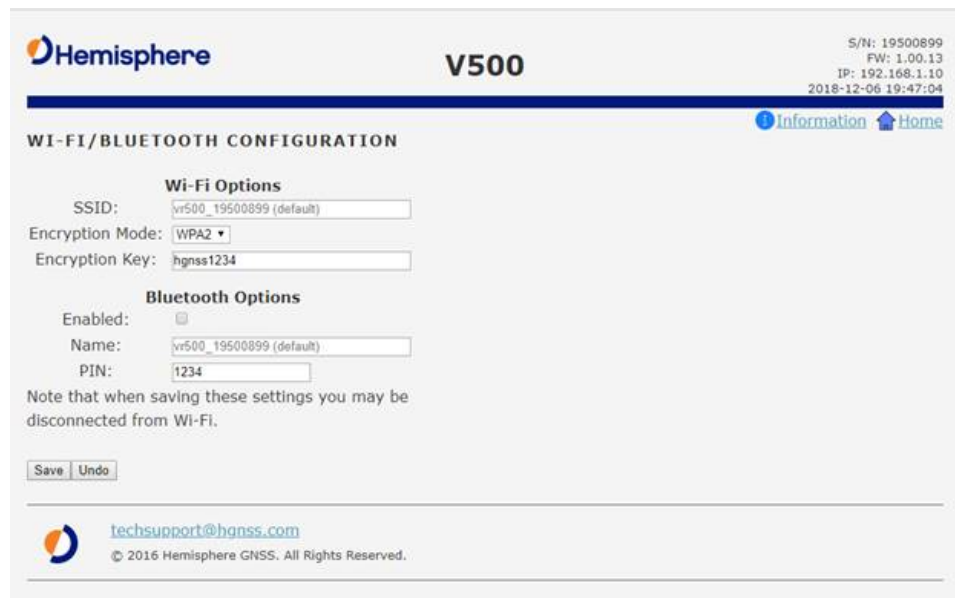
**Device name** Change the name of the receiver (displayed at the top of the WebUI).



The screenshot shows the Hemisphere V500 WebUI interface. At the top, the Hemisphere logo and 'V500' are displayed. On the right, system information is shown: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and a timestamp of 2018-12-06 19:46:15. Below this, there are links for 'Information' and 'Home'. The main heading is 'DEVICE NAME'. A sub-heading states: 'The following is a custom device name that will appear on each page.' Below this, there is a text input field labeled 'Device Name:' containing the text 'V500', followed by a 'Save' button. At the bottom, there is a footer with the Hemisphere logo, the email 'techsupport@hgns.com', and the copyright notice '© 2016 Hemisphere GNSS. All Rights Reserved.'

**Wi-Fi Bluetooth configuration** Configure the WiFi access name, encryption mode, and encryption key of the V500 in the WiFi/Bluetooth configuration settings. Click to enable Bluetooth options and type the PIN of the V500.

**Note:** The V500 internal filesystem cannot be accessed when Bluetooth is enabled. To access the internal filesystem, disable Bluetooth.



The screenshot shows the Hemisphere V500 WebUI interface for 'WI-FI/BLUETOOTH CONFIGURATION'. At the top, the Hemisphere logo and 'V500' are displayed. On the right, system information is shown: S/N: 19500899, FW: 1.00.13, IP: 192.168.1.10, and a timestamp of 2018-12-06 19:47:04. Below this, there are links for 'Information' and 'Home'. The main heading is 'WI-FI/BLUETOOTH CONFIGURATION'. Under 'Wi-Fi Options', there are three fields: 'SSID:' with the value 'vr500\_19500899 (default)', 'Encryption Mode:' with a dropdown menu set to 'WPA2', and 'Encryption Key:' with the value 'hgns1234'. Under 'Bluetooth Options', there is an 'Enabled:' checkbox which is currently unchecked, a 'Name:' field with the value 'vr500\_19500899 (default)', and a 'PIN:' field with the value '1234'. A note below these options states: 'Note that when saving these settings you may be disconnected from Wi-Fi.' At the bottom, there are 'Save' and 'Undo' buttons. At the very bottom, there is a footer with the Hemisphere logo, the email 'techsupport@hgns.com', and the copyright notice '© 2016 Hemisphere GNSS. All Rights Reserved.'

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

### Logging

Log data to the internal memory of the V500 or download a previously saved log.



**Table 4-5: Logging configuration**

Field	Description
Enabled checkbox	Click to enable logging.  Each time the V500 is powered on, logging begins with the specified settings.
Filename	Choose a filename.  All filenames automatically have an appended date and timestamp.
Start/Stop	Set a time to start and a time to stop logging.
Now/Forever	Select the logs to start logging now, or to log indefinitely (until shut off).

*Continued on next page*



## Configuring the V500 Using the WebUI, Continued

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Logging,  
continued

**Table 4-5: Logging configuration (continued)**

<b>Field</b>	<b>Description</b>
File Splitting	Automatically closes a file and restarts a new file after a period of time.  Use file splitting to decrease file sizes or to prevent the loss of a file resulting in the loss of all data
GGA	Turn on GGA message logging at 0.2Hz, 1Hz, 10Hz, or 20HZ.
Position Velocity	Log the position and velocity of the receiver at 0.2Hz, 1Hz, 10Hz, or 20HZ.
Observations*	Log raw GNSS observations at 0.2Hz, 1Hz, 10Hz, or 20HZ.  *This feature is only available if you have a "Raw" activation on the receiver.

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*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

Logging,  
continued

**Table 4-5: Logging configuration (continued)**

Field	Description
Ephemeris*	Log raw GNSS ephemeris messages at 0.2Hz, 1Hz, 10Hz, or 20HZ.  <small>*This feature is only available if you have a "Raw" activation on the receiver.</small>
Corrections	Log the correction messages coming into the receiver.
High Speed	High Speed logs diagnostic data.  <b>Note:</b> Selecting that dropdown option forces the GGA, "corrections" and "ephemeris" options on.
Heading	Heading logs the following messages: <ul style="list-style-type: none"> <li>• GPHDT</li> <li>• GPHDM</li> <li>• GPHDG</li> <li>• HPR</li> <li>• BIN3</li> </ul>

To stop logging, de-select the **Enabled** button and press **Save Settings**.

**⚠ WARNING:**  
**If you turn off the receiver without properly closing a log, the log file will become corrupted.**

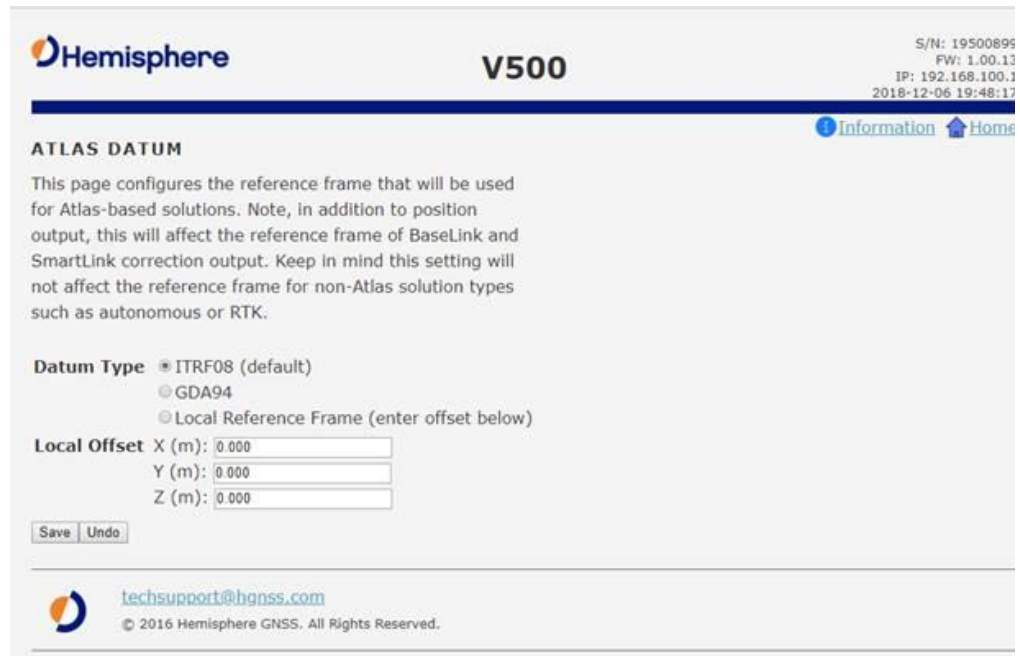
*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

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**Atlas Datum** If using Atlas (**not RTK**), datum defaults to ITRF08.

You can change Datum Type to GDA94 or enter custom reference frame offsets.



The screenshot shows the Hemisphere V500 web interface. At the top, the Hemisphere logo and 'V500' are displayed. On the right, system information is shown: S/N: 19500895, FW: 1.00.13, IP: 192.168.100.1, and 2018-12-06 19:48:17. Below this is a navigation bar with 'Information' and 'Home' links. The main section is titled 'ATLAS DATUM' and contains the following text: 'This page configures the reference frame that will be used for Atlas-based solutions. Note, in addition to position output, this will affect the reference frame of BaseLink and SmartLink correction output. Keep in mind this setting will not affect the reference frame for non-Atlas solution types such as autonomous or RTK.' Below the text are three radio buttons for 'Datum Type': 'ITRF08 (default)' (selected), 'GDA94', and 'Local Reference Frame (enter offset below)'. Under 'Local Reference Frame', there are three input fields for 'Local Offset': 'X (m): 0.000', 'Y (m): 0.000', and 'Z (m): 0.000'. At the bottom left of the form are 'Save' and 'Undo' buttons. The footer contains the email 'techsupport@hgnss.com' and the copyright notice '© 2016 Hemisphere GNSS. All Rights Reserved.'

**Filesystem** The filesystem can be used to download log files that have been previously stored onto the V500, or the filesystem can be used to upgrade both GNSS firmware or carrier board firmware.

**Note:** The filesystem cannot be used when Bluetooth is enabled. If Bluetooth is enabled, an option will be given to disable Bluetooth.

*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

Filesystem,  
continued



After Bluetooth is disabled, the filesystem displays. Any log files stored on the receiver will be available for download.

To upgrade firmware, click **Choose File**, select the GNSS or carrier board firmware, and press "Upload."



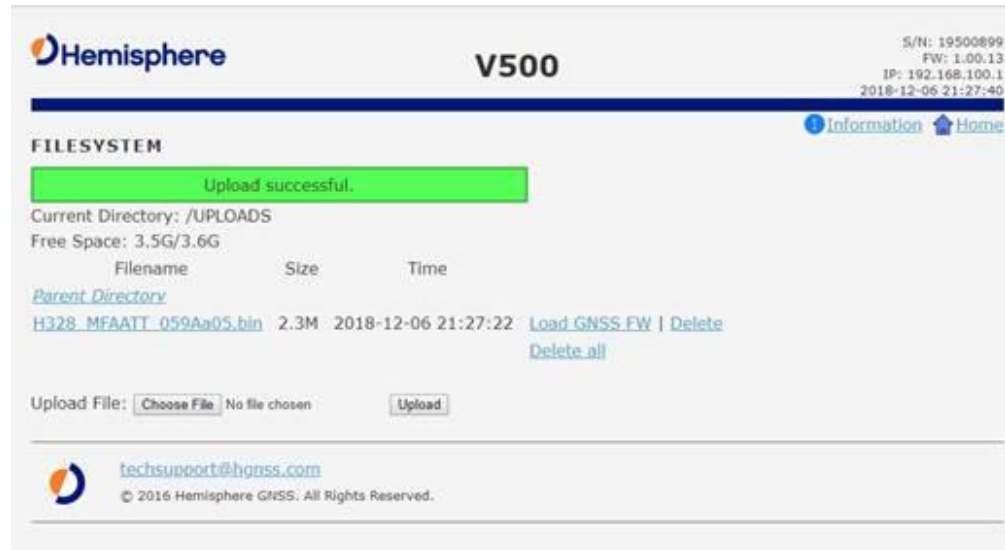
*Continued on next page*

## Configuring the V500 Using the WebUI, Continued

**Filesystem,**  
continued

After the file is uploaded, the list of files display.

Click **Load GNSS FW** or **Load Carrier FW**. When the FW is complete, click **Delete**.



The screenshot shows the Hemisphere V500 WebUI Filesystem page. At the top right, system information is displayed: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and 2018-12-06 21:27:40. The page title is "V500". Below the title, there are links for "Information" and "Home". The main heading is "FILESYSTEM". A green notification box says "Upload successful.". Below this, it shows "Current Directory: /UPLOADS" and "Free Space: 3.5G/3.6G". A table lists files with columns for "Filename", "Size", and "Time". One file is listed: "H328\_MFAATT\_059Aa05.bin" with a size of 2.3M and a time of 2018-12-06 21:27:22. To the right of the file name are links for "Load GNSS FW | Delete" and "Delete all". Below the table, there is an "Upload File:" section with a "Choose File" button, the text "No file chosen", and an "Upload" button. At the bottom, there is a contact email "techsupport@hgns.com" and a copyright notice "© 2016 Hemisphere GNSS. All Rights Reserved."

**Reboot**

Click **OK** to hard-boot the receiver.



The screenshot shows the Hemisphere V500 WebUI Reboot page. At the top right, system information is displayed: S/N: 19500899, FW: 1.00.13, IP: 192.168.100.1, and 2018-12-06 19:54:10. The page title is "V500". Below the title, there are links for "Information" and "Home". The main heading is "REBOOT". Below this, it says "This unit will now reboot. Please wait...". At the bottom, there is a contact email "techsupport@hgns.com" and a copyright notice "© 2016 Hemisphere GNSS. All Rights Reserved."

## Appendix A: Troubleshooting

### Overview

---

**Introduction** Appendix A provides troubleshooting for common problems.

---

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## Troubleshooting

### Appendix A troubleshooting

**Table A-1: V500 Troubleshooting**

Symptom	Possible Solution
Receiver fails to power	<ul style="list-style-type: none"> <li>• Check to see if the power LED is turned on</li> <li>• Verify polarity of power leads</li> <li>• Check integrity of power cable connectors</li> <li>• Check power input voltage (7 to 32 VDC)</li> <li>• Check the voltage from the connector at the end of the cable</li> <li>• Check current restrictions imposed by power source (minimum available should be &gt; 1.0 A)</li> </ul>
No data from V500	<ul style="list-style-type: none"> <li>• Check receiver power status to ensure the receiver is powered</li> <li>• Verify desired messages are activated (using PocketMax4, the WebUI, or \$JSHOW command in any terminal program)</li> <li>• Ensure the baud rate of the V500 matches that of the receiving device</li> <li>• Check integrity and connectivity of power and data cable connections</li> </ul>
Random data from V500	<ul style="list-style-type: none"> <li>• Verify that RTCM or binary messages are not being output (use the WebUI to see which messages are turned on)</li> <li>• Ensure the baud rate of the V500 matches that of the remote device</li> <li>• Ensure the requested throughput does not exceed the amount of data allowed by the baud rate of the COM port</li> </ul>
No GNSS lock	<ul style="list-style-type: none"> <li>• Verify the V500 has a clear view of the sky</li> <li>• Use PocketMax4 or the WebUI to see how many satellites are in view and the SNR values</li> </ul>

*Continued on next page*

## Troubleshooting, Continued

Appendix A  
troubleshooting  
, continued

**Table A-1: V500 Troubleshooting (continued)**

Symptom	Possible Solution
No heading or incorrect heading value	<ul style="list-style-type: none"> <li>• Check CSEP value is constant without varying more than 1 cm (0.39 in)—larger variations may indicate a high multipath environment and require moving the receiver location</li> <li>• \$JATT,SEARCH command forces the V500 to acquire a new heading solution (unless gyro is enabled)</li> <li>• Enable GYROAID to provide heading for up to three minutes during GNSS signal loss</li> <li>• Enable TILTAID to reduce heading search times</li> <li>• Monitor the number of satellites and SNR values for both antennas within PocketMax—at least four satellites should have strong SNR values</li> <li>• The V500 calculates heading from the primary to secondary GNSS antenna (the secondary antenna has an arrow underneath). Ensure via the WebUI or PocketMax there is not a heading bias added to the heading solution</li> </ul>

*Continued on next page*



## Troubleshooting, Continued

Appendix A  
troubleshooting  
, continued

**Table A-1: V500 Troubleshooting (continued)**

<b>Symptom</b>	<b>Possible Solution</b>
Constellations	<ul style="list-style-type: none"> <li>• If the V500 is not using satellites from a specific constellation (such as Galileo or BeiDou), verify the base station supports those constellations. Only satellites used at the base station can be used at the rover</li> <li>• If the V500 is not using satellites from a specific constellation, ensure the \$JSIGNAL command has not disabled the missing constellations</li> <li>• Check the WebUI for multi-GNSS activation</li> </ul>
Atlas Corrections Are Not Working	<ul style="list-style-type: none"> <li>• Check your subscription end-date in the WebUI</li> <li>• Use the L-band tab to check the frequency and bandwidth of the tracked satellite. We suggest pressing <b>Auto</b> to use your position to automatically tune to the correct frequency for your region</li> </ul>

## Appendix B: Technical Specifications

### Overview

---

**Introduction** Appendix B provides the V500 technical specifications and the V500 certification information.

---

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## V500 Technical Specifications

### V500 GNSS receiver

**Table B-1: V500 GNSS receiver**

Item	Specification
Receiver type	Vector GNSS RTK Receiver
Signal Received	GPS, GLONASS, BeiDou, Galileo, QZSS <sup>7</sup> , IRNSS <sup>7</sup> , and Atlas
Channels	1059
GPS Sensitivity	-142 dBm
SBAS Tracking	2-channel, parallel tracking
Update Rate	20 Hz standard
Timing (1PPS) Accuracy	20 ns
Rate of Turn	100°/s maximum
Cold Start	60 s (no almanac or RTC)
Warm Start	30 s typical (almanac and RTC)
Hot Start	10 s typical (almanac, RTC and position)
Heading Fix	10 s typical (Hot Start)
Antenna Input Impedance	50 Ω
Maximum Speed	1,850 mph (999 kts)
Maximum Altitude	18,288 m (60,000 ft)
Differential Options	SBAS, Atlas (L-band), RTK

### V500 accuracy

**Table B-2: V500 accuracy**

Item	Specification	
	RMS (657%)	2DRMS(95%)
<b>Positioning</b>		
Single Point <sup>1</sup>	2.4 m	
SBAS <sup>2</sup>	0.6 m	
Atlas H10 <sup>6</sup>	0.08 m	0.16m
Atlas H30 <sup>6</sup>	0.3 m	
Atlas Basic <sup>6</sup>	0.5 m	
RTK <sup>1,3</sup>	8 mm + 1 ppm	15 mm + 2 ppm
Heading (RMS)	< 0.27°	
Pitch/Roll (RMS)	1°	
Heave (RMS)	30 cm (DGPS) <sup>1,6</sup> , 10 cm (Atlas) <sup>1,6</sup> , 5 cm (RTK) <sup>6</sup>	

*Continued on next page*

## V500 Technical Specifications, Continued

V500 communications **Table B-3: V500 communications**

Item	Specification
Ports	1x full-duplex RS-232/RS-422, , 1x RS-232, 2x CAN, 1x Ethernet
Baud rates	4800 - 115200
Radio Interfaces	Bluetooth 2.0 (Class 2), Wi-Fi 2.4 GHz
Correction I/O protocol	Hemisphere GNSS proprietary ROX format, RTCMv2.3, RTCM v3.2, CMR <sup>8</sup> , CMR+ <sup>8</sup>
Data I/O protocol	NMEA 0183, Hemisphere GNSS binary
Timing Output	1PPS, CMOS, falling edge sync
Event Marker Input	Open drain, falling edge sync, 10 k $\Omega$ , 10 pF load

V500 power **Table B-4: V500 power**

Item	Specification
Input voltage	9 - 32 VDC
Power consumption	7.5W maximum
Current consumption	1.8A maximum
Power Isolation	No
Reverse Polarity Protection	Yes

*Continued on next page*

## V500 Technical Specifications, Continued

### V500 environmental

**Table B-5: V500 environmental**

<b>Item</b>	<b>Specification</b>
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing
Vibration	ISO 16750-3:2012 Section 4.1.2.7 Table 12 IEC 60945 Section 8.7
EMC	IEC60945:2002 EN 301 489-1 V2.1.1 EN 301 489-5 V2.1.1 EN 301 489-19 V2.1.0 EN 301 489-17 3.1.1 EN 303 413 V1.1.1
IMO Wheelmark Certification	No
Enclosure	IPx7/IPx9K

### V500 mechanical

**Table B-6: V500 mechanical**

<b>Item</b>	<b>Specification</b>
Dimensions	68.6 L x 22.0 W x 12.3 H cm 27.0 L x 8.7 W x 4.8 H (in)
Weight	3.7 kg (8.2 lb.)
Status indications (LED)	Power, GNSS Lock, Heading
Power/Data connector	22-Pin environmentally sealed

*Continued on next page*

## V500 Technical Specifications, Continued

### V500 L-band receiver

**Table B-7: V500 L-band receiver**

Item	Specification
Channels	1525 to 1560 MHz
Sensitivity	-130 dBm
Channel Spacing	5 kHz
Satellite Selection	Manual or Automatic
Reacquisition Time	15 sec (typical)

### V500 Aiding devices

**Table B-8: Aiding devices**

Device	Description
Gyro	Provides smooth heading, fast heading reacquisition and reliable < 0.1° per min heading for periods up to 3 min. when loss of GPS has occurred <sup>4</sup>
Tilt Sensors	Provide pitch, roll data and assist in fast start-up and reacquisition of heading solution

<sup>1</sup>Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity

<sup>2</sup>Depends on multipath environment, number of satellites in view, WAAS coverage and satellite geometry

<sup>3</sup>Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for differential services), and ionospheric activity

<sup>4</sup>Based on a 40 second time constant

<sup>5</sup>Hemisphere GNSS proprietary

<sup>6</sup>Requires a Hemisphere GNSS subscription

<sup>7</sup>With future firmware upgrade and activation

<sup>8</sup>CMR and CMR+ do not cover proprietary messages outside of the typical standard

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