Hemisphere®

875-0377-0

Vector VR1000 GNSS Receiver

User Guide
Revision: A1
June 17, 2019

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Device Compliance, License and Patents

Device Compliance

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

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

This product complies with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be consulted at HTTPS://HEMISPHEREGNSS.COM/ABOUT-US/QUALITY-COMMITMENT.

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	

Continued on next page

Device Compliance, License and Patents, Continued

Notice to Customers

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

Hemisphere GNSS, Inc
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
Phone: (480) 348-6380
Fax: (480) 270-5070
PRECISION@HGNSS.COM
WWW.HGNSS.COM

Technical Support

If you need to contact Hemisphere GNSS Technical Support:

Hemisphere GNSS, Inc.
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
Phone: (480) 348-6380
Fax: (480) 270-5070
Technical Support

Documentation Feedback

Hemisphere GNSS is committed to the quality and continuous improvement of our products and services. We urge you to provide Hemisphere GNSS with any feedback regarding this guide by opening a support case at the following website: SUPPORT.HGNSS.COM

VR1000 Terms & Definitions

Introduction

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

VR1000 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.
Atlas	Atlas is a subscription-based service provided by Hemisphere that enables the VR1000 to achieve sub-decimeter accuracy without a base station or datalink.
Atlas Frequency	The frequency of the L-band correction source being tracked.
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 UHF radio or the internet.
BeiDou	BeiDou is a Chinese satellite-based navigation system.
Bit Error Rate	The number of bit errors during a set amount of time. The maximum value is 500, and indicates that the receiver isn't tracking L-band. An ideal value is at or near 0.
Carrier Lock	Carrier Lock indicates that tracking of the L-band signal has begun.
DGPS/DGNSS	Differential GPS/GNSS refers to a receiver using Differential Corrections.
Differential Corrections	Two GNSS receivers placed in a nearby area will have similar error. A base station is placed over a known point. Since the actual position of the base station is known, error can be calculated, and corrections can then be applied to nearby rovers. This differs from RTK.
DSP Lock	0 when L-Band is engaged, regardless if Atlas converged to a solution. 1 when tracking SBAS signal and it is used in the solution

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VR1000 Terms & Definitions, Continued

VR1000 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.
Firmware	Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.
Frame Synchronization	Set to yes after the data words of the message have been lined up. It is recommended to remove Frame Sync 2 from the product.
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, BeiDou, 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.
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.

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VR1000 Terms & Definitions, Continued

VR1000 Terms & definitions, continued

Term	Definition
ROX	ROX is a Hemisphere GNSS propriety RTK message format that can be used as an alternative to RTCM3 when both the base and rover are Hemisphere branded.
RTCM	Radio Technical Commission for Maritime Services (RTCM) is a standard used to define RTK message formats so that receivers from any manufacturer can be used together.
RTK	Real-Time-Kinematic (RTK) is a real-time differential GPS method that provides better accuracy than differential corrections.
SBAS	Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.
Source	Refers to the source of L-band correction (i.e. Atlas).
Subscription	A subscription is a feature that is enabled for a limited time. Once the end-date of the subscription has been reached, the feature will turn off until the subscription is renewed.
WAAS	Wide Area Augmentation System (WAAS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of North America.

Chapter 1: Introduction

Overview

Introduction

This User Guide provides information to help you quickly set up your Vector VR1000 GNSS Receiver™. You can download this manual from the Hemisphere GNSS website at WWW.HGNSS.COM.

Contents

Product Overview

Product overview

Based on Eclipse Vector™ GNSS technology, the VR1000 (Figure 1-1) is designed for machine control applications that require precise heading and RTK position performance from the Vector VR1000 GNSS Receiver.

Featuring a Hemisphere GNSS Eclipse Vector-based receiver, integrated UHF radio, and two GNSS antennas, supporting a baseline of up to 20.0 m. The VR1000 achieves heading accuracy of up to 0.01º RMS (depending on antenna separation, and environmental conditions) and offers robust positioning performance.

Figure 1-1 VR1000 GNSS Receiver

Continued on next page

Product Overview, Continued

Product overview, continued

The VR1000 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 VR1000 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 VR1000 tracks GPS, GLONASS, Galileo, QZSS, IRNSS and BeiDou satellites and uses the Athena RTK engine.

The VR1000 can be upgraded via activations or subscriptions to support Atlas L-band corrections.

Athena RTK

Athena RTK (Real Time Kinematic) technology is available on Eclipse-based GNSS receivers. This is Hemisphere's most advanced RTK processing software and is standard on the VR1000.

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 environments
- **Performance on long baselines -** Industry-leading position stability for long baseline applications

Continued on next page

Product Overview, Continued

Atlas L-band

Atlas L-band is Hemisphere's industry leading correction service, which can be added to the VR1000 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

For more information about Atlas L-band, see:
HTTP://HEMISPHEREGNSS.COM/ATLAS

Key Features

VR1000 key features

Key features of the VR1000 include:

- High-precision positioning in Athena RTK, Atlas L-band, and SBAS
- Athena technology for improved RTK performance, especially with GLONASS, Galileo, and BeiDou
- Atlas* L-band technology providing highly accurate corrections over the air (*Requires the purchase of a subscription)
- Heave of 30 cm RMS (DGNSS), 10 cm (RTK)
- Pitch and roll < 1° RMS
- Heading accuracy up to .01°

What's Included in Your Kit

VR1000 kit

Table 1-1 lists the parts included with your VR1000.

Note: The VR1000's parts comply with IEC 60945 Section 4.4: "Exposed to the weather."

VR1000 Parts list

Table 1-1 VR1000 Parts list

Part No.	Description	Qty
940-3122-10	HGNSS VR1000	1
752-0030-10	HGNSS VR1000 Receiver	1
5231000001	Cable, Main, VR1000	1
710-0161-10	Kit, Mounting Magnets, VR1000	1

All the following items are available for purchase separately from your VR1000 receiver:

Part No.	Description	Qty
051-0398-20	Power/data cable, 15m	1
710-0152-10	VR500 22-Pin to 18-Pin Adapter Kit	1
710-0147-10	VR500 External UHF, B/T Kit	1

Firmware Upgrades

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 VR1000, 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
2. Use the internal WebUI.

RightArm Updates

Connect the VR1000 to a computer over serial. Firmware can be loaded over either 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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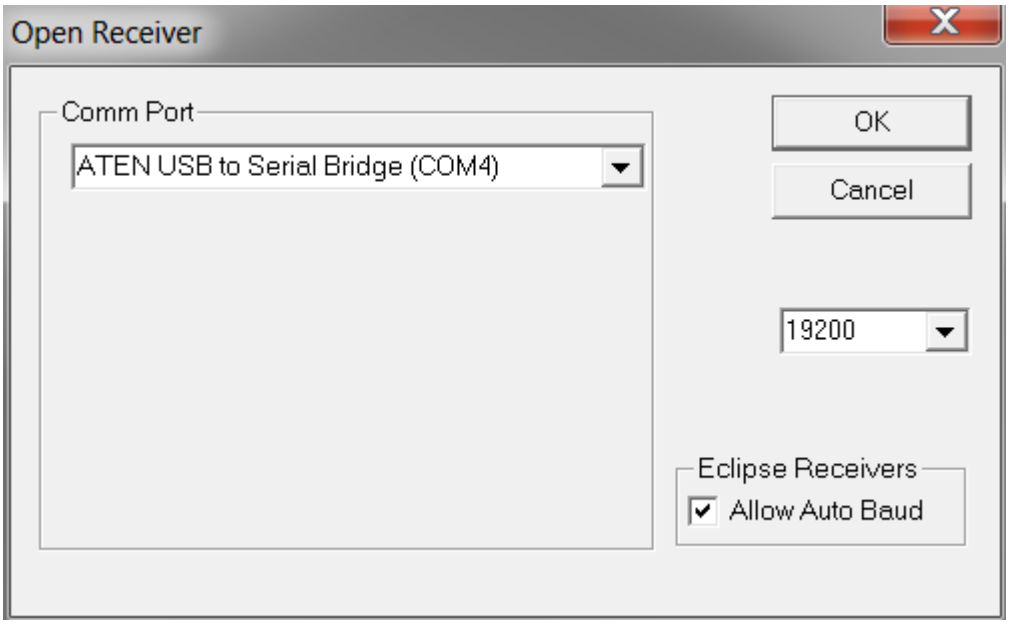
Firmware Upgrades, Continued

RightArm Updates, continued

Choose the COM port connected to the VR1000 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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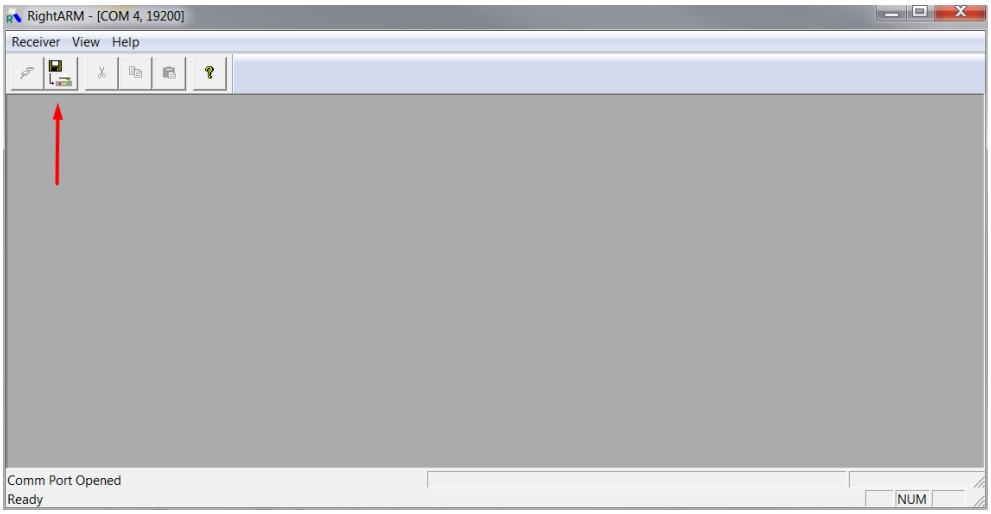
Firmware Upgrades, Continued

RightArm Updates, continued

Click the **Programming** button.



Select a **Program Type**.

The VR1000 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 not the same as the newly loaded firmware, the VR1000 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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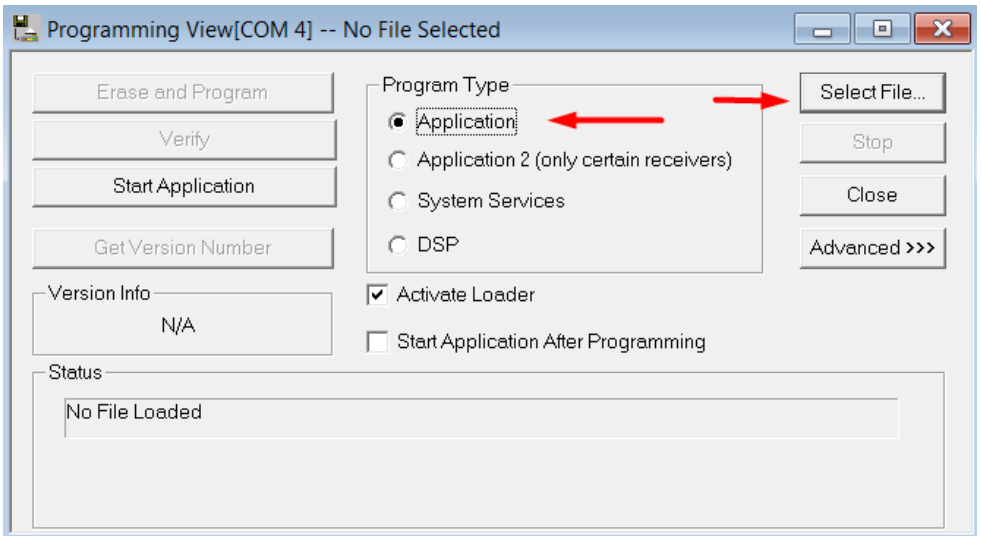
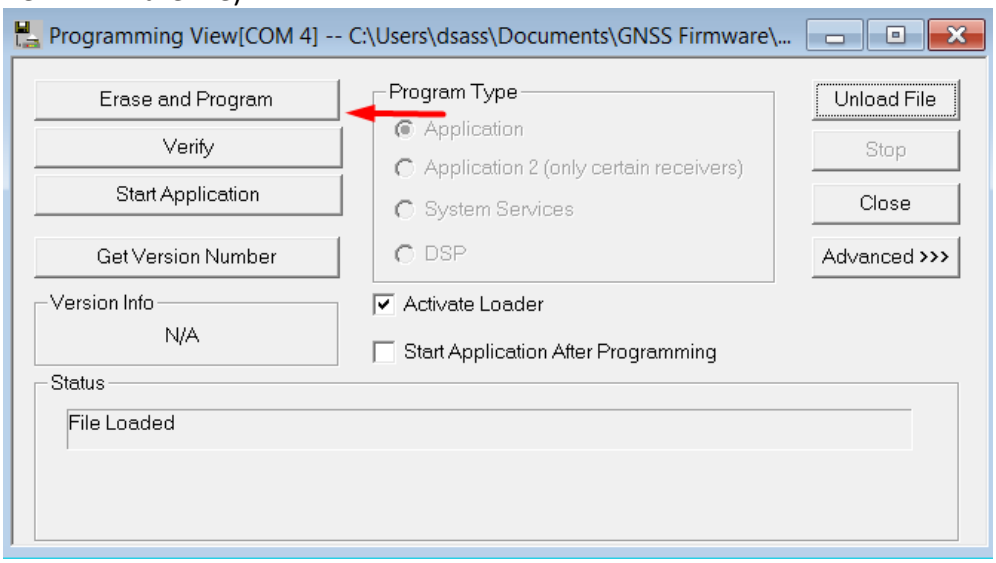
Firmware Upgrades, Continued

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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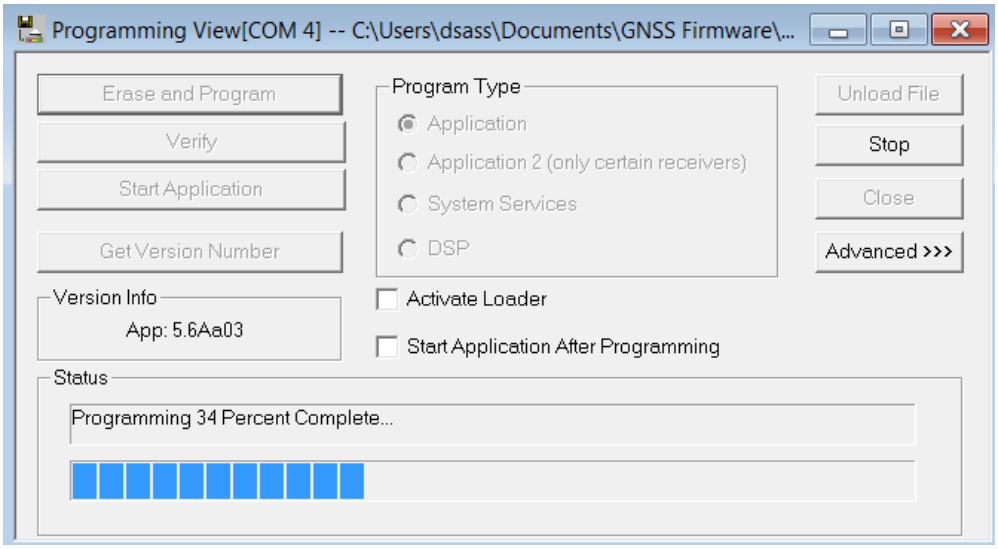
Firmware Upgrades, Continued

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 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 VR1000

Overview

Introduction

This chapter provides instructions on how to mount and install your VR1000 receiver.

Contents

Mounting the VR1000

Introduction

This section provides information on mounting the VR1000 in the optimal location, orientation considerations, environmental considerations, and other mounting options.

GNSS satellite reception

When considering where to mount the VR1000, consider the following satellite reception recommendations:

- Ensure cable length is adequate to route into the machine to reach a breakout box or terminal strip.
- Do not mount the receiver where environmental conditions exceed those specified in the VR1000 Technical Specifications of this document.
  Route cables away from any potential source of mechanical damage. Do not locate the antenna where environmental conditions exceed those specified in Appendix B, Technical Specifications of this document.

Environmental considerations

Hemisphere Vector GNSS Receivers are designed to withstand harsh environmental conditions; however, adhere to the following limits when storing and using the VR1000:

- 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 VR1000 outputs heading, pitch, and roll readings regardless of the orientation of the VR1000. 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.

Continued on next page

Mounting the VR1000, Continued

Parallel orientation

Install the GNSS antennas 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 antennas, you can enter a heading bias in the VR1000 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 receiver is not installed in a horizontal plane.

Perpendicular orientation

Install the GNSS antennas perpendicular to the centerline of the machine's axis. In this orientation:

- Enter a heading bias of +90° if the secondary antenna is installed on the right side of the machine, and -90° if the secondary antenna is installed on the left side of the machine.
- Configure the receiver to specify the GNSS receiver is measuring the roll axis using the VR1000 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 receiver is not installed in a horizontal plane.

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Mounting the VR1000, Continued

Mounting orientation example

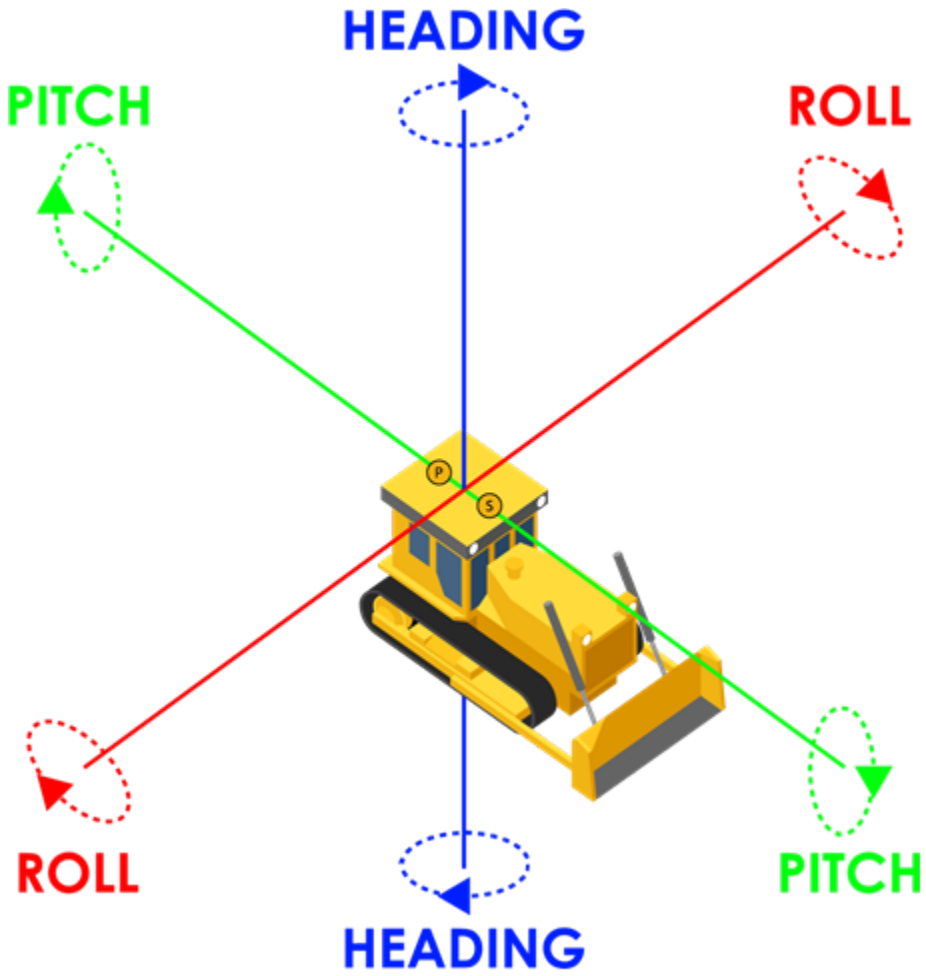

Figure 2-2: 0-degree heading bias example

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Mounting the VR1000, Continued

Mounting orientation example, continued

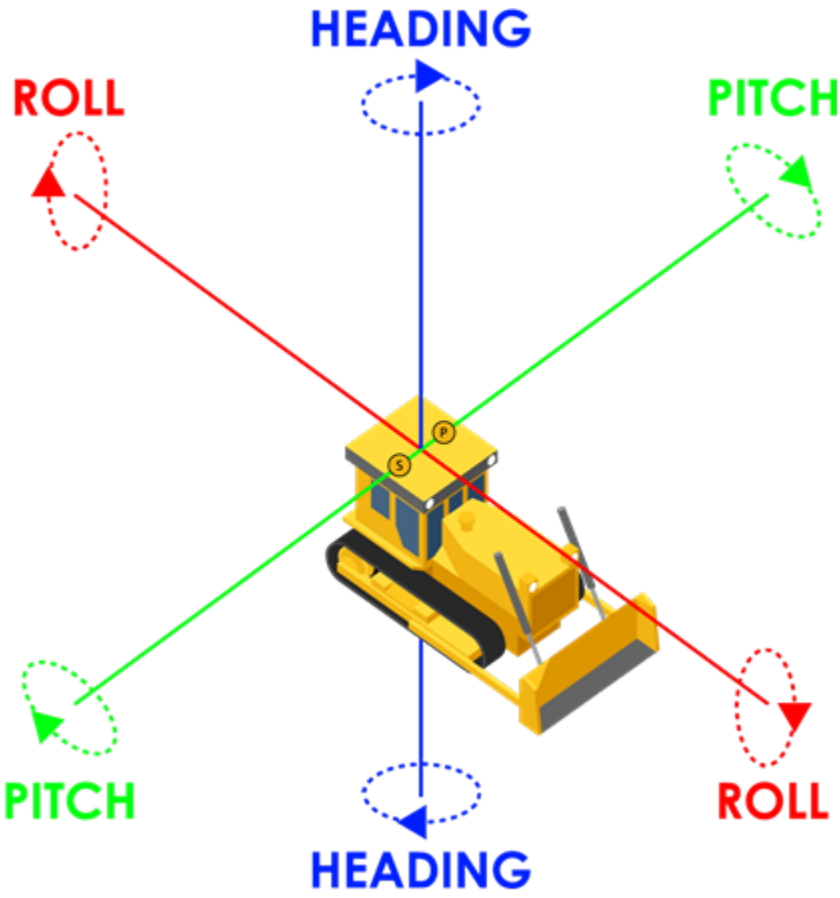

Figure 2-3: 90-degree heading bias example

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Mounting the VR1000, Continued

Mounting orientation example, continued

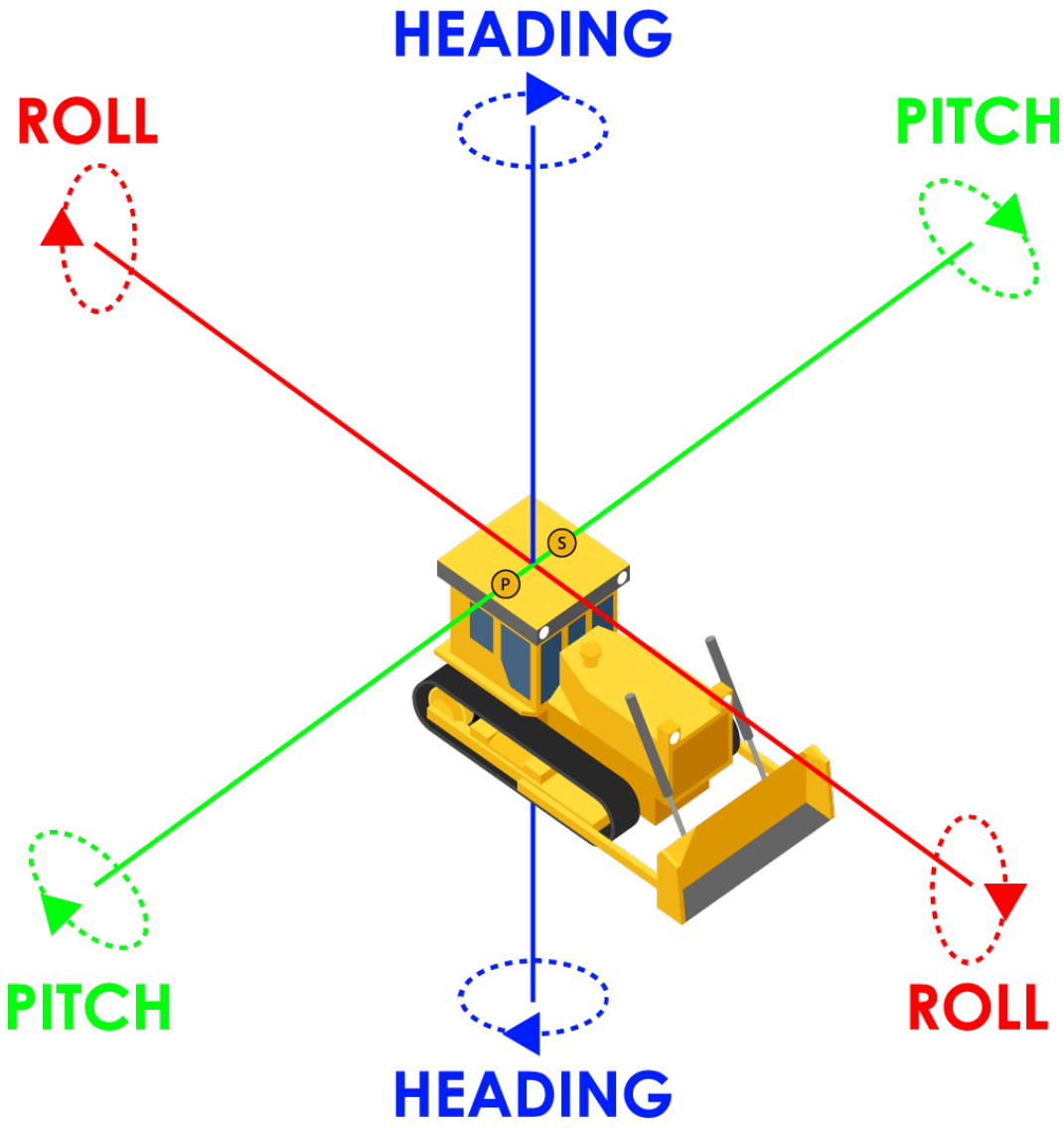

Figure 2-4: Negative 90-degree heading bias example

Mounting orientation example, continued

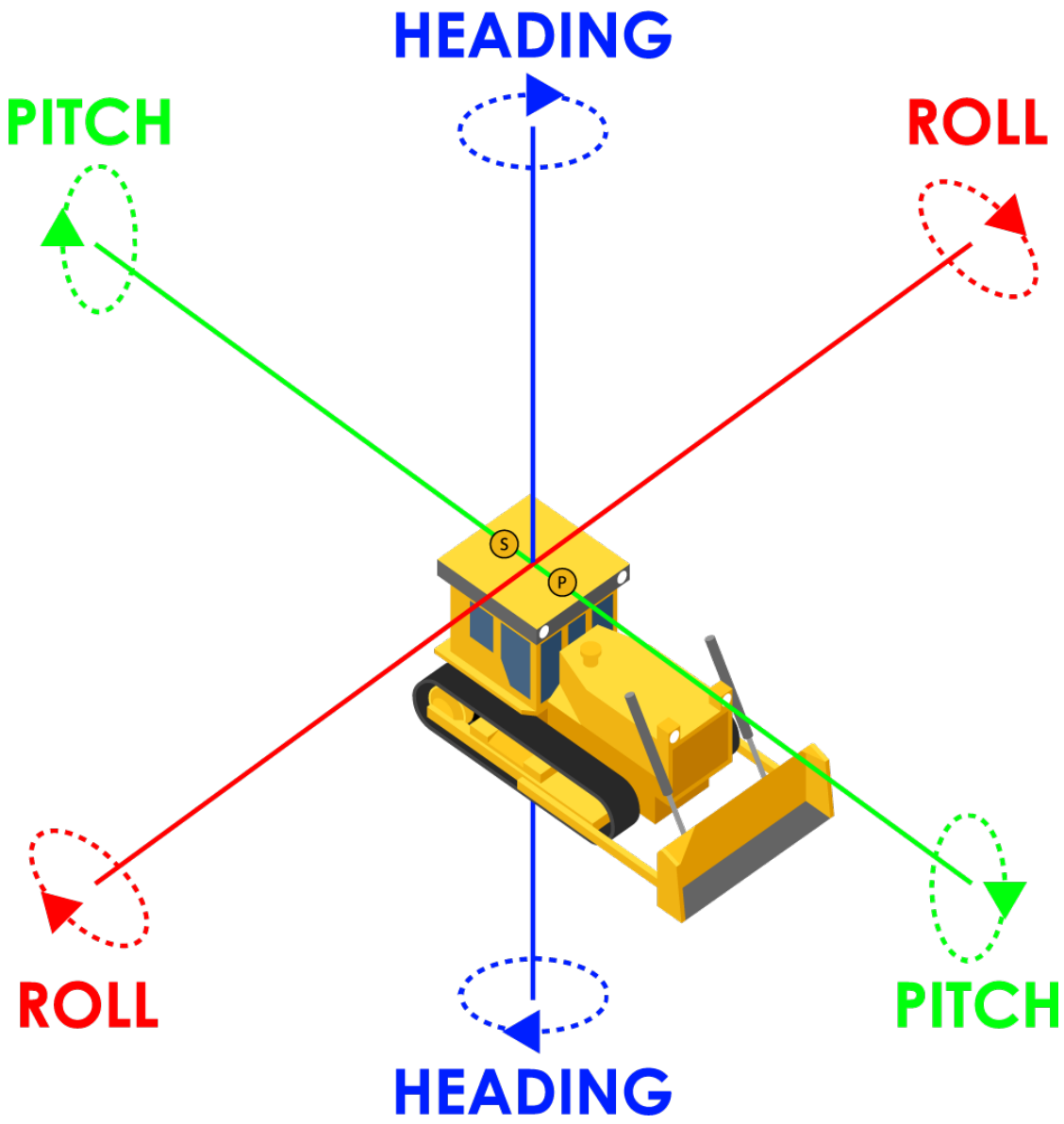

Figure 2-5: 180-degree heading bias example

Mounting the VR1000, Continued

Mounting options

The VR1000 allows for two different mounting options: mount with bolts, or mount with magnets.

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.

Note: For successful communications, use the 8-N-1 protocol and set the baud rate of the VR1000's serial ports to match that of the devices to which they are connected. Flow control is not supported.

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.

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Mounting the VR1000, Continued

VR1000 dimensions

Figure 2-6 illustrates the physical dimensions of the VR1000.

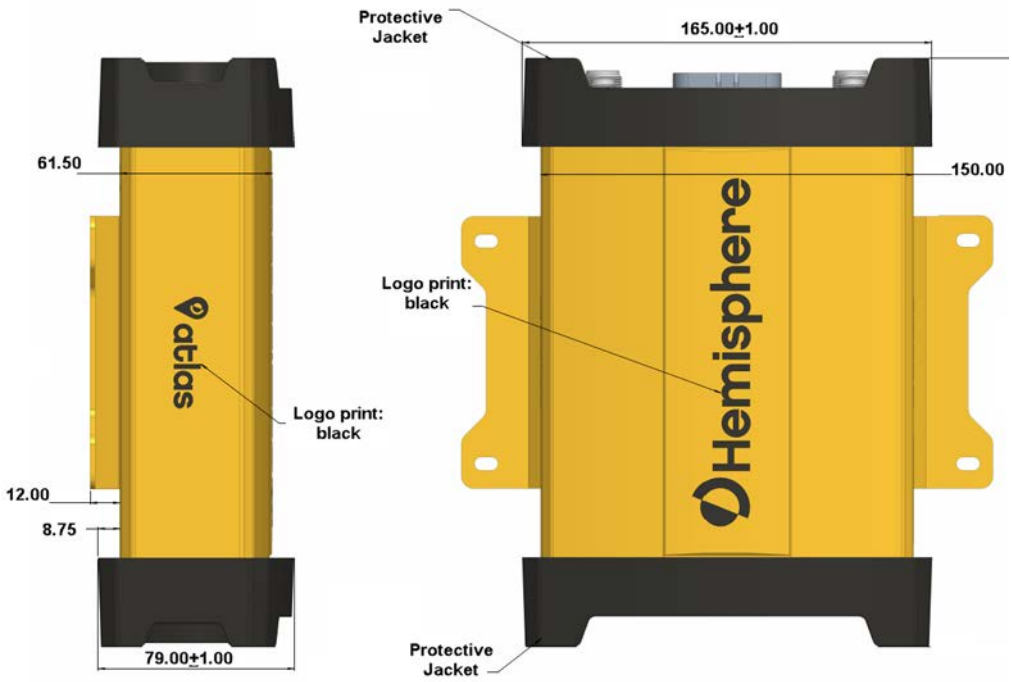

Figure 2-6: VR1000 dimensions

Continued on next page

Mounting the VR1000, Continued

Power/Data cable considerations

Before mounting the VR1000, 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 VR1000 end.	
Secure along the cable route using plastic tie wraps.	

WARNING: Improperly installed cable near machinery can be dangerous.

Connecting the Serial Power/Data cable

1. Align the cable connector key-way with the VR1000 connector key.
2. Push the connector in until it locks. The locking action is firm; you will feel a positive “click” when it has locked.

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UHF Radio Antenna

VR1000 UHF Radio Antenna

The VR1000 has an internal UHF radio for receiving RTK corrections with no need for an external radio.

The UHF antenna should be mounted to the top of the machine and the coaxial cable should be run safely and securely to the VR1000.

Ports

Overview

The VR1000 offers serial port, CAN, and Ethernet port functionality.

Serial ports

The VR1000 has two serial ports:

- Port A is full-duplex RS-232
- Port B can be either RS-232 or 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 update firmware via Port A or Port B (RS-232).

Note: The VR1000 has maximum baud rate of 115200.

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.

Note: For successful communications, use the 8-N-1 protocol and set the baud rate of the VR1000'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 VR1000 to External Devices

Recommend-ations for connecting to other devices

When interfacing to other devices, ensure the transmit data output and the signal grounds from the VR1000 are connected to the data input, and signal grounds 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 VR1000 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 VR1000 using the WebUI.

Power/Data cable considerations

The VR1000 uses a single 3 m cable for power and data input/ output.

The receiver end of the cable is terminated with an environmentally-sealed 23-Pin connection while the opposite end is terminated with multiple connectors. Ensure that the PWR-/B- wire is connected to a clean chassis ground. **DO NOT** ground directly to the battery.

Continued on next page

Connecting the VR1000 to External Devices, Continued

Power/data cable pin-out assignments

For VR1000 pin-out information, refer to Table 2-1: VR1000 Pin-Out assignments and Figure 2-7: VR1000 Back Panel and Pin-Out.

Table 2-1: VR1000 Back Panel Connector Definition

Panel	Connector
PWR/Comm	(23PIN x 1)
RADIO	(TNC x 1)
BT/Wi-Fi	(TNC x 1)
GNSS ANT	(N-Type x 2)

Table 2-2 lists the VR1000 connector pin-out. Refer to Appendix B, Figure B-1: Cable drawing for more detailed information.

Continued on next page

Connecting the VR1000 to External Devices, Continued

Power/data cable pin-out specifications

Table 2-2: VR1000 pin-out specifications

Pin	Description
1	CAN2 Low
2	CAN1 High
3	Ethernet RX-
4	Ethernet TX-
5	RS232 Port A Rx
6	1PPS OUT
7	Port B RS422 TX+/SPEED OUT
8	Power Ground
9	CAN2 High
10	CAN1 Low
11	Ethernet RX+
12	Ethernet TX+
13	RS232 Port A Tx
14	Port B RS422 RX-/EVENT MARK
15	Power Ground
16	CAN2 Shield
17	CAN1 Shield
18/19	Signal Ground
20	Port B RS232 TX/RS422 TX-
21	Port B RS232 RX/RS422 RX+
22/23	Power Positive

Continued on next page

Connecting the VR1000 to External Devices, Continued

Power/data cable pin-out specifications, continued

Figure 2-7 shows the VR1000 back panel and pin-out.

Figure 2-7: VR1000 back panel and pin-out

Table 2-3: VR1000 Connectors

#	Connector
1	Primary antenna GNSS Primary RF +5V to power antenna
2	Secondary antenna GNSS Secondary RF +5V to power antenna
3	Radio antenna Radio RF
4	BT/Wi-Fi antenna BT/Wi-Fi RF

Chapter 3: Understanding the VR1000

Overview

Introduction

The GNSS receiver begins tracking satellites when it is powered on. 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 VR1000 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

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 VR1000 will result in positioning accuracies of 2.5m 95% of the time.

To improve positioning quality, the VR1000 can receive DGNSS corrections over SBAS, L-band corrections with Hemisphere GNSS' Atlas L-band technology, or RTK corrections over serial or internal UHF radio.

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 VR1000 and does not require an activation or subscription code. The VR1000 automatically scans and tracks SBAS signals without the need to tune the receiver.

The VR1000 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 VR1000 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 VR1000 can use RTK through either serial port or its internal UHF radio. 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 radio or modem) is 8 bits/byte, 1 stop bit, no parity and no flow control.

Connect the external device to the serial port of the VR1000. Some cables may require the use of a gender changer and/or null modem adapter. For instructions on configuring the internal UHF radio, please see Configuring the VR1000 Using the WebUI.

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 VR1000 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

The VR1000 comes standard with all signals and constellations activated.

For a heading calculation, GPS, GLONASS, Galileo and BeiDou satellites are used interchangeably, as intersystem biases cancel inside the VR1000—this translates into being able to work in more obstructed areas and maintain a GNSS heading solution.

Supplemental Sensors

Overview

The VR1000 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 VR1000.

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 VR1000'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 VR1000 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).

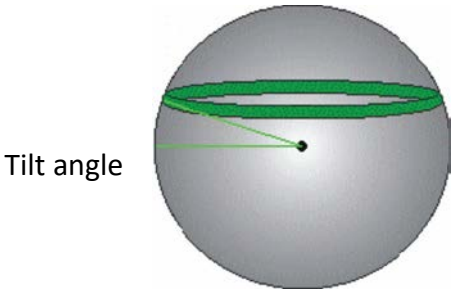


Figure 3-1: VR1000 tilt aiding

Continued on next page

Supplemental Sensors, Continued

Gyro aiding

The VR1000'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).

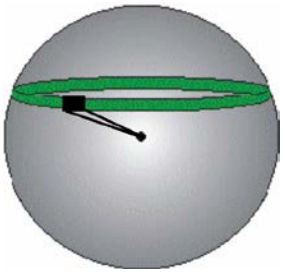


Figure 3-2: VR1000 gyro aiding

The gyro aiding accurately smooths the heading output and the rate of turn, and provides an accurate substitute heading for a short 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 1º 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 VR1000 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, ensure the dynamics the gyro experiences during this warm-up period are similar to the regular operating dynamics.

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

Overview

The VR1000 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.

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.

Continued on next page

Time Constants, Continued

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.
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 VR1000

Overview

Introduction

The chapter includes information about powering and configuring your VR1000 receiver.

Contents

Powering the Receiver On/Off

Power the receiver on/off

The VR1000 powers on when it receives clean power with 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 VR1000.

⚠WARNING:
Do not apply a voltage higher than 32 VDC. This will damage the receiver and void the warranty. Also, do not attempt to operate the VR1000 with the fuse bypassed as this will void the warranty.

The VR1000 features reverse polarity protection to prevent damage if the power leads are accidentally reversed. Although the VR1000 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 VR1000 may take up to 5 minutes to receive a full ionospheric map from SBAS. Optimum accuracy is obtained once the VR1000 is processing corrected positions using complete ionospheric information.

Electrical isolation

The VR1000's power supply is isolated from the communication lines and the enclosure isolates the electronics mechanically from the machine (preventing machine hull electrolysis).

LED Indicators

Overview

The VR1000 has twelve LED lights located on the front panel of the unit. Table 3-1 below describes each LED indicator function and description.

Figure 3-3: VR1000 LED

Table 3-1: LED indicators

Indicator	Description/Function
Power	Solid GREEN indicates receiver is powered on
Primary GNSS	Solid GREEN indicates tracking 4+ satellites Solid RED indicates No Satellites
Secondary GNSS	Solid GREEN indicates tracking 4+ satellites Solid RED indicates No Satellites
Heading	Solid GREEN indicates 2D GNSS heading Solid AMBER indicates 2D sensor heading
Quality	Solid GREEN indicates RTK fixed Flashing GREEN (1/sec) indicates DGPS / Float Solid AMBER indicates Autonomous Flashing AMBER indicates No Position Solid RED indicates No Satellites
Atlas	Flashes GREEN each time an Atlas message is received Solid GREEN indicates Atlas locked Solid AMBER indicates Atlas activated but not locked

Continued on next page

LED Indicators, Continued

Overview, continued

Table 3-1: LED indicators (continued)

Indicator	Description/Function
Bluetooth	Solid BLUE indicates Bluetooth is turned on Flashing BLUE (1/sec) indicates Bluetooth is connected
Wi-Fi	Solid GREEN indicates Wi-Fi is operational Flashing GREEN (1/sec) indicates Wi-Fi is connected
CAN1	Solid GREEN indicates CAN operational Flashing GREEN (1/sec) indicates CAN in use
CAN2	Solid GREEN indicates CAN operational Flashing GREEN (1/sec) indicates CAN in use
Ethernet	Solid GREEN indicates Ethernet operational Flashing GREEN (1/sec) indicates Ethernet in use
Radio	Flashes GREEN each time radio message is received/sent Solid GREEN indicates radio mode but no data

Configuring the VR1000 Using the WebUI

Overview

The VR1000 is equipped with an onboard WebUI.

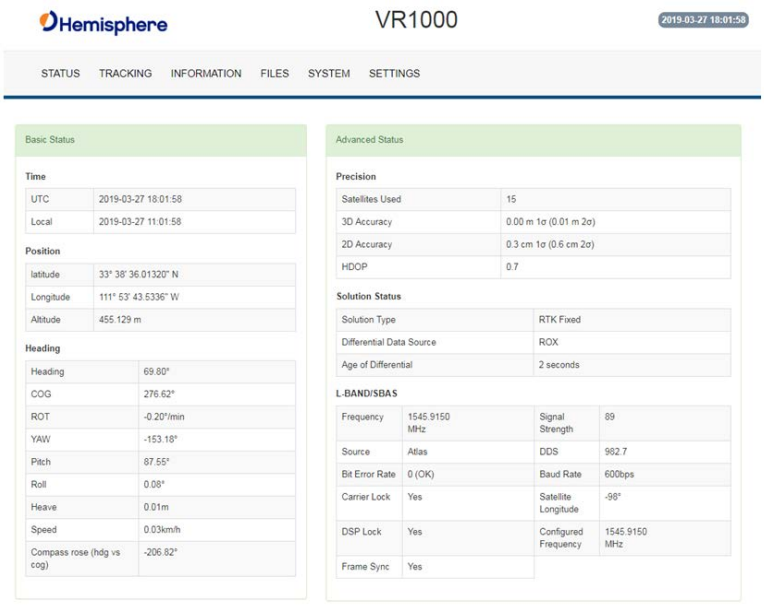
Note: The VR1000 WebUI supports Chrome and Firefox web browsers.

First, connect the Bluetooth/WiFi antenna to the connector. The receiver displays as an available Wi-Fi device in your available networks. Connect your device to the VR1000's Wi-Fi. The password is hgnss1234.

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

Status

The VR1000 **Status** tab displays. You can view RX Info, Position, Heading, L-band and SBAS.



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Configuring the VR1000 Using the WebUI, Continued

Status, continued

Table 3-2: Status fields

Field	Description
Time	UTC time obtained from satellites; Local time configured in Settings; Miscellaneous tab
Position	Latitude, Longitude, Altitude
Heading	Heading, COG, ROT, YAW, pitch, roll, heave, speed, and the difference between heading and COG
Precision	Satellites used in solution, 3D Accuracy, 2D Accuracy, horizontal dilution of precision
Solution Status	Solution type, correction source, correction signal latency
L-band /SBAS	Atlas Frequency, Source, Bit Error Rate, Carrier Lock, DSP Lock, Frame Sync, Frame Sync 2*

***Note:** For a definition of the L-band/SBAS fields refer to VR1000 Terms and Definitions.

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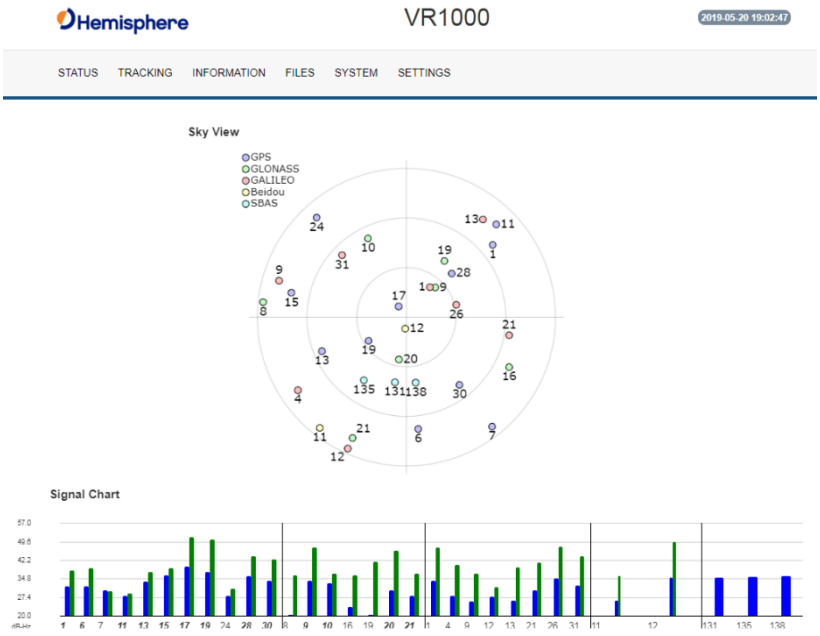
Configuring the VR1000 Using the WebUI, Continued

Tracking

On the **Tracking** tab, the Sky Plot shows the azimuth, elevation, and SNR values of all tracked satellites.



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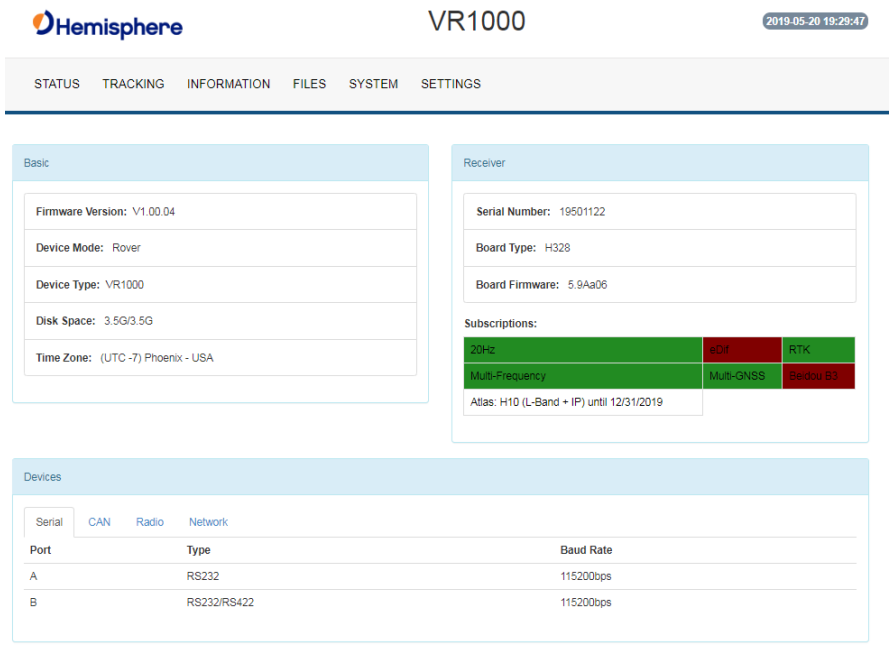
Configuring the VR1000 Using the WebUI, Continued

Information tab

On the **Information** tab, the Serial Number, Board Type, Board Firmware, Subscriptions, Devices, RX info, and Port information is displayed.

Activated items are in green.

Important: If you have purchased an activation or subscription, use the field on the **System** screen to enter the Subscription Code, and click ***the 'arrows' button***.



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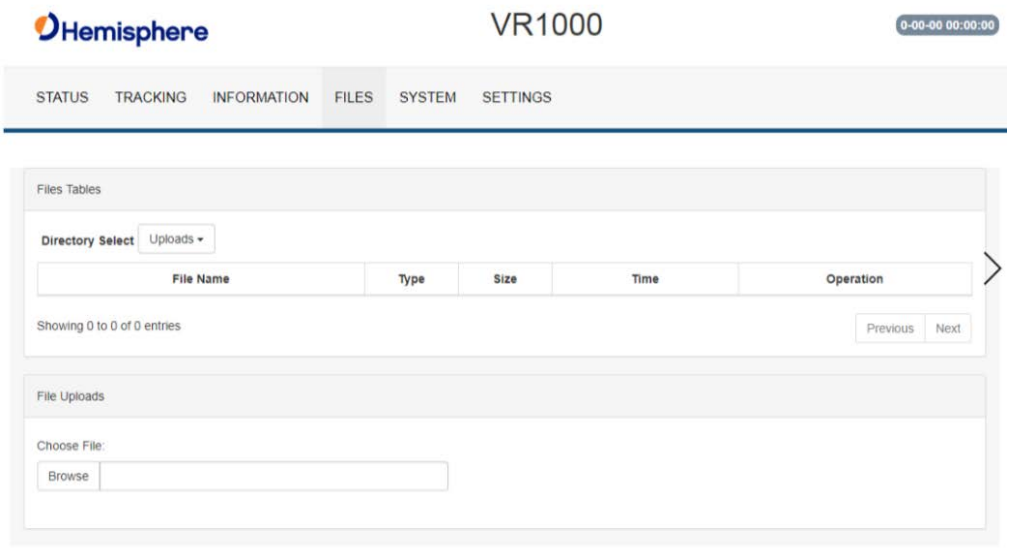
Configuring the VR1000 Using the WebUI, Continued

Files tab

Use the file tab to upload files and download log files from the receiver.



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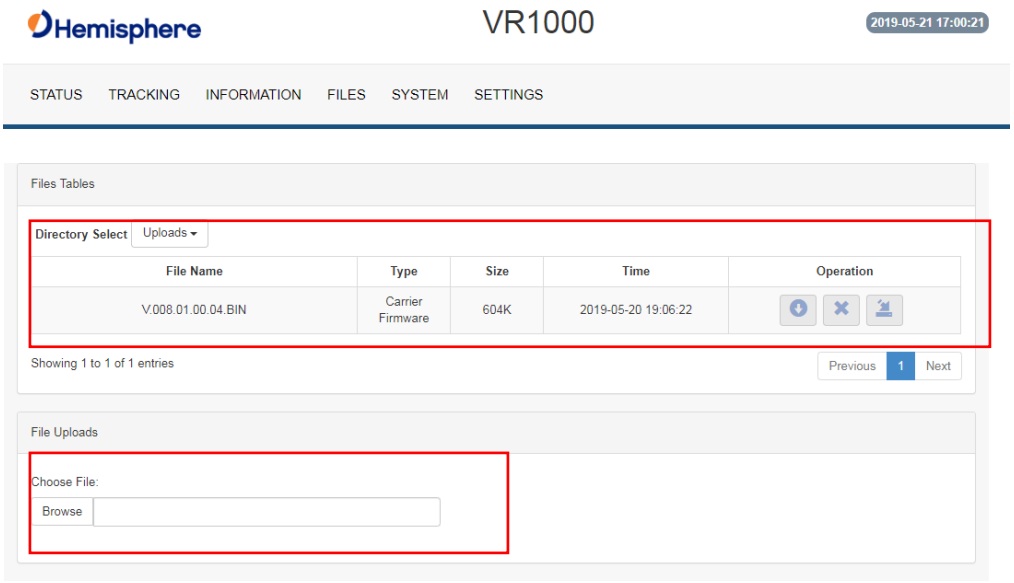
Configuring the VR1000 Using the WebUI, Continued

Files tab, continued

To install firmware, use the following steps.

1. Click **Browse** and choose a file to upload. The uploaded files display.
2. Next to **Directory Select**, click the dropdown arrow to select from **Uploads** (your uploaded files) and **Logs** (log files).
3. Next to each filename is the filetype (e.g. carrier firmware or GNSS firmware), size, time of upload, and operation. Click the down arrow to download the file, or Click **X** to delete the file.
4. Click the downward facing arrow to install the firmware file.



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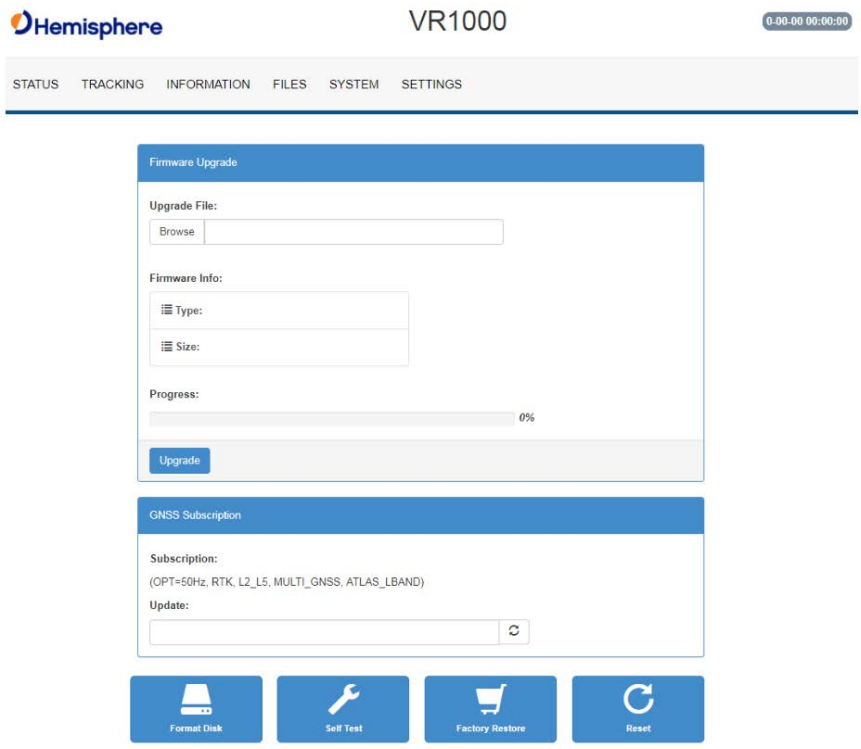
Configuring the VR1000 Using the WebUI, Continued

System

The System tab can be used to upgrade both GNSS firmware or carrier board firmware. You can add subscription codes on this screen.

Use the buttons at the bottom of the screen:

- **Format Disk**-format the internal storage
- **Self Test**- run a receiver self-test
- **Factory Restore**- restore the unit to factory settings
- **Reboot**-reboot the unit



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

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Configuring the VR1000 Using the WebUI, Continued

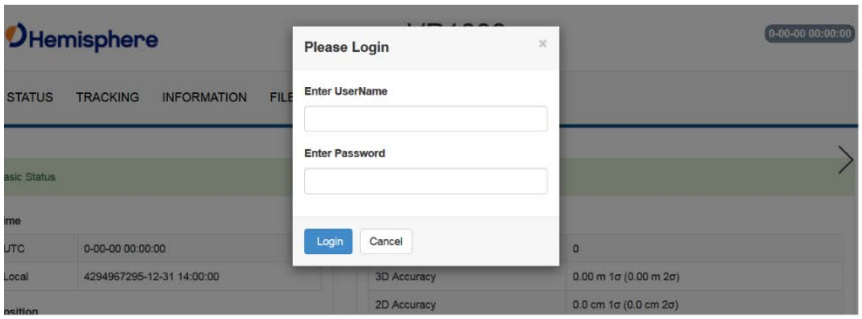
System, continued

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."

Settings

A pop-up dialog box displays prompting for username and password. Type the UserName: admin and the password: Hemi3384.



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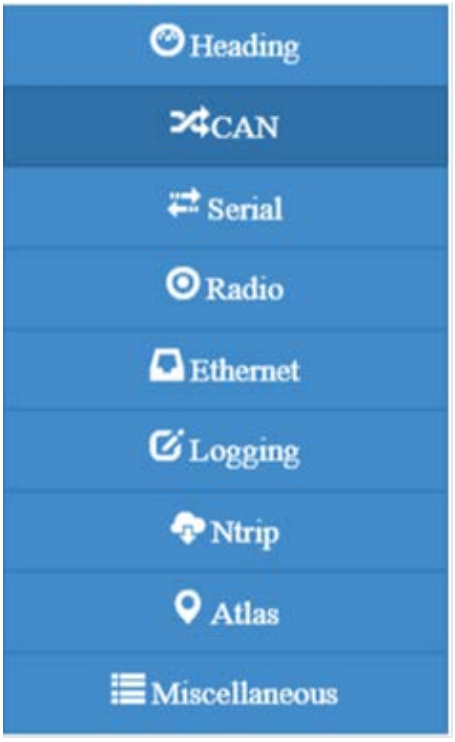
Configuring the VR1000 Using the WebUI, Continued

Settings, continued

You can configure the following using the VR1000 WebUI:

- Heading
- CAN
- Serial
- Radio
- Ethernet
- Logging
- Ntrip
- Atlas
- Miscellaneous



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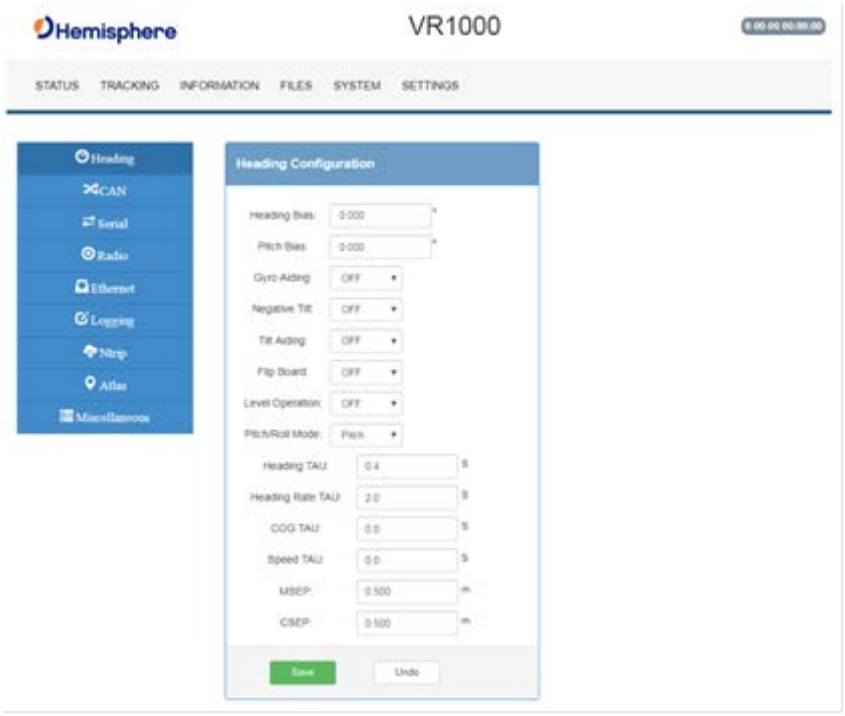
Configuring the VR1000 Using the WebUI, Continued

Heading menu

The **Heading menu** displays the following data.

Various heading settings can also be configured.

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



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Configuring the VR1000 Using the WebUI, Continued

Heading menu, continued

Table 3-3: Heading Configurations

Heading Configuration	Description
Heading Bias	Add a bias to the heading value the receiver outputs. Heading is defined as the direction of the vector created from the primary to secondary antenna. Heading is measured using true north. 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
Level Operation	If the Vector will be operated within +/- 10 degrees of level, you may use this mode of operation for increased robustness and faster acquisition times of the heading solution.

Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Heading menu, continued

Table 3-3: Heading Configurations (continued)

Heading Configuration	Description
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 to ROLL. **Note:** If your HBIAS is -90 or +90, set this to ROLL. If your HBIAS is 0 or 180, set this to PITCH.
Heading TAU	Adjust the responsiveness to true heading. If the machine is large and unable to turn quickly, increase this value. For longer baselines (10 m) HTAU should be between 0.1 and 0.5, since the gyro introduces noise. **Default value:** 0.1 s with gyro enabled **Range:** 0.0 to 60 s **Formula:** htau (s) = 40 / max rate of turn (°/s) *with gyro ON* htau (s) = 10 / max rate of turn (°/s) *with gyro OFF*
Heading Rate TAU	Adjust the responsiveness to the rate of heading change. If the machine is large and unable to turn quickly, increase this value. **Default value:** 2.0 s with gyro enabled **Range:** 0.0 to 60 s **Formula:** hrtau (s) = 10 / max rate of the rate of turn (°/s^2)

Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Heading menu, continued

Table 3-3: Heading Configurations (continued)

Heading Configuration	Description
COG TAU	The direction the machine is moving. Adjust the responsiveness to the course over ground measurement. If the machine is small and dynamic, leave this value at 0.0 s to be conservative. If the machine is large and resistant to motion, increase this value. **Default value:** 0.0 s . **Range:** 0.0 to 60 s **Formula:** cogtau (s) = 10 / max rate of change of course (°/sec)
Speed TAU	Speed of machine in km/h. Adjust the responsiveness to speed. If the machine is small and dynamic, leave this value at 0.0 s to be conservative. If the machine is large and resistant to motion, increase this value. **Default value:** 0.0 s **Range:** 0.0 to 60 s **Formula:** spdtau (s) = 10 / max acceleration (m/s^2)
MSEP	The measured distance between the primary and secondary antenna. Must be accurate to within 2 cm.

Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Heading menu, continued

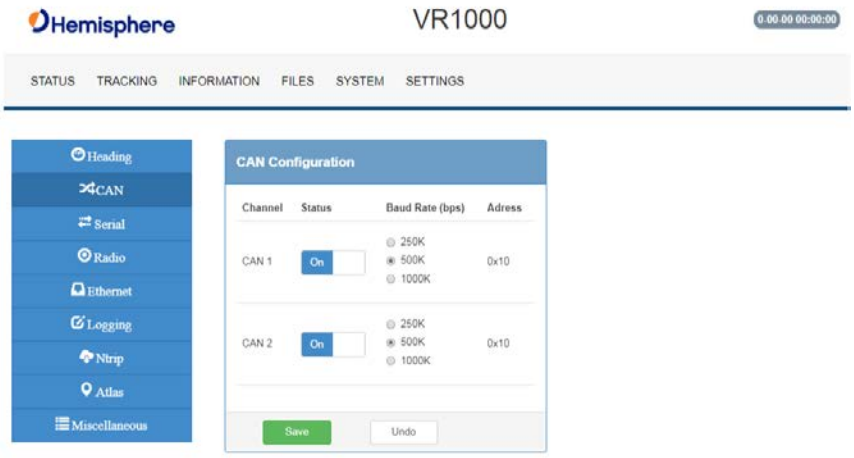
Table 3-3: Heading Configurations (continued)

Heading Configuration	Description
CSEP	This is the antenna separation calculated by the receiver. Ensure the CSEP value is within 0.02 of the MSEP value. **Note:** If CSEP value is "0" the receiver is unable to calculate the separation between the primary and secondary antennas, and you will not receive a valid heading.

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

CAN Configuration

On the CAN configuration menu, turn ON/OFF CAN and select the baud rate (250 kbps, 500 kbps, or 1000 kbps).



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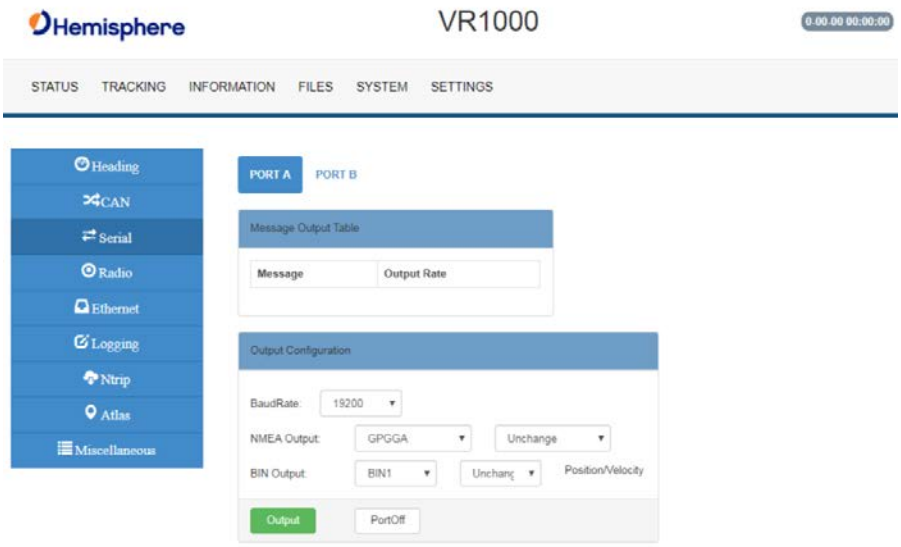
Configuring the VR1000 Using the WebUI, Continued

Serial

Use Serial 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 RS232 to RS422 and RS422 to RS232 reciprocally.

Configure the Serial Port and click **Output**.



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Configuring the VR1000 Using the WebUI, Continued

Radio Basic

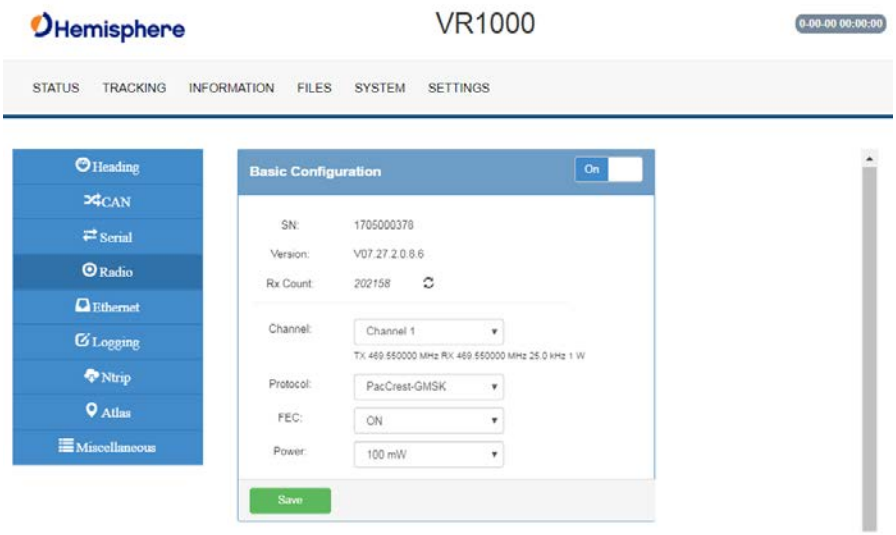
Use Radio Basic to configure the internal UHF radio (protocol, frequency, etc.).

The Radio Configuration defaults to a no-frequency setting.

Use the drop-down arrows to select pre-configured channels. Each channel has an associated frequency, and bandwidth.

Select a protocol (see Table 3-4: Radio mode). The list of available protocols is dependent upon the bandwidth of your channel. For example, if the bandwidth of the channel you are using is 12.5KHz, Trimtalk 2 will not display.

To add new channels, obtain and load a .ucf file from your dealer using the **Upload Config File** button. Choose a channel and select the protocol. For Satel protocol, you may turn FEC OFF/ON.



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Configuring the VR1000 Using the WebUI, Continued

Radio Basic, continued

Use the following table to configure Radio settings. You may configure any settings in the blue boxes.

Table 3-4: Radio mode

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

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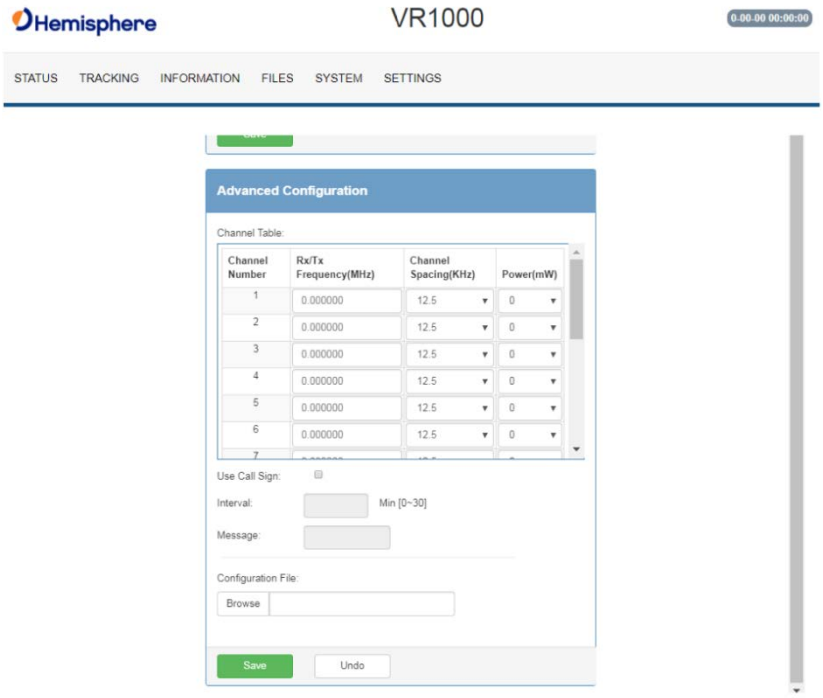
Configuring the VR1000 Using the WebUI, Continued

Radio Advanced

Use the Radio Advanced Configuration screen to manually enter Radio frequencies or upload a Configuration file of frequencies. Contact HGNSS Technical Support for Configuration files.



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Configuring the VR1000 Using the WebUI, Continued

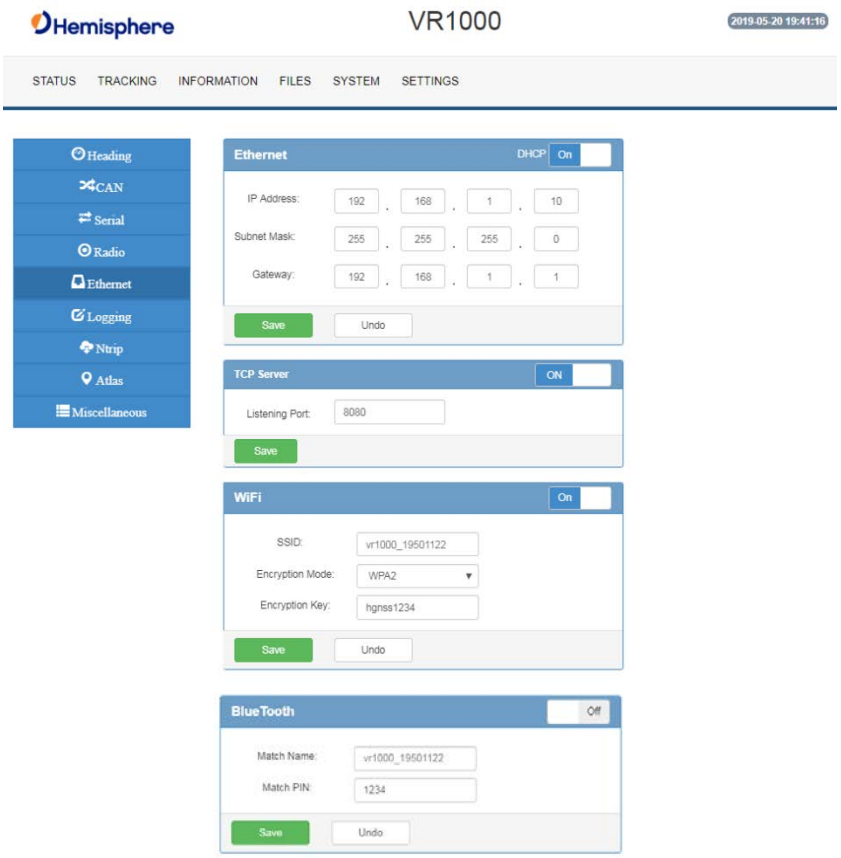
Ethernet

Use the VR1000 WebUI to configure the Ethernet connection.

Wi-Fi, Ethernet, and Bluetooth configuration-configure the WiFi access name, encryption mode, and encryption key of the VR1000 in the WiFi/Bluetooth configuration settings. Scroll to the bottom of the screen, and click to enable Bluetooth options and type the PIN of the VR1000.

TCP Server-use to change the listening port.

Note: Files cannot be downloaded from the VR1000 filesystem when Bluetooth is enabled.



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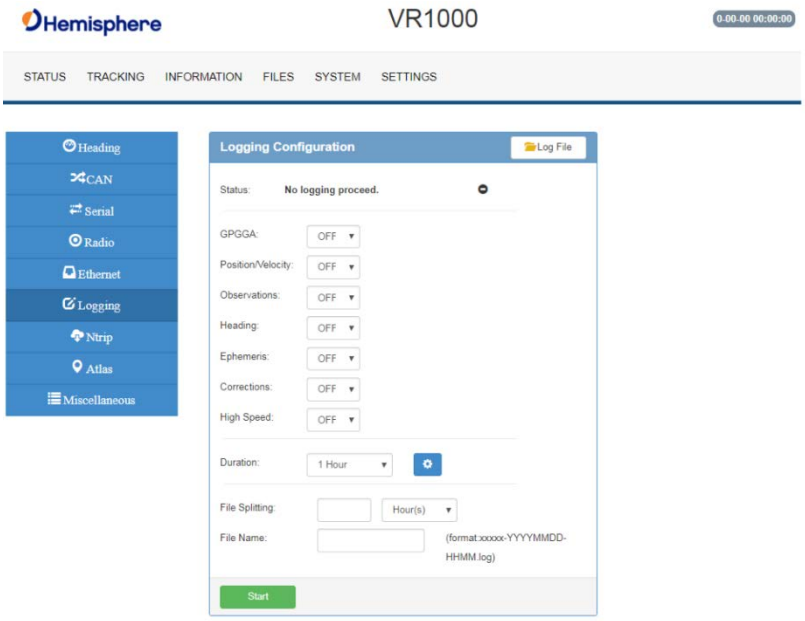
Configuring the VR1000 Using the WebUI, Continued

Logging

Log data to the internal memory of the VR1000 or download a previously saved log.



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Configuring the VR1000 Using the WebUI, Continued

Logging, continued

Table 3-5: Logging configuration

Field	Description
GPGGA	Turn on GGA message logging at 0.2Hz, 1Hz, 10Hz, or 20HZ. **Note:** 10Hz and 20Hz are only available with activations (some kits may come with 10Hz or 20Hz included).
Position/Velocity	Log the position and velocity of the receiver at 0.2Hz, 1Hz, 10Hz, or 20HZ. **Note:** 10Hz and 20Hz are only available with activations (some kits may come with 10Hz or 20Hz included).
Observations* *This feature is only available if you have a "Raw" activation on the receiver.	Log raw GNSS observations at 0.2Hz, 1Hz, 10Hz, or 20HZ. **Note:** 10Hz and 20Hz are only available with activations (some kits may come with 10Hz or 20Hz included).
Heading	Heading logs the following messages: • GPHDT • GPHDM • GPHDG • HPR • BIN3

Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Logging, continued

Table 3-5: Logging configuration (continued)

Field	Description
Ephemeris* *This feature is only available if you have a "Raw" activation on the receiver.	Log raw GNSS ephemeris messages at 0.2Hz, 1Hz, 10Hz, or 20HZ. **Note:** 10Hz and 20Hz are only available with activations (some kits may come with 10Hz or 20Hz included).
Corrections	Log the correction messages coming into the receiver.
High Speed	High Speed logs diagnostic data. **Note:** Selecting that dropdown option forces the GGA, "corrections" and "ephemeris" options on.
Duration	Set the period for which you wish to record data.
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.
Filename	Choose a filename. All filenames automatically have an appended date and timestamp.

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

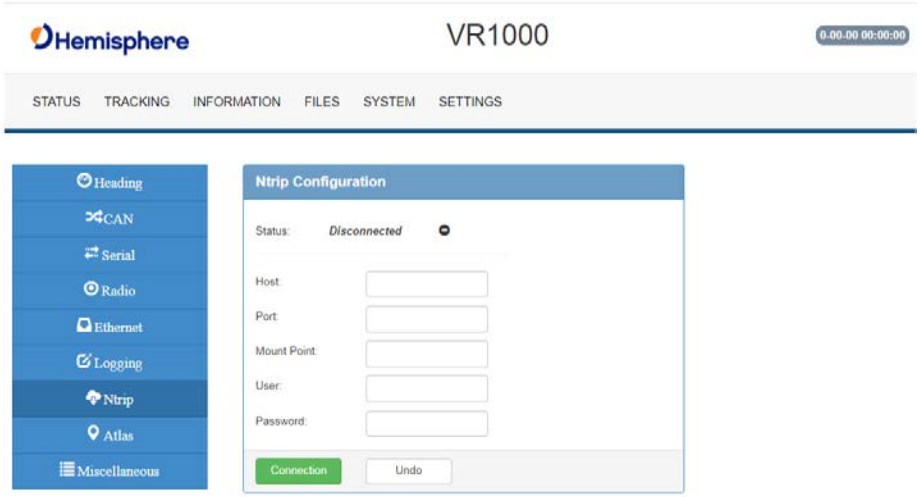
WARNING: If you power off the receiver without properly closing a log, the log file will become corrupted.

Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Ntrip Configuration

Use the Ntrip Configuration screen to enable the receiver to use corrections from an Ntrip Caster.



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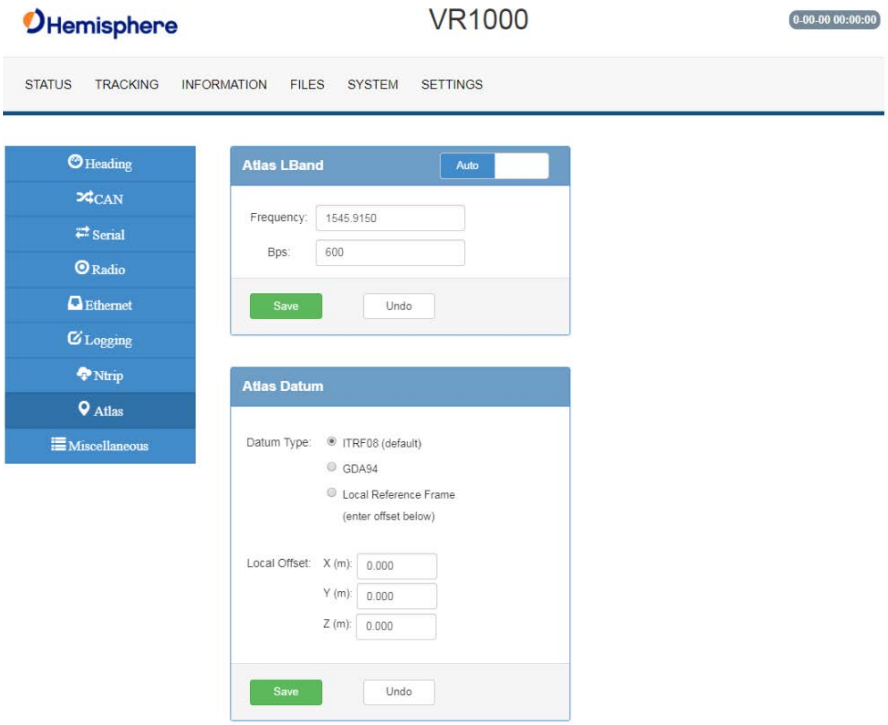
Configuring the VR1000 Using the WebUI, Continued

Atlas tab

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.



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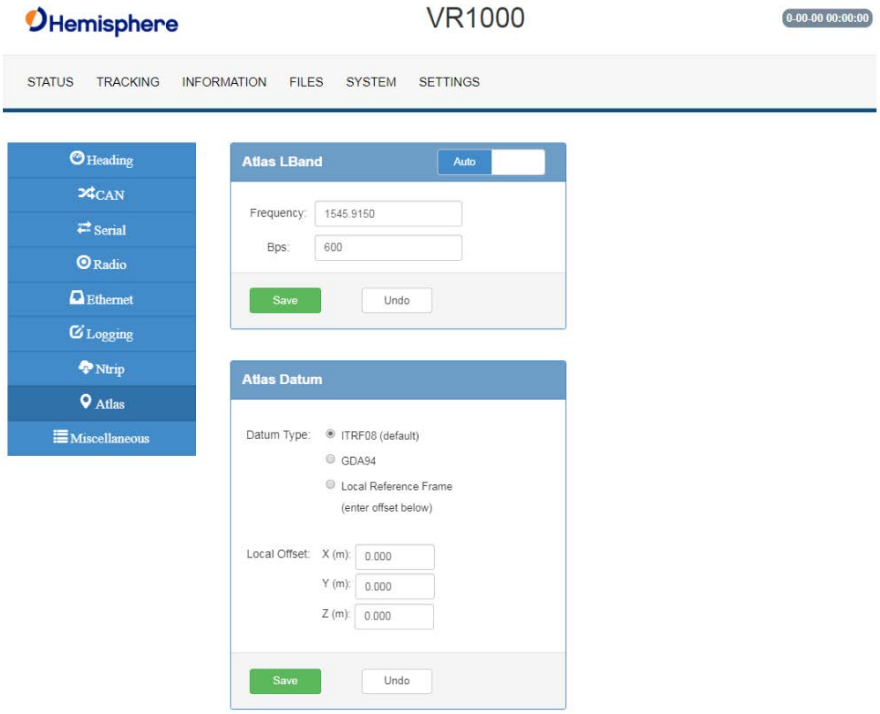
Configuring the VR1000 Using the WebUI, Continued

Atlas Datum

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

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



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Configuring the VR1000 Using the WebUI, Continued

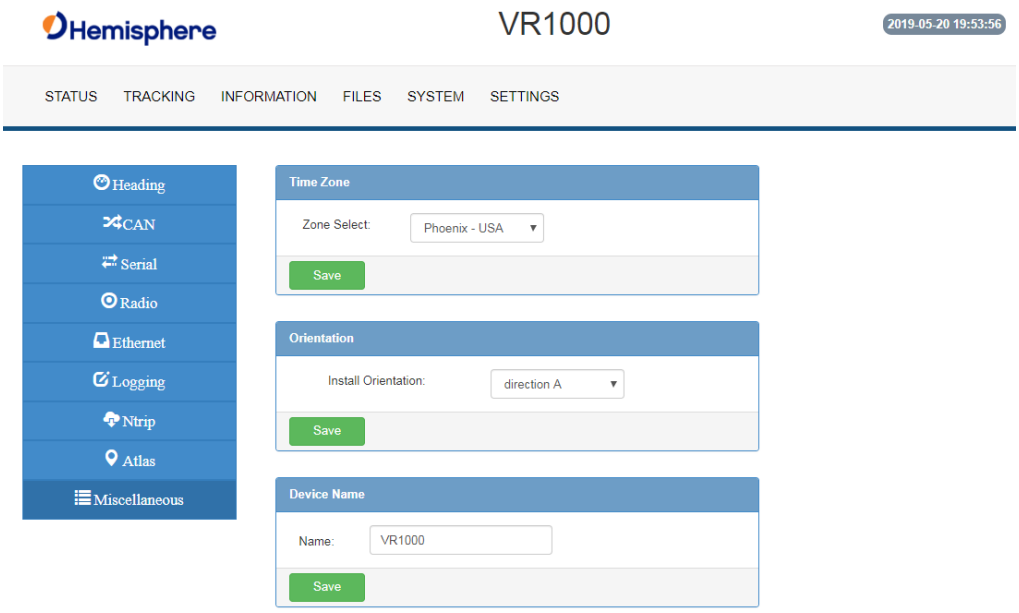
Miscellaneous

Time Zone- In the example below, the Time Zone is set to UTC-10, Honolulu - USA time.

To change the Time Zone, click the down arrow, and select the desired time zone. Please note this does not affect UTC time in NMEA output.

Orientation-selects the position in which the receiver is installed.

Device Name-the name of device that displays at the top of the screen.



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Appendix A: Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for common problems.

Contents

Troubleshooting

Appendix A troubleshooting

Table A-1: VR1000 Troubleshooting

Symptom	Possible Solution
Receiver fails to power on	• Check to see if the power LED is lit • Verify polarity of power leads • Check integrity of power cable connectors • Check power input voltage (9 to 32 VDC) • Check the voltage from the connector at the end of the cable • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from VR1000	• Check receiver power status to ensure the receiver is powered on • Verify desired messages are activated (using PocketMax4, the WebUI, or $JSHOW command in any terminal program) • Ensure the baud rate of the VR1000 matches that of the receiving device • Check integrity and connectivity of power and data cable connections
Random data from VR1000	• Verify that RTCM or binary messages are not being output (use the WebUI to see which messages are turned on) • Ensure the baud rate of the VR1000 matches that of the remote device • Ensure the requested throughput does not exceed the amount of data allowed by the baud rate of the COM port
No GNSS lock	• Verify the VR1000 has a clear view of the sky • Use PocketMax4 or the WebUI to see how many satellites are in view and the SNR values

Continued on next page

Troubleshooting, Continued

Appendix A troubleshooting, continued

Table A-1: VR1000 Troubleshooting (continued)

Symptom	Possible Solution
No heading or incorrect heading value	• Ensure MSEP value is correct, within 2 cm. • 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 • $JATT,SEARCH command forces the VR1000 to acquire a new heading solution (unless gyro is enabled) • Enable GYROAID to provide heading for up to three minutes during GNSS signal loss • Enable TILTAID to reduce heading search times • Monitor the number of satellites and SNR values for both antennas within PocketMax—at least four satellites should have strong SNR values • The VR1000 calculates heading from the primary to secondary GNSS antenna (the secondary antenna has an arrow underneath). Ensure via the WebUI or PocketMax4 there is not a heading bias added to the heading solution
VR1000 will not go RTK fixed	• Check to see if the UHF indicator is blinking. If it is not blinking, check to see if the UHF base radio is transmitting data • Ensure the frequency and settings (modulation, protocol, channel spacing, forward error corrections, and scrambling) of the base radio match the VR1000 radio • Check other VR1000 receivers in the same area are going RTK Fixed. If they are not, the area may not have UHF coverage. Check if the VR1000 works closer to the base radio. Installation of a repeater may be necessary • An external UHF radio antenna may be installed to improve UHF performance

Continued on next page

Troubleshooting, Continued

Appendix A troubleshooting, continued

Table A-1: VR1000 Troubleshooting (continued)

Symptom	Possible Solution
VR1000 will not go RTK fixed (continued)	• Check the RTK latency. If the VR1000 remains in RTK Float, but the latency keeps climbing, this usually indicates the radio settings are correct, but the environment is poor (or lacks adequate UHF coverage) . If the RTK latency is consistently 1, but the VR1000 stays RTK Float, ensure the VR1000 has an RTK activation.
Constellations	• If the VR1000 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. • Check the WebUI for multi-GNSS activation.
Atlas Corrections Are Not Working	• Check your subscription end-date in the WebUI. • Use the L-band tab to check the frequency and bandwidth of the tracked satellite. We suggest pressing **Auto** to use your position to automatically tune to the correct frequency for your region.

Appendix B: Technical Specifications

Technical Specifications

Introduction

Appendix B provides the VR1000 technical specifications and VR1000 drawings.

Contents

VR1000 Technical Specifications

VR1000 sensor specifications

Table B-1: VR1000 Sensor

Item	Specification
Receiver type	GNSS Position & Heading RTK Receiver
Signals Received	GPS, GLONASS, BeiDou, Galileo, QZSS, IRNSS and Atlas
Channels	-142 dBm
SBAS Tracking	3-channel, parallel tracking
Update Rate	10 Hz standard, 20 Hz optional
Timing (1PPS Accuracy)	20 ns
Rate of Turn	100°/s maximum
Cold Start	40 s (no almanac or RTC)
Warm Start	20 s typical (almanac and RTC)
Hot Start	5 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
Positioning	<table><tr><th></th><th>Horizontal (95%)</th><th>Vertical (95%)</th></tr><tr><td>RTK[1]</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr><tr><td>Atlas [2, 3]</td><td>0.04 m</td><td>0.08 m</td></tr><tr><td>SBAS (WAAS)[2]</td><td>0.25 m</td><td>0.5 m</td></tr><tr><td>Autonomous, no SA[2]</td><td>1.2 m</td><td>2.5 m</td></tr></table>
Heading (RMS)	< 0.2° @ 0.5 m antenna separation < 0.1° @ 1.0 m antenna separation < 0.05° @ 2.0 m antenna separation < 0.02° @ 5.0 m antenna separation < 0.01° @ 10.0 m antenna separation
Pitch/roll accuracy	1˚
Heave (RMS)	30 cm (DGPS)[3] ,10 cm (RTK) [3]

Continued on next page

VR1000 Technical Specifications, Continued

VR1000 communication specifications

Table B-2: VR1000 Communication

Item	Specification
Ports	1x full-duplex RS-232/RS-422, 1x full-duplex RS232, 2x CAN, 1x Ethernet
Baud rates	4800 - 115200
Correction I/O protocol	Atlas, Hemisphere GNSS proprietary, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+
Data I/O Protocol	NMEA 0183, Hemisphere GNSS binary
Timing output	1PPS, CMOS, active high, rising edge sync, 10 kΩ, 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 kΩ, 10 pF load
Radio Interfaces	Bluetooth 2.0 (Class 2), Wi-Fi 2.4 GHz, UHF (400 MHz)

VR1000 environmental specifications

Table B-3: VR1000 Environmental

Item	Specification
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Mechanical Shock	50G, 11ms half sine pulse (MIL-STD-810G w/ Change 1 Method 516.7 Procedure 1)
Vibration	7.7Grms (MIL-STD-810G w/Change 1 Method Category 24)
EMC	CE (ISO14982/EN13309/ISO13766/IEC60945), Radio Equipment Directive 2014/53/EU, E-Mark, RCM
Enclosure	IP69K

Continued on next page

VR1000 Technical Specifications, Continued

VR1000 mechanical specifications

Table B-4: VR1000 Mechanical

Item	Specification
Dimensions	No mounting Plate 23.2 L x 16.5 W x 7.9 H (cm) 9.1 L x 6.5 W x 3.1 H (in) With Mounting Plate 23.2 L x 21.4 W x 8.3 H (cm) 9.1 L x 8.4 W x 3.3 H (in)
Status indications (LED)	Power, Primary Antenna, Secondary Antenna, Heading, Quality, Atlas, Bluetooth, Wi-Fi, CAN1, CAN2, Ethernet, Radio
Power/Data connector	23-pin multi-purpose

VR1000 L-band sensor specifications

Table B-5: VR1000 L-band sensor

Item	Specification
Channels	1530 to 1560 MHz
Receiver Type	Single Channel
Sensitivity	-140 dBm
Channel spacing	5 kHz
Satellite selection	Manual or Automatic
Reacquisition time	15 sec (typical)

VR1000 aiding device specifications

Table B-6: VR aiding device

Device	Description
Gyro	Provides smooth heading, fast heading reacquisition and reliable < 0.5° per min heading for periods up to 3 min. when loss of GNSS has occurred[4]
Tilt sensor	Provide pitch, roll data and assist in fast start-up and reacquisition of heading solution

1 Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity
2 Depends on multipath environment, number of satellites in view, WAAS coverage and satellite geometry
3 Requires a subscription
4 Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for differential services), and ionospheric activity
5 Hemisphere GNSS proprietary

VR1000 Drawings

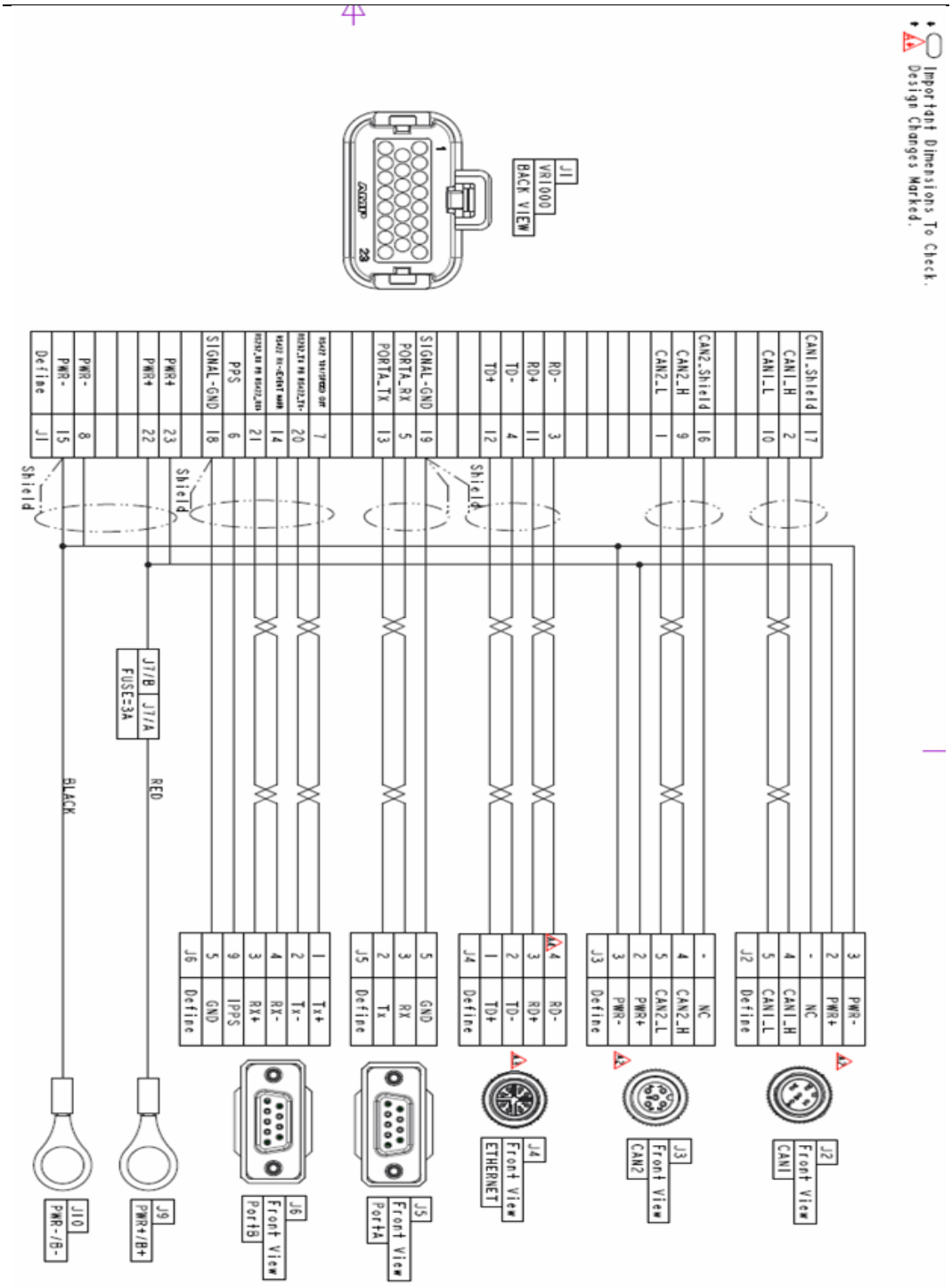

Figure B-1 Cable Drawing

Note: This cable is **not** available for purchase.

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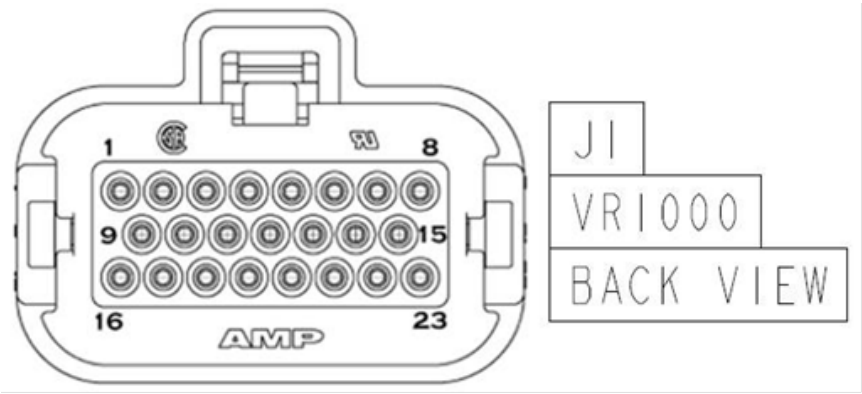
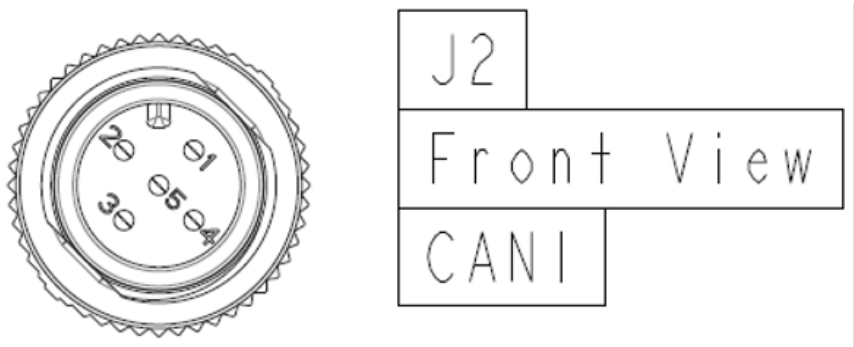
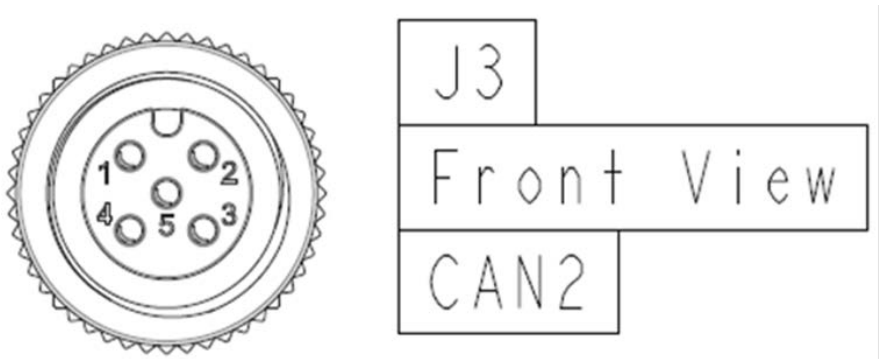
VR1000 Drawings, Continued

Figure B-2 shows the pin assignments for the J1 – J6 connectors.







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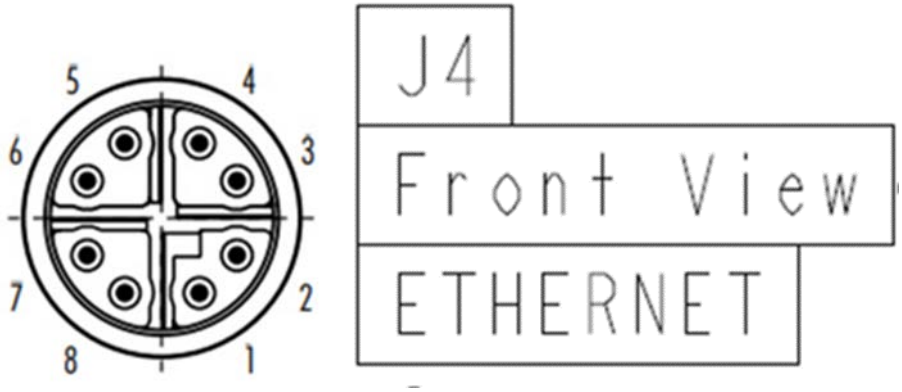
VR1000 Drawings, Continued



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VR1000 Drawings, Continued

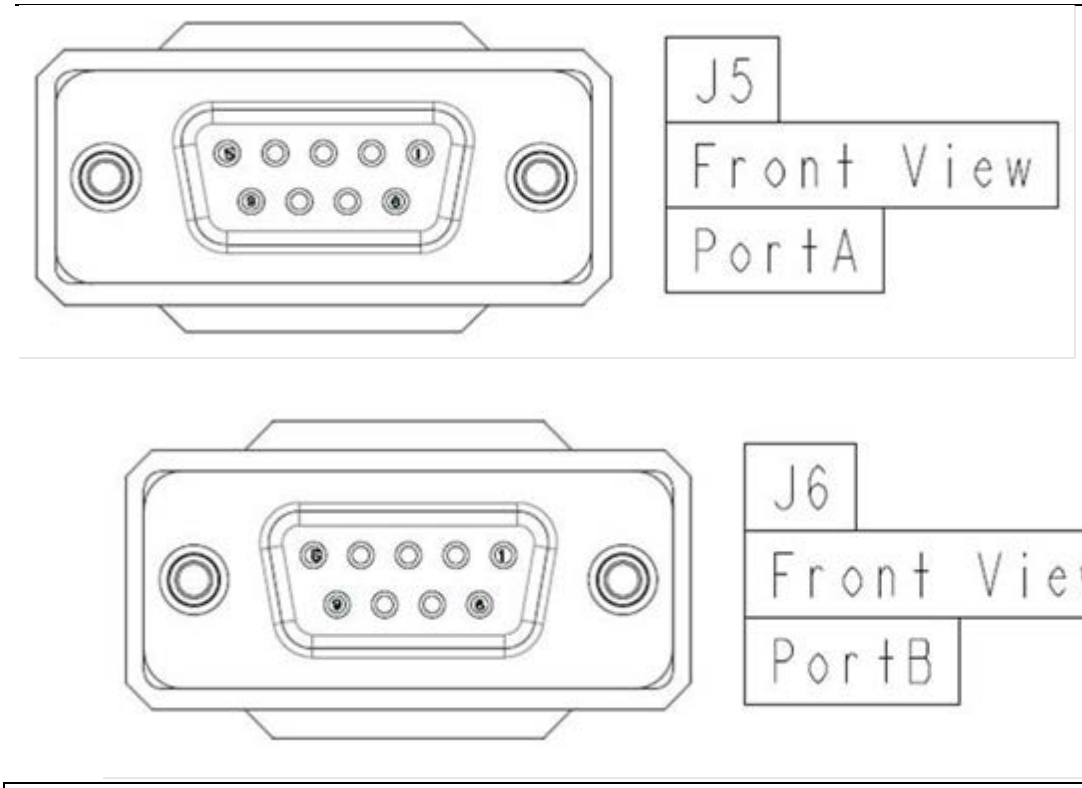

Figure B2: J1 – J6 Connectors

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Warranty notice

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LIMITED WARRANTY: Hemisphere GNSS warrants solely to the end purchaser of the Products, subject to the exclusions and procedures set forth below, that the Products sold to such end purchaser and its internal components shall be free, under normal use and maintenance, from defects in materials, and workmanship and will substantially conform to Hemisphere GNSS's applicable specifications for the Product, for a period of 12 months from delivery of such Product to such end purchaser (the ”Warranty Period”). Repairs and replacement components for the Products are warranted, subject to the exclusions and procedures set forth below, to be free, under normal use and maintenance, from defects in material and workmanship, and will substantially conform to Hemisphere GNSS's applicable specifications for the Product, for 90 days from performance or delivery, or for the balance of the original Warranty Period, whichever is greater.

EXCLUSION OF ALL OTHER WARRANTIES. The LIMITED WARRANTY shall apply only if the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS relevant User’s Manual and Specifications, AND the Product is not modified or misused. The Product is provided “AS IS” and the implied warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and ALL OTHER WARRANTIES,
express, implied or arising by statute, by course of dealing or by trade usage, in connection with the design, sale, installation, service or use of any products or any component thereof, are EXCLUDED from this transaction and shall not apply to the Product. The LIMITED WARRANTY is IN LIEU OF any other warranty, express or implied, including but not limited to, any warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, title, and non-infringement.

LIMITATION OF REMEDIES. The purchaser’s EXCLUSIVE REMEDY against Hemisphere GNSS shall be, at Hemisphere GNSS's option, the repair or replacement of any defective Product or components thereof. The purchaser shall notify Hemisphere GNSS or a Hemisphere GNSS's approved service center immediately of any defect. Repairs shall be made through a Hemisphere GNSS approved service center only. Repair, modification or service of Hemisphere GNSS products by any party other than a Hemisphere GNSS approved service center shall render this warranty null and void. The remedy in this paragraph shall only be applied in the event that the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS's relevant User’s Manual and Specifications, AND the Product is not modified or misused. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE
TO PURCHASER, even if Hemisphere GNSS has been advised of the possibility of such damages. Without limiting the foregoing, Hemisphere GNSS shall not be liable for any damages of any kind resulting from installation, use, quality, performance or accuracy of any Product.

HEMISPHERE IS NOT RESPONSIBLE FOR PURCHASER’S NEGLIGENCE OR UNAUTHORIZED USES OF THE PRODUCT. IN NO EVENT SHALL Hemisphere GNSS BE IN ANY WAY RESPONSIBLE FOR ANY DAMAGES RESULTING FROM PURCHASER’S OWN NEGLIGENCE, OR FROM OPERATION OF THE PRODUCT IN ANY WAY OTHER THAN AS SPECIFIED IN Hemisphere GNSS's RELEVANT USER’S MANUAL AND SPECIFICATIONS. Hemisphere GNSS is NOT RESPONSIBLE for defects or performance problems resulting from (1) misuse, abuse, improper installation, neglect of Product; (2) the utilization of the Product with hardware or software products, information, data, systems, interfaces or devices not made, supplied or specified by Hemisphere GNSS; (3) the operation of the Product under any specification other than, or in addition to, the specifications set forth in Hemisphere GNSS's relevant User’s Manual and Specifications; (4) damage caused by accident or natural events, such as lightning (or other electrical discharge) or fresh/ salt water immersion of Product; (5) damage occurring in transit; (6) normal wear and tear; or (7) the operation or failure of operation of any satellite-based positioning system or differential correction service; or the availability or performance of any satellite-based positioning signal or differential correction signal.

THE PURCHASER IS RESPONSIBLE FOR OPERATING THE VEHICLE SAFELY. The purchaser is solely responsible for the safe operation of the vehicle used in connection with the Product, and for maintaining proper system control settings. UNSAFE DRIVING OR SYSTEM CONTROL SETTINGS CAN RESULT IN PROPERTY DAMAGE, INJURY, OR DEATH.

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Warranty Notice, Continued

Warranty notice, continued

The purchaser is solely responsible for his/her safety and for the safety of others. The purchaser is solely responsible for maintaining control of the automated steering system at all times. THE PURCHASER IS SOLELY RESPONSIBLE FOR ENSURING THE PRODUCT IS PROPERLY AND CORRECTLY INSTALLED, CONFIGURED, INTERFACED, MAINTAINED, STORED, AND OPERATED IN ACCORDANCE WITH Hemisphere GNSS's RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GNSS does not warrant or guarantee the positioning and navigation precision or accuracy obtained when using Products. Products are not intended for primary navigation or for use in safety of life applications. The potential accuracy of Products as stated in Hemisphere GNSS literature and/or Product specifications serves to provide only an estimate of achievable accuracy based on performance specifications provided by the satellite service operator (i.e. US Department of Defense in the case of GPS and differential correction service provider. Hemisphere GNSS reserves the right to modify Products without any obligation to notify, supply or install any improvements or alterations to existing Products.

GOVERNING LAW. This agreement and any disputes relating to, concerning or based upon the Product shall be governed by and interpreted in accordance with the laws of the State of Arizona.

OBTAINING WARRANTY SERVICE. In order to obtain warranty service, the end purchaser must bring the Product to a Hemisphere GNSS approved service center along with the end purchaser's proof of purchase. Hemisphere GNSS does not warrant claims asserted after the end of the warranty period. For any questions regarding warranty service or to obtain information regarding the location of any of Hemisphere GNSS approved service center, contact Hemisphere GNSS at the following address:

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