Vector VR1000 GNSS Receiver Quick Reference Guide (QRG)

Introduction

Created by Hemisphere GNSS, this QRG provides information and the steps to follow to set up your Vector VR1000 GNSS Receiver.

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°

Mounting

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.

Figure 1: VR1000 GNSS Receiver

Continued on next page

Vector VR1000 GNSS Receiver Quick Reference Guide (QRG),
Continued

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.

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.

`*Continued on next page*

Vector VR1000 GNSS Receiver Quick Reference Guide (QRG),
Continued

Mounting orientation

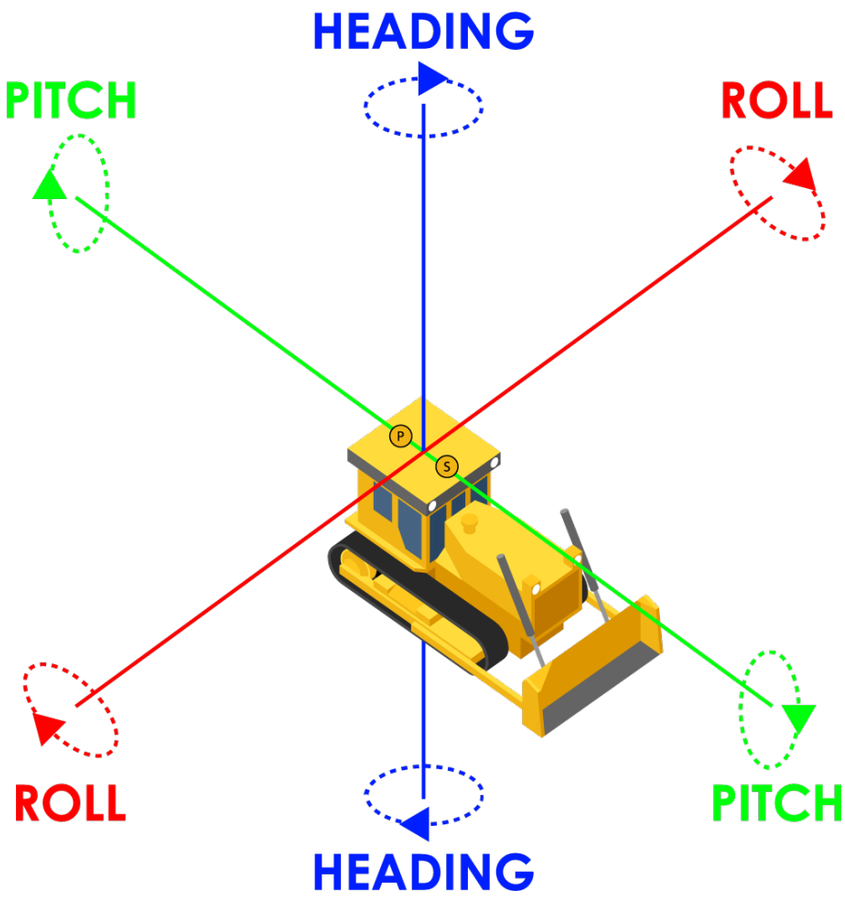


Figure 2: 0-degree heading bias example

Continued on next page

Mounting orientation example

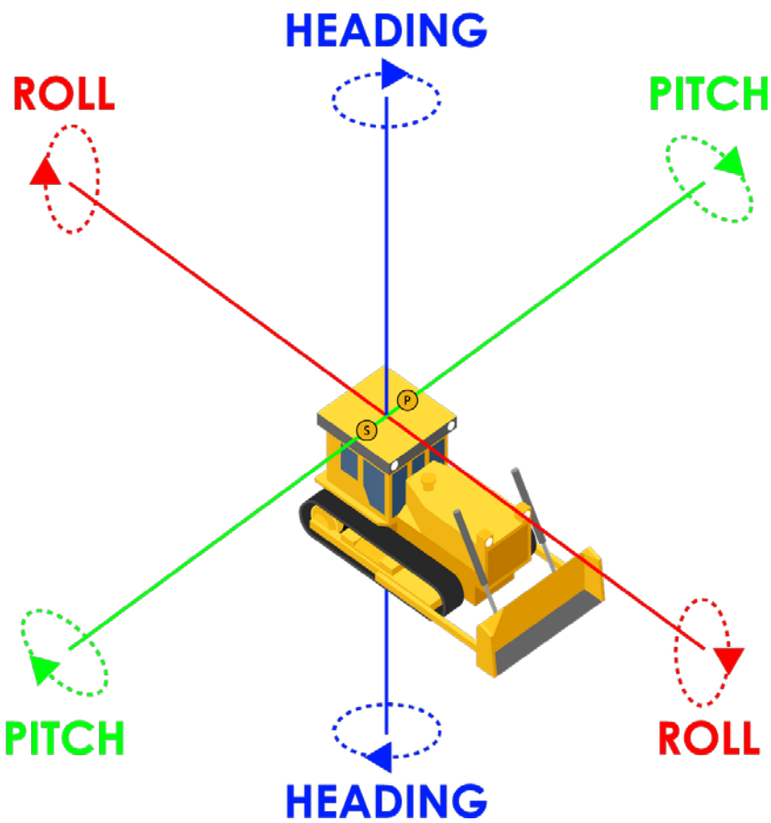


Figure 3: 90-degree heading bias example

Continued on next page

Mounting orientation example, continued

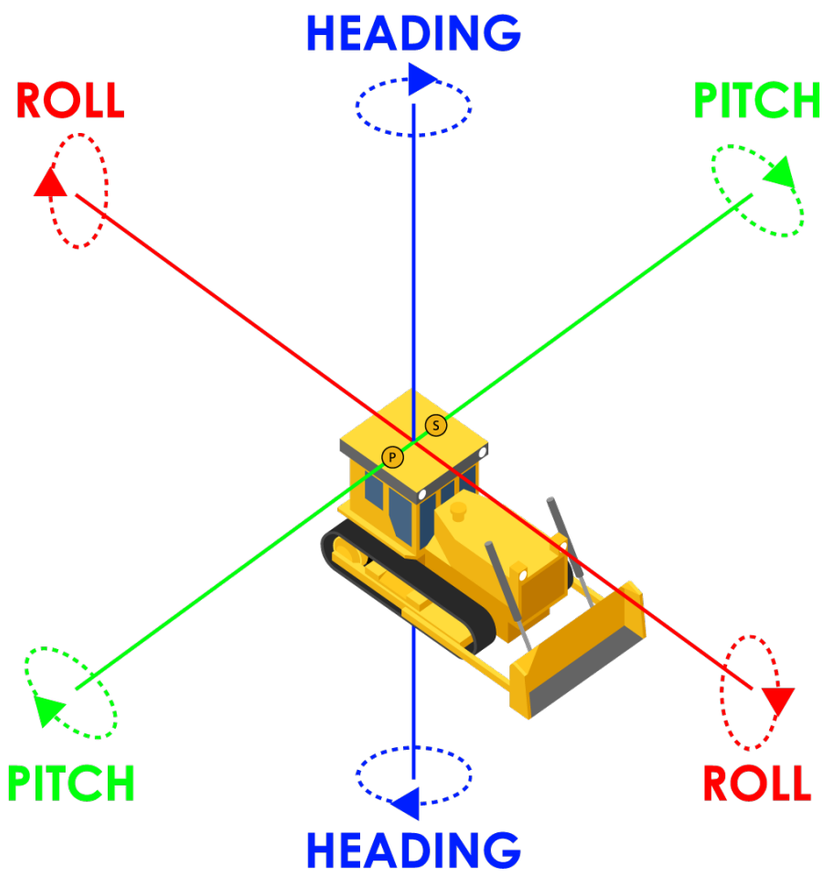


Figure 4: Negative 90-degree heading bias example

Continued on next page

Mounting orientation example, continued

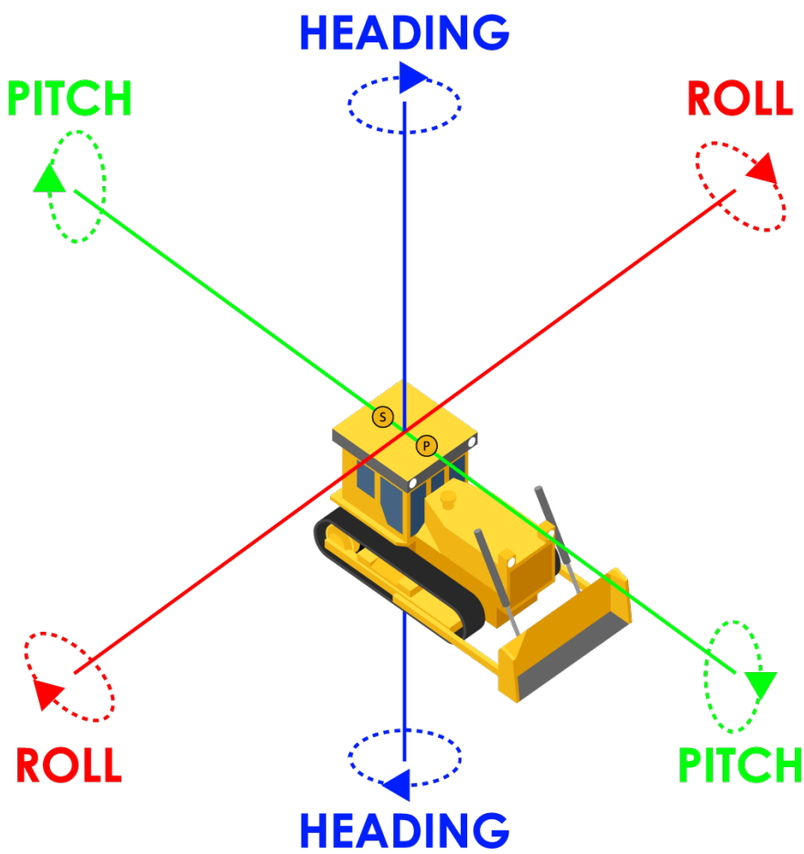


Figure 5: 180-degree heading bias example

Continued on next page

Vector VR1000 GNSS Receiver Quick Reference Guide (QRG),
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.

Continued on next page

VR1000 communication specifications

Table 1 lists the communication items and technical specifications of the VR1000 GNSS receiver.

Table 1: VR1000 Communication Specifications

Item	Specification
I/O ports	2x CAN, 1x Ethernet, 2x Serial (Port A RS232, Port B RS232/RS422)
Baud rates	4800 - 115200
Correction I/O protocol	Atlas, Hemisphere GNSS proprietary, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ [1] 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)

Power/data cable pin-out assignments, continued

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

VR1000 Back Panel Connector Definition:

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

Continued on next page

Power/data cable pin-out assignments, continued

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

Table 2: VR1000 Connector Pin-out

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
8/15	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
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

Power/data cable pin-out assignments, continued

Figure 6 shows the VR1000 back panel and pin-out.

Figure 6: VR1000 back panel and pin-out

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

Continued on next page

LED Indicators

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

Figure 7: VR1000 LED

Table 3: 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

Table 3: 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

Continued on next page

Vector VR1000 GNSS Receiver Quick Reference Guide (QRG), Continued

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.

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.

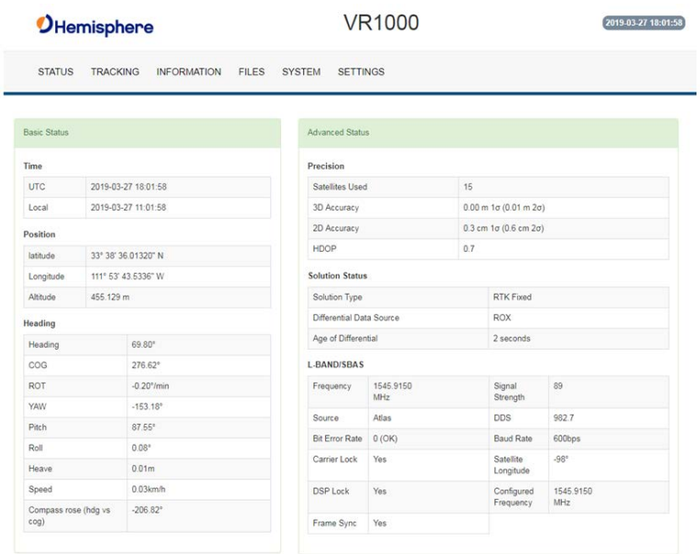


Table 4: Status fields

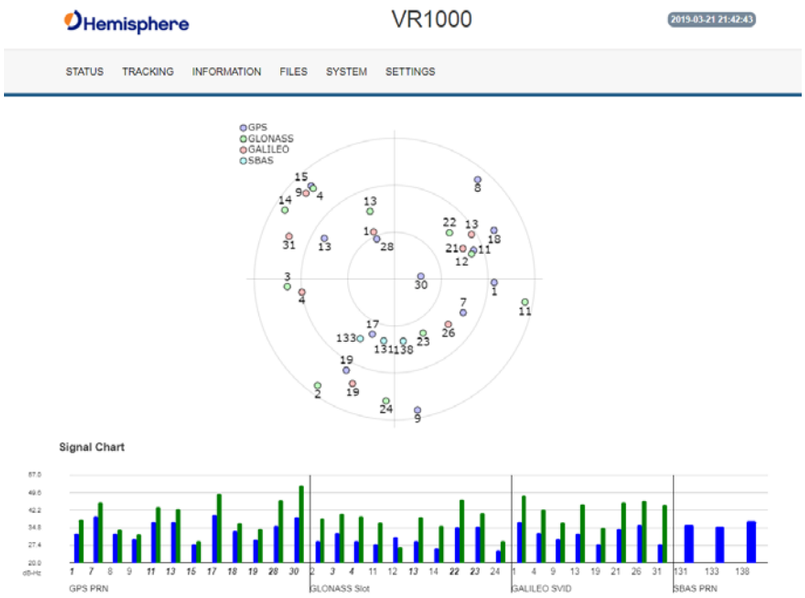
Field	Description
Time	UTC time obtained from satellites, Local time configured in Settings; Miscellaneous tab
Position	Latitude, Longitude, Altitude
Heading	Heading, COG, ROT, YAW, pitch, roll, heave, speed, and the difference between heading and COG
Precision	Satellites used in solution, 3D Accuracy, 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 Appendix A, Terms and Definitions.

Continued on next page

Tracking

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



Continued on next page

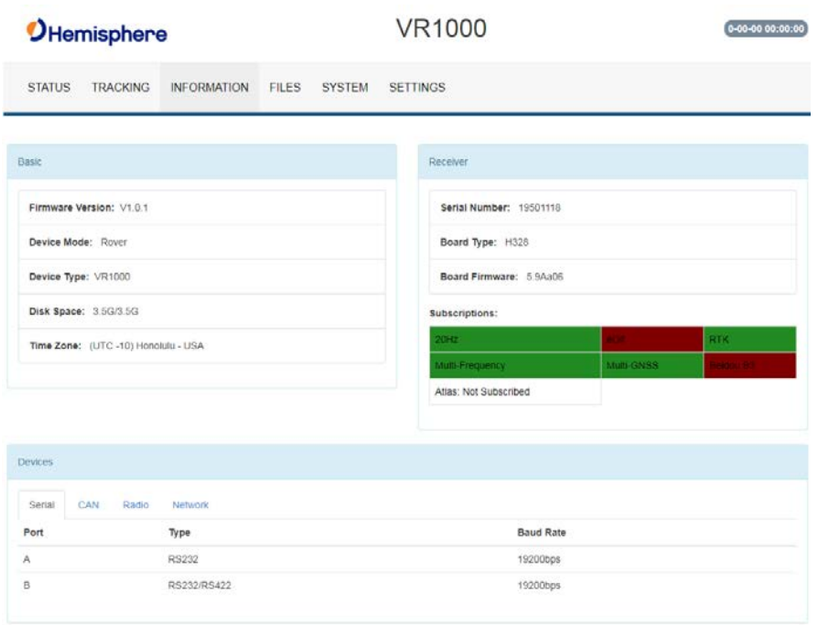
Configuring the VR1000 Using the WebUI, Continued

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***.

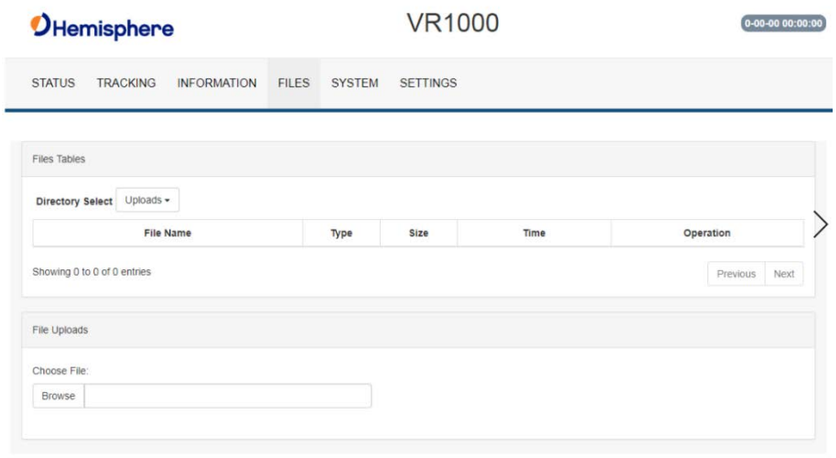


Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Files tab

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

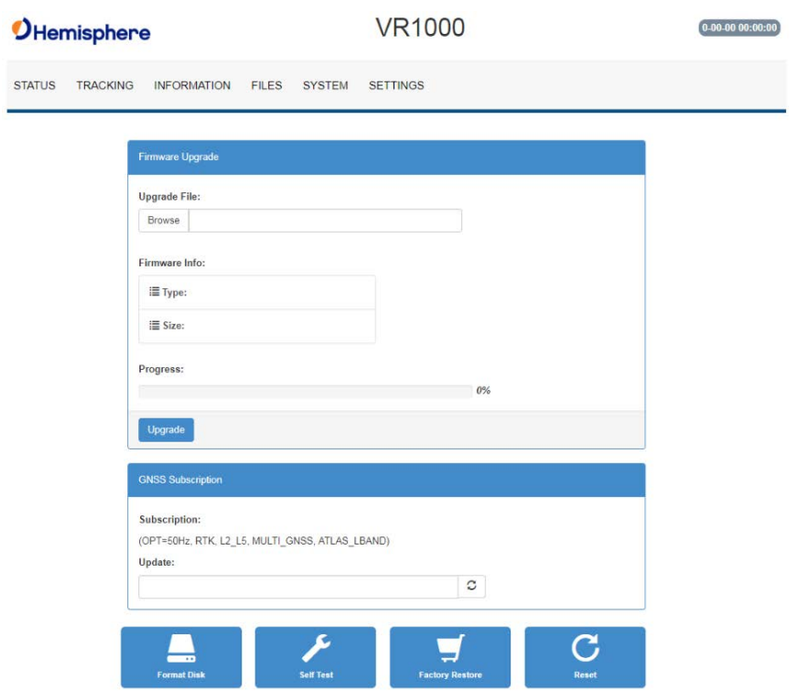


System

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.

Continued on next page

Configuring the VR1000 Using the WebUI, Continued

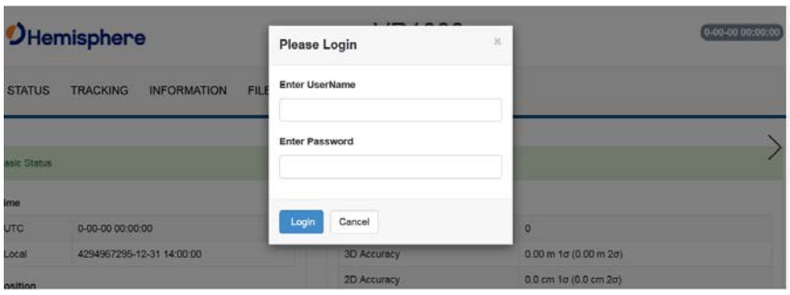
System, continued

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."

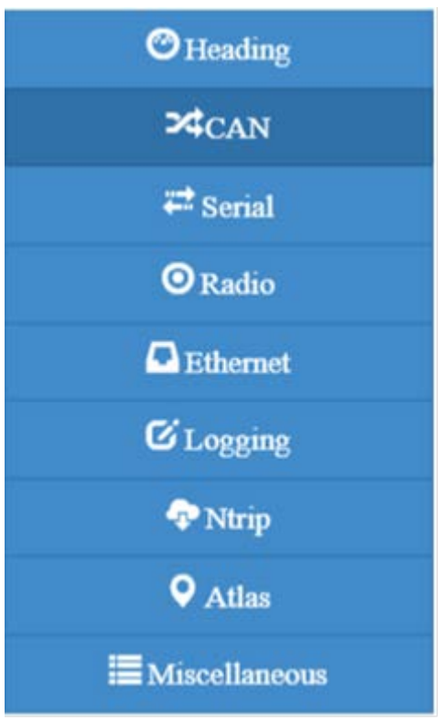
Settings

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



You can configure the following using the VR1000 WebUI:

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



Continued on next page

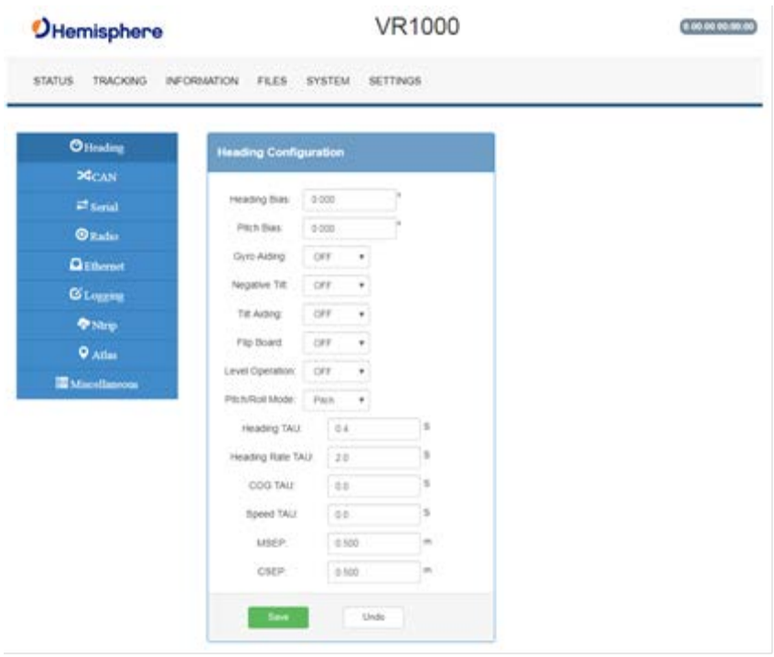
Configuring the VR1000 Using the WebUI, Continued

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.



Continued on next page

Heading menu, continued

Table 5 lists the heading configurations.

Table 5: 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

Heading menu, continued

Table 5: 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

Heading menu, continued

Table 5: 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

Heading menu, continued

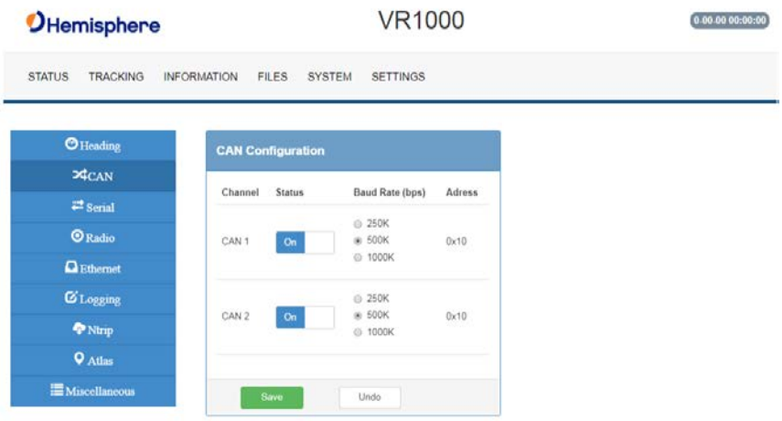
Table 5: Heading Configurations (continued)

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).



Continued on next page

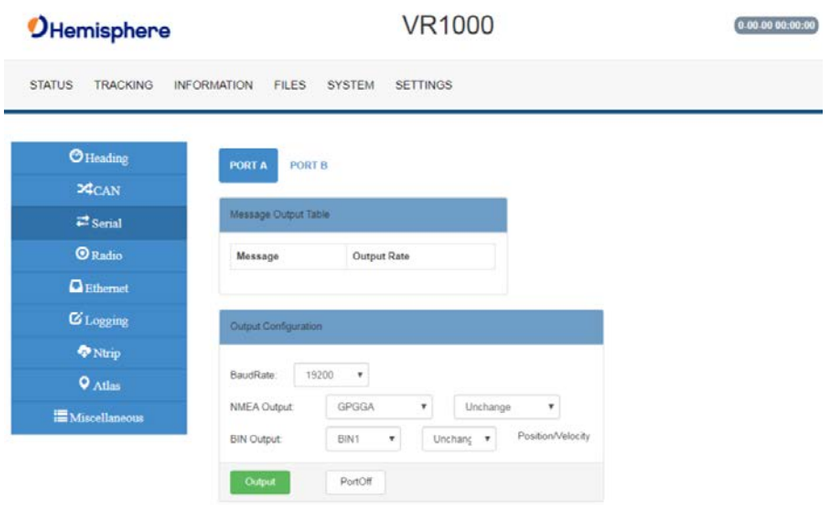
Configuring the VR1000 Using the WebUI, Continued

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**.



Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Radio Basic

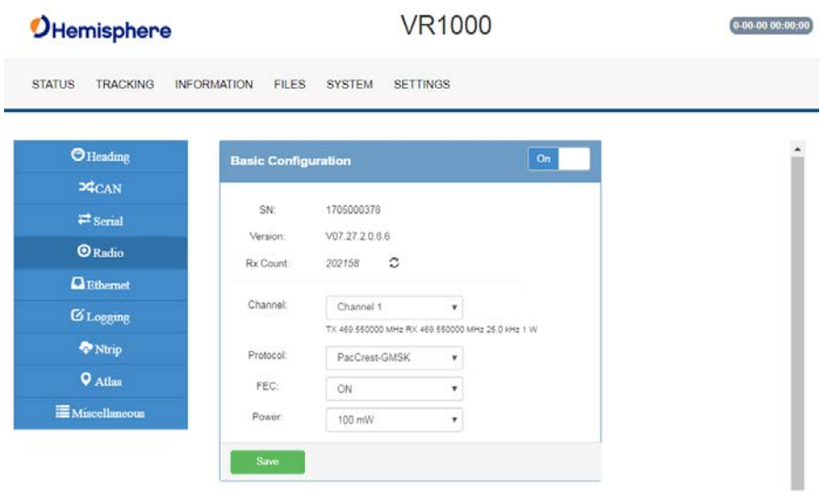
Use Radio Basic to configure the internal UHF radio (protocol, frequency, etc.).

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 6: 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.



Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Radio Basic, continued

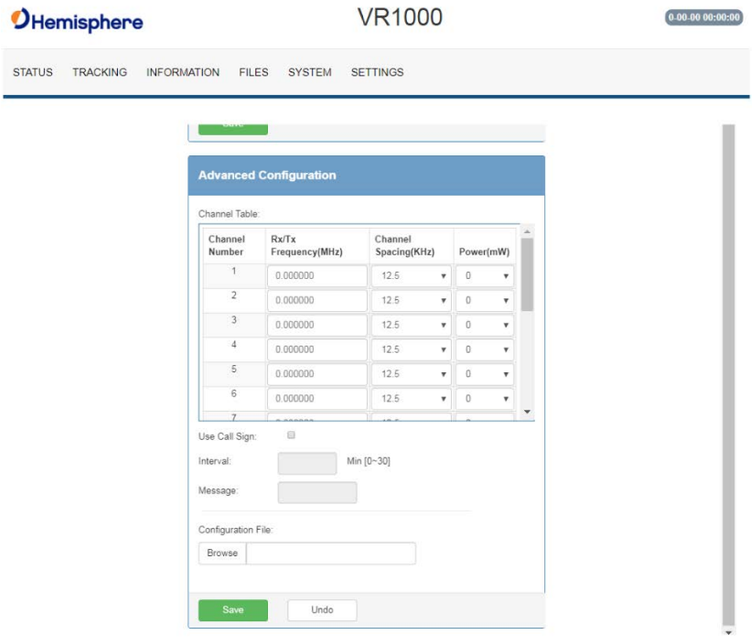
Use the following table to configure Radio settings. You may configure any settings in the blue boxes.

Table 6: 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

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.



Continued on next page

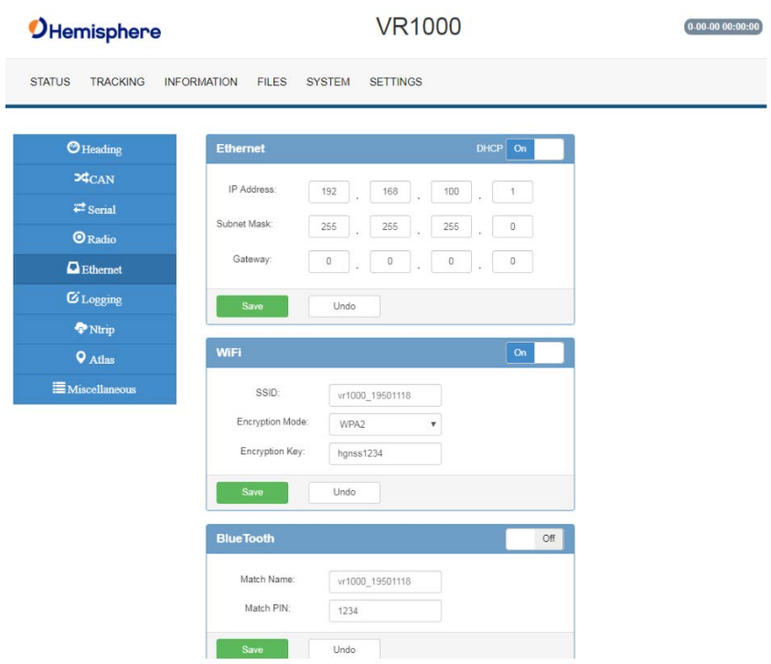
Configuring the VR1000 Using the WebUI, Continued

Ethernet

Use the VR1000 WebUI to configure the Ethernet connection.

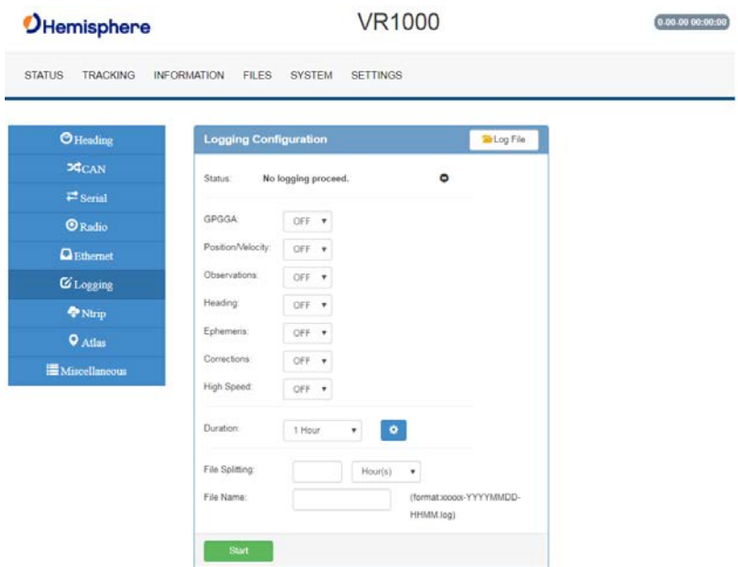
Wi-Fi Bluetooth configuration-configure the WiFi access name, encryption mode, and encryption key of the VR1000 in the WiFi/Bluetooth configuration settings. Click to enable Bluetooth options and type the PIN of the VR1000.

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



Logging

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



Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Logging, continued

Table 7: 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

Logging, continued

Table 7: 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.

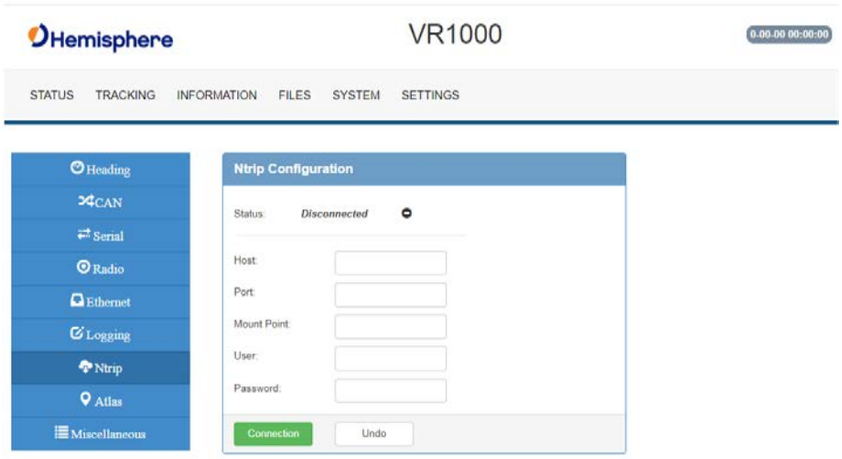
To stop logging, de-select the **Enabled** button and press **Save Settings**.

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

Continued on next page

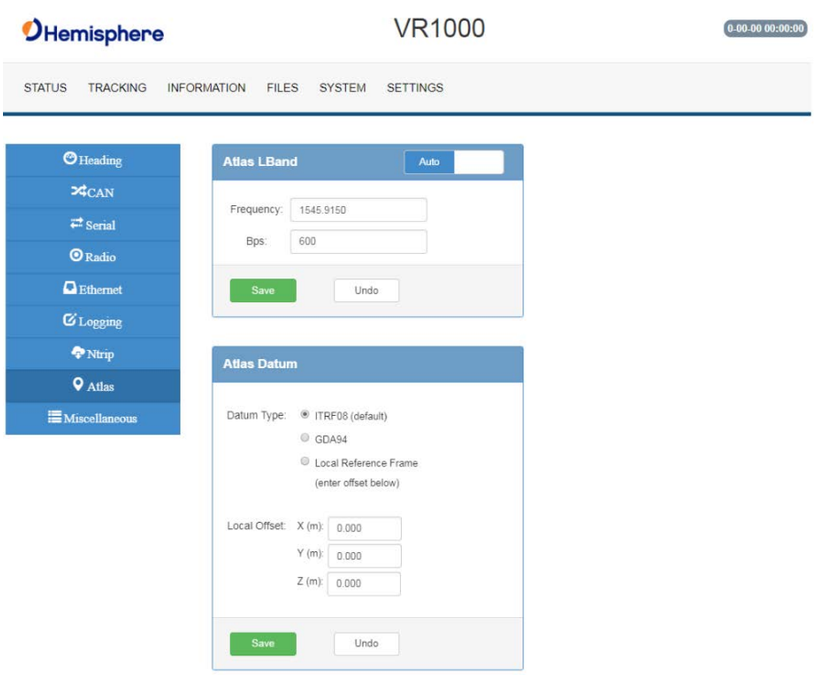
Ntrip Configuration

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



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.



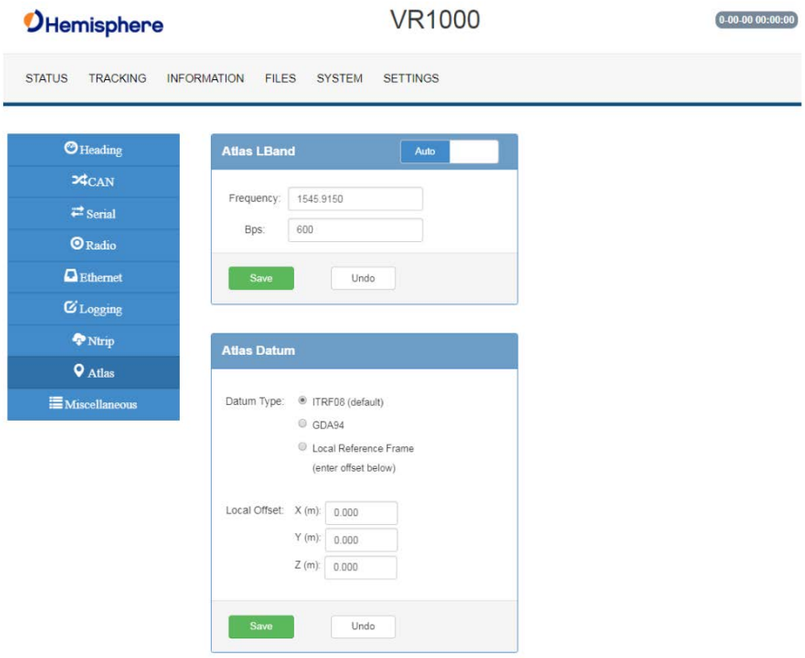
Continued on next page

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.



Continued on next page

Configuring the VR1000 Using the WebUI, Continued

Miscellaneous

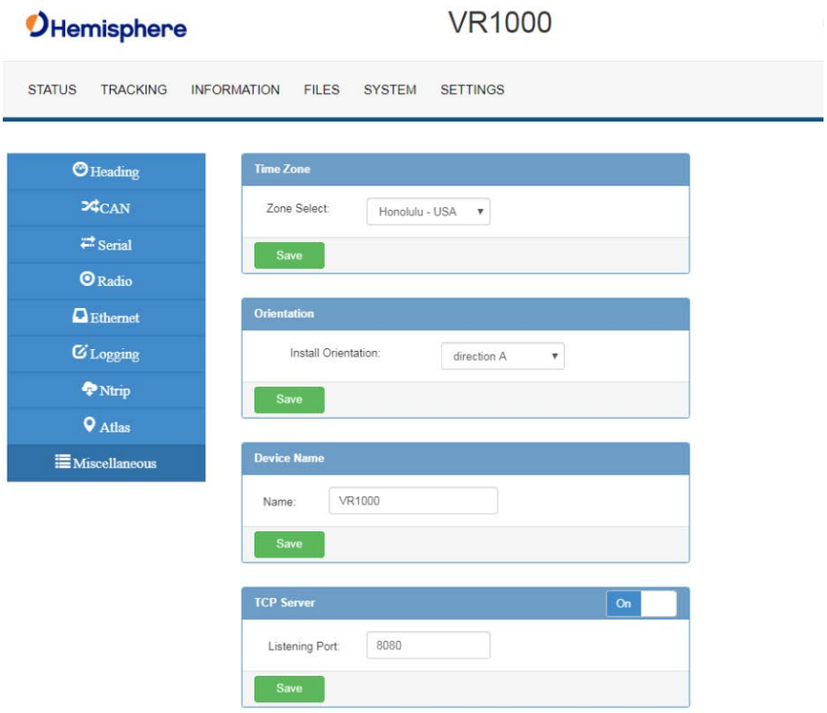
Time Zone- In the example below, the Time Zone is set to UTC-10, Honolulu - USA time.

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.

TCP Server-use to change the listening port.



Continued on next page

Appendix A

Terms and definitions

Refer to Table A-1 for a listing of the terms and definitions contained in this document.

Table A-1: Terms and Definitions

Term	Definition
Atlas Frequency	The Atlas™ satellite transmit frequency which ranges from 1525 MHz to 1560 MHz.
Bit Error Rate	The average number of symbol errors per message frame.
Carrier Lock	Indicates the receiver is tracking the satellite frequency.
Frame Sync	Indicates the receiver is properly decoding the Atlas™ data message.

Appendix B

Figure B-1 shows the VR1000 Cable Pin-out assignments.

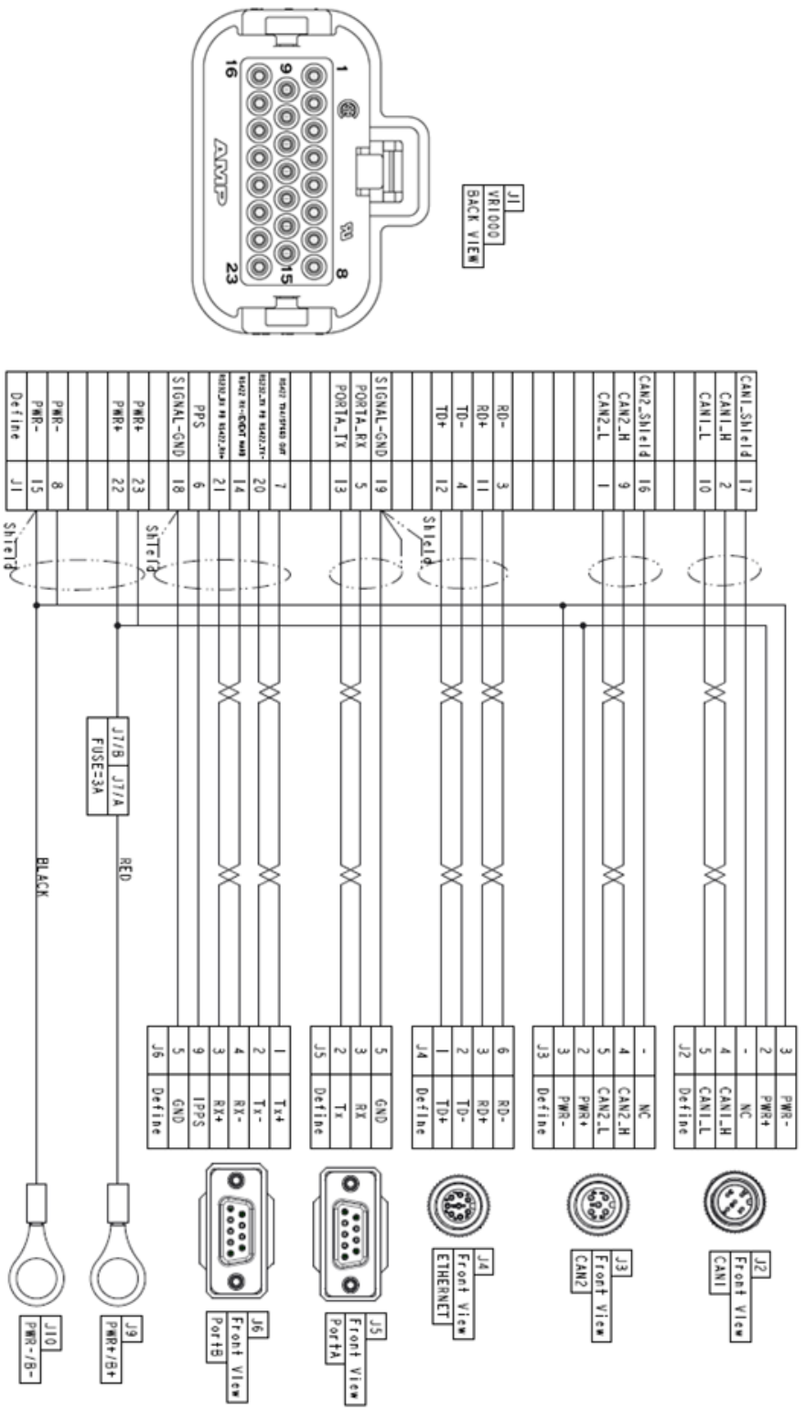


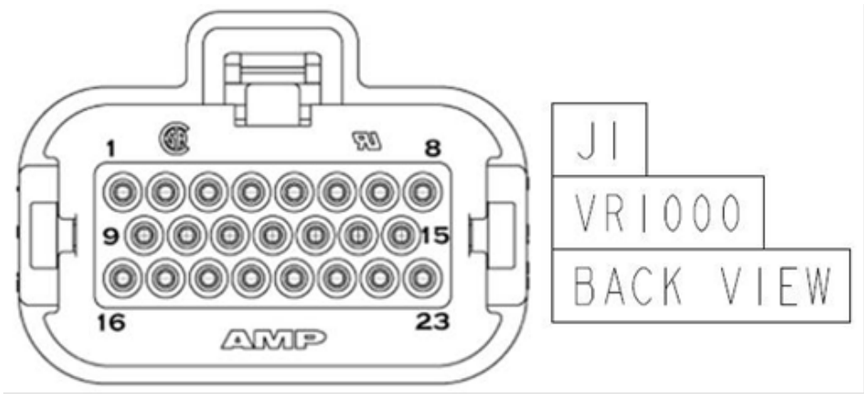
Figure B-1 Cable Drawing

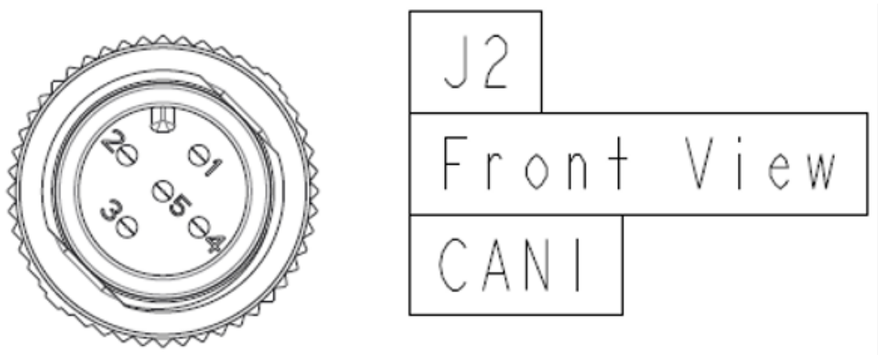
Note: This cable is **not** available for purchase.

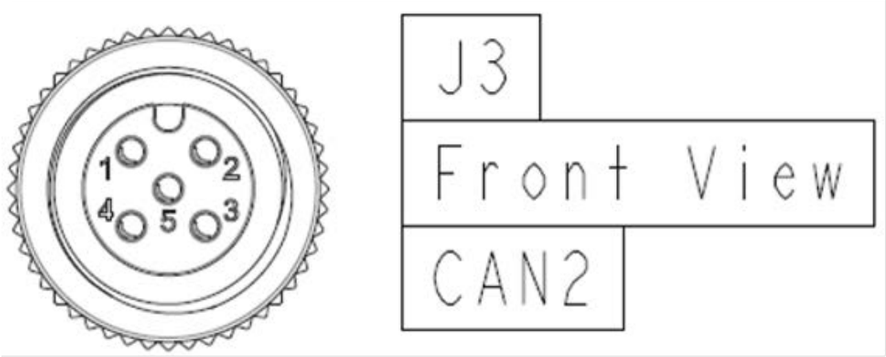
Continued on next page

Appendix B, Continued

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







Continued on next page

Appendix B, Continued

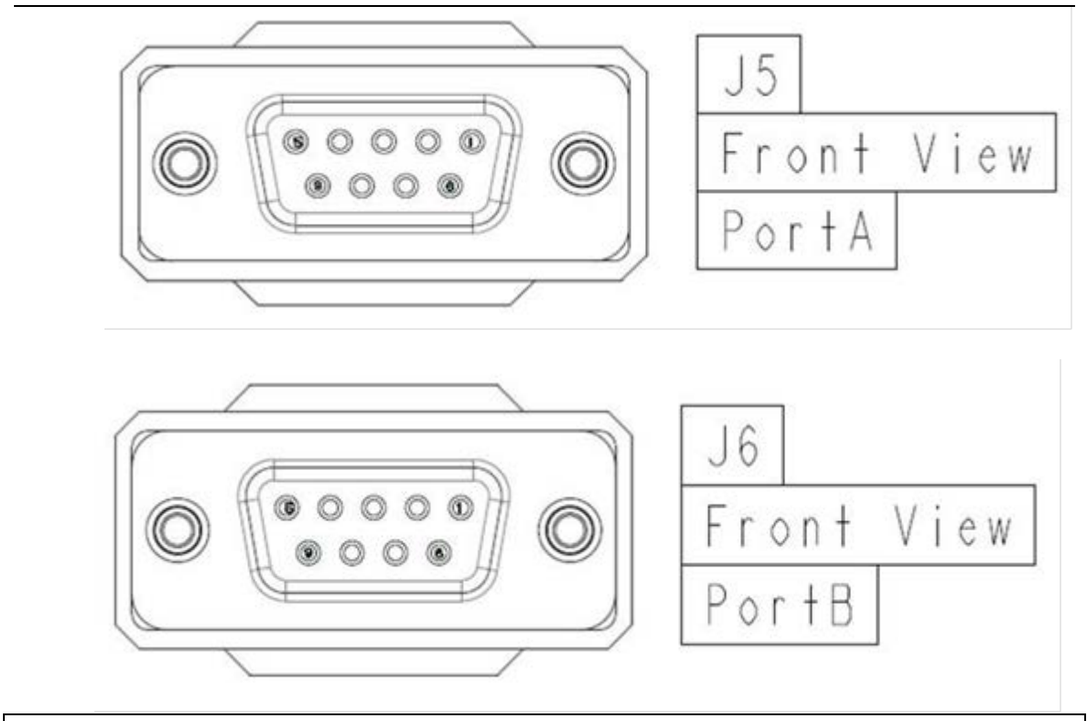


Figure B2: J1 – J6 Connectors