# 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**

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# 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.

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

**Mounting orientation**

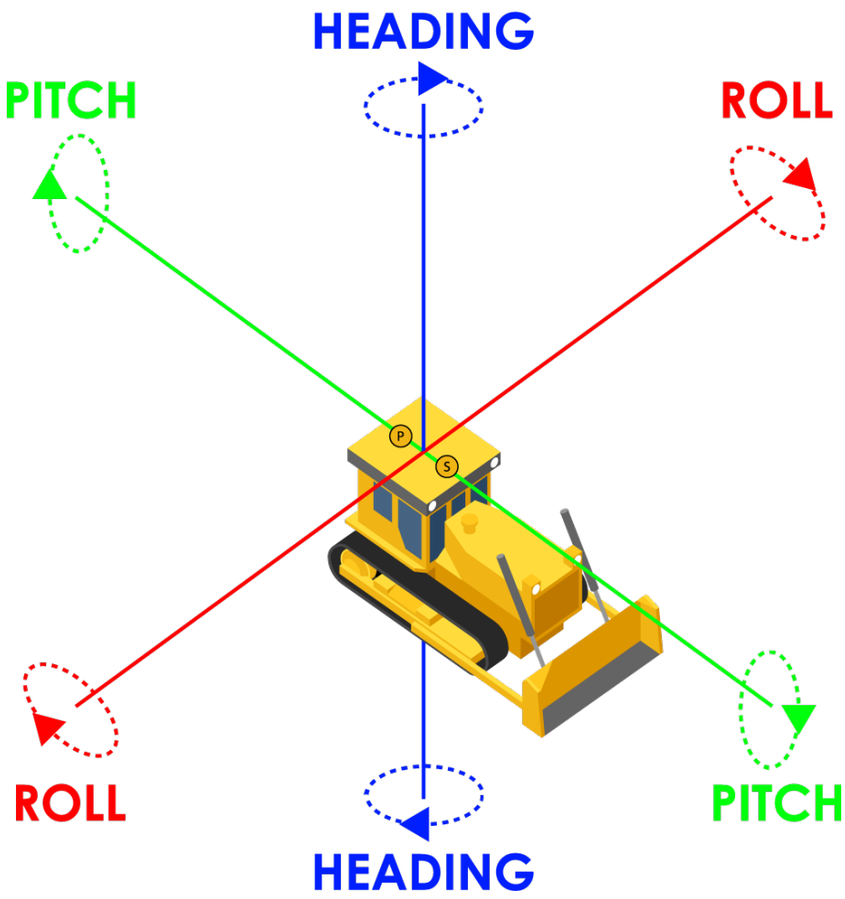


**Figure 2: 0-degree heading bias example**

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**Mounting orientation example**

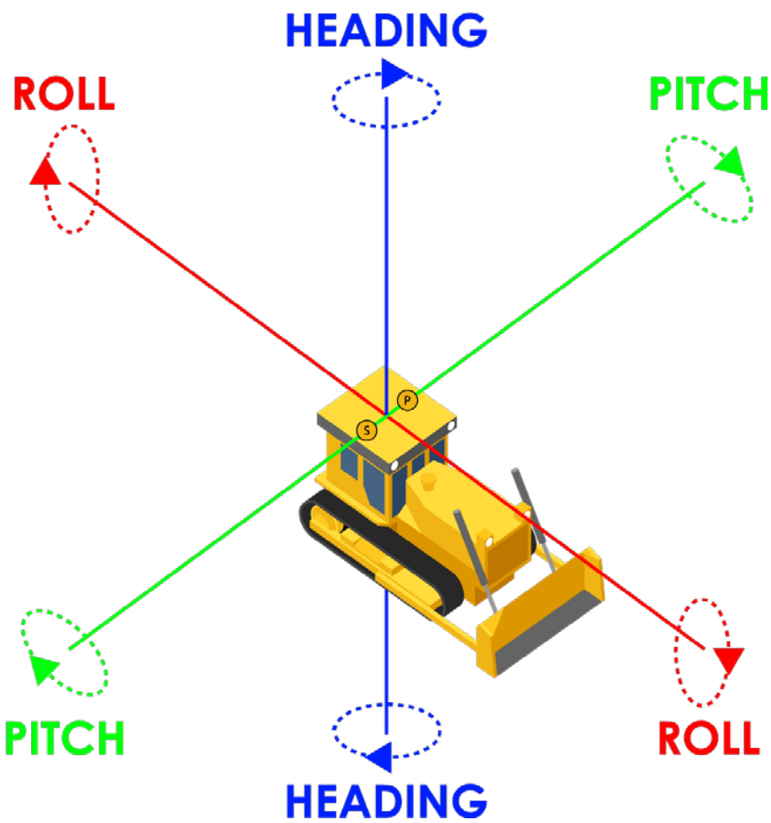


**Figure 3: 90-degree heading bias example**

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**Mounting orientation example,** continued

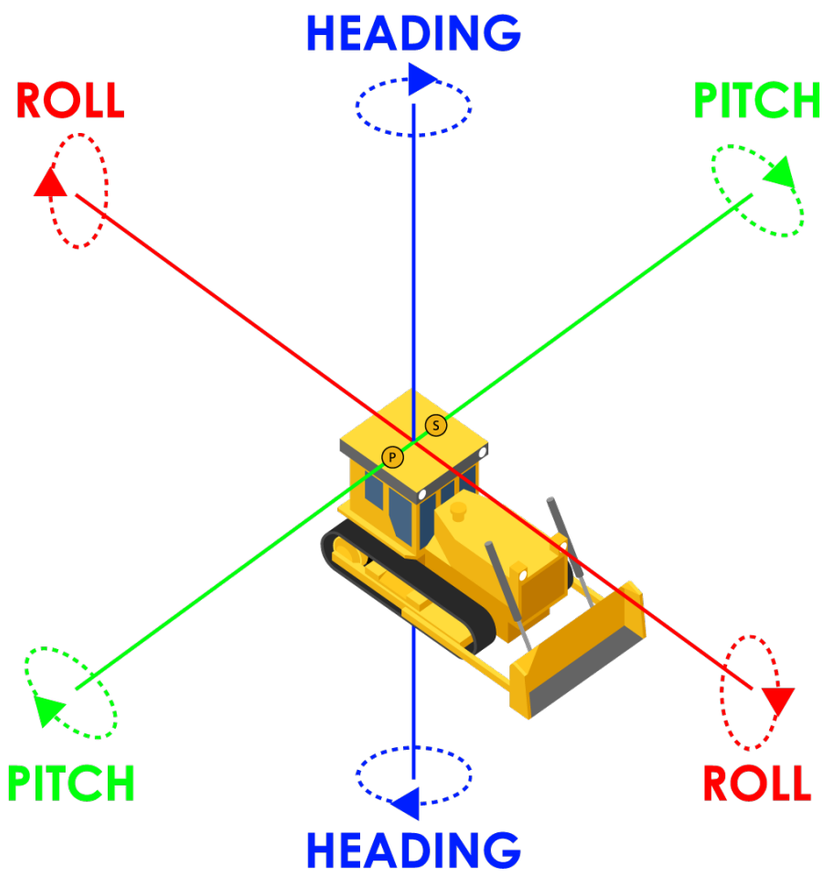


**Figure 4: Negative 90-degree heading bias example**

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**Mounting orientation example,** continued

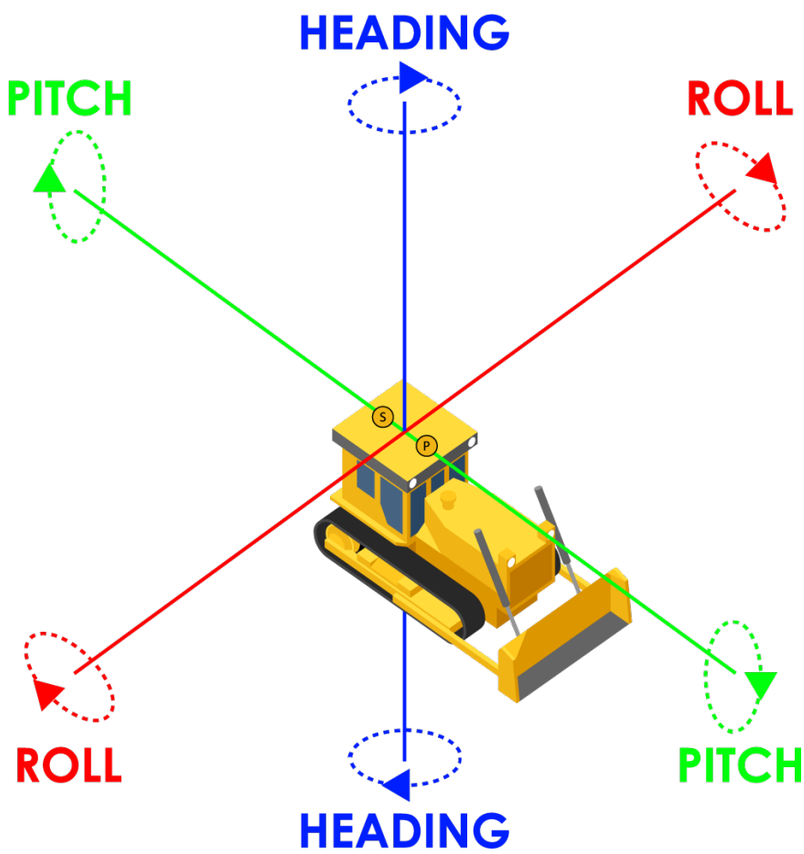


**Figure 5: 180-degree heading bias example**

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# 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.

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**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)

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**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 |

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**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

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**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<br>Solid RED indicates No Satellites |
| Secondary GNSS | Solid GREEN indicates tracking 4+ satellites<br>Solid RED indicates No Satellites |
| Heading | Solid GREEN indicates 2D GNSS heading<br>Solid AMBER indicates 2D sensor heading |
| Quality | Solid GREEN indicates RTK fixed<br>Flashing GREEN (1/sec) indicates DGPS / Float<br>Solid AMBER indicates Autonomous<br>Flashing AMBER indicates No Position<br>Solid RED indicates No Satellites |
| Atlas | Flashes GREEN each time an Atlas message is received<br>Solid GREEN indicates Atlas locked<br>Solid AMBER indicates Atlas activated but not locked |

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**LED Indicators**, continued

**Table 3: LED indicators (continued)**

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

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## 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.<br><br>The RS-422 is a balanced signal with positive and negative signals referenced to ground; ensure you maintain the correct polarity.<br><br>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.<br><br>The negative transmit data signal from the VR1000 is then connected to the receive data negative input of the other device.<br><br>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.<br><br>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.

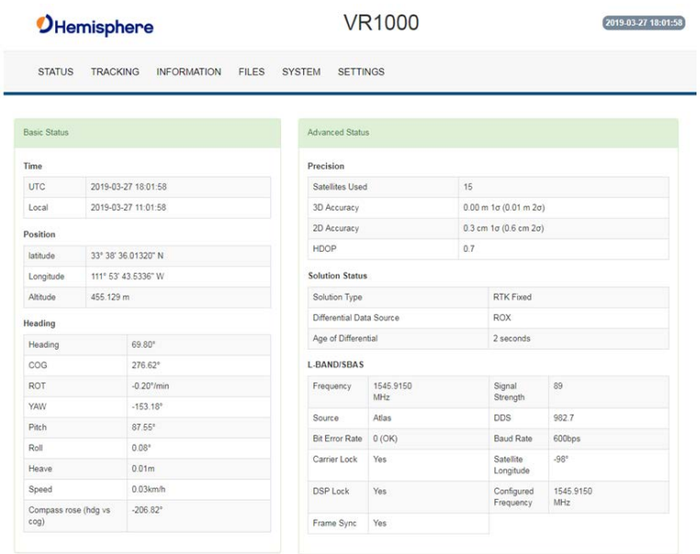


**Table 4: Status fields**

| 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.

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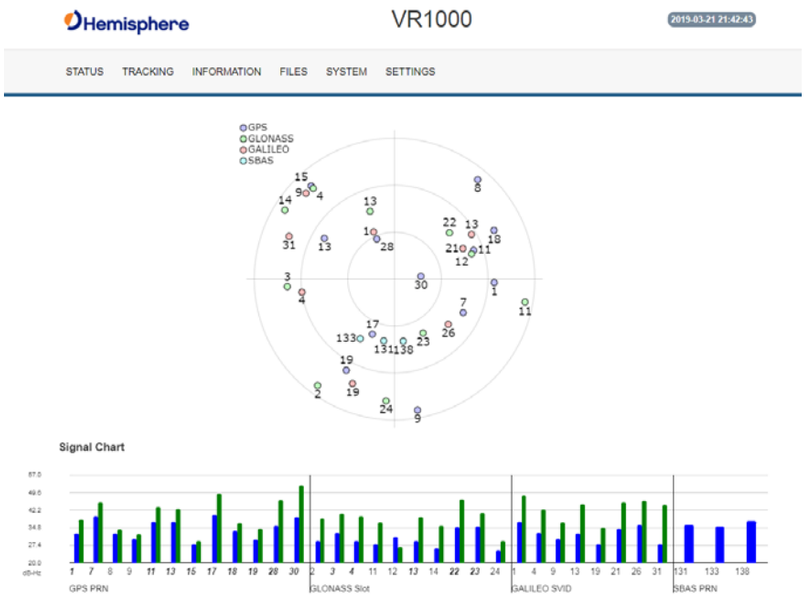
**Tracking**

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

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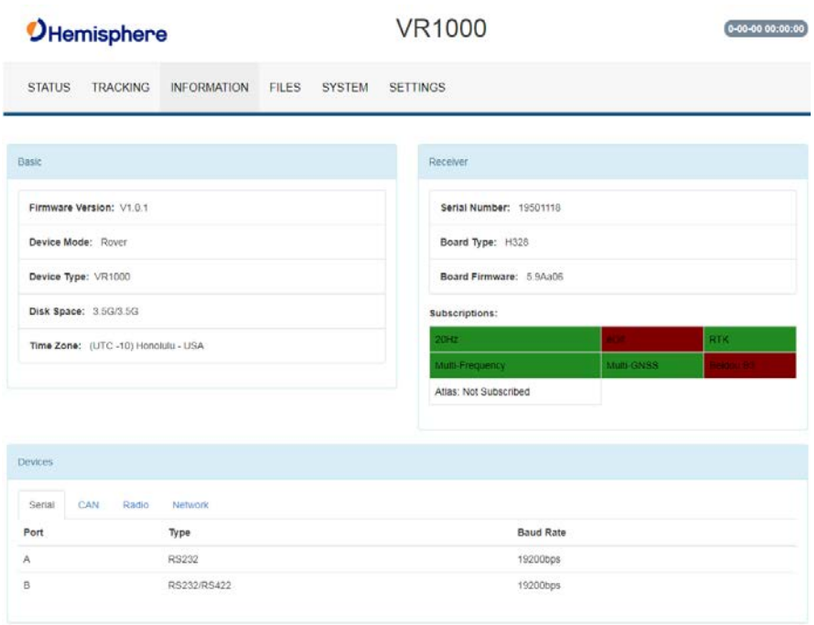
## Configuring the VR1000 Using the WebUI, Continued

**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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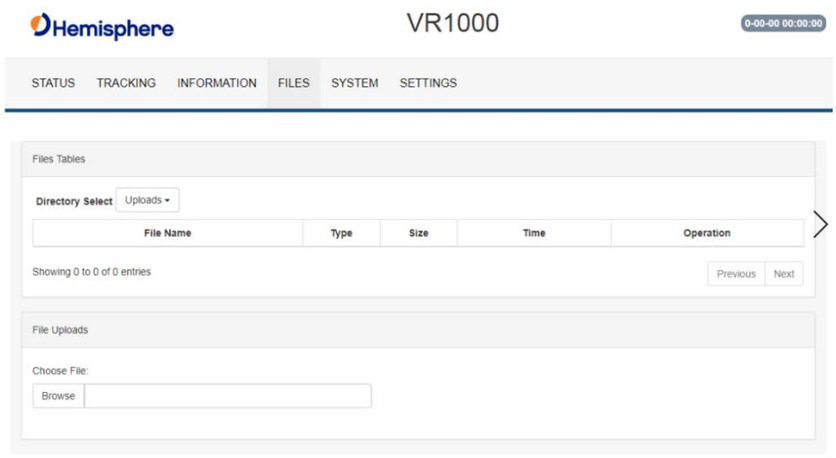
## Configuring the VR1000 Using the WebUI, Continued

**Files tab**

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

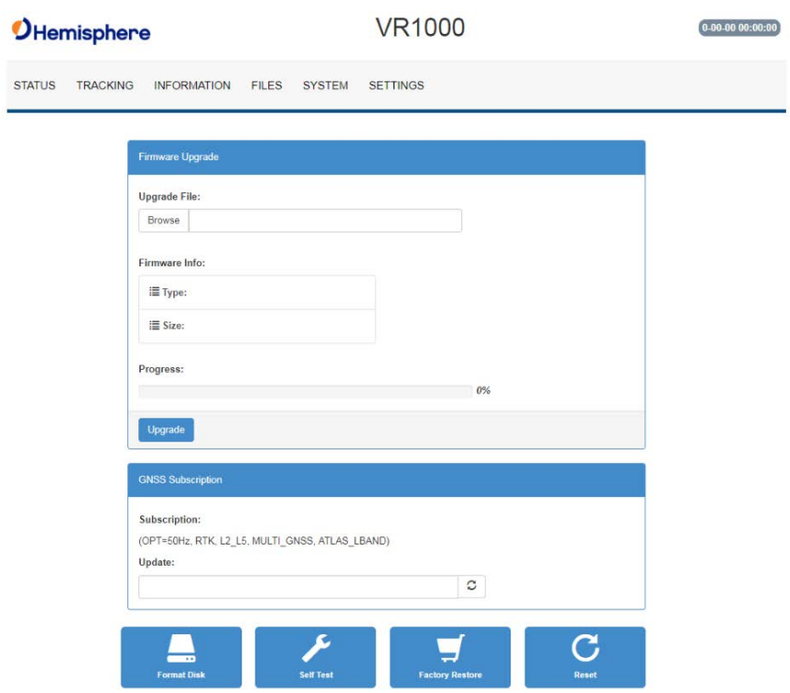



**System**

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

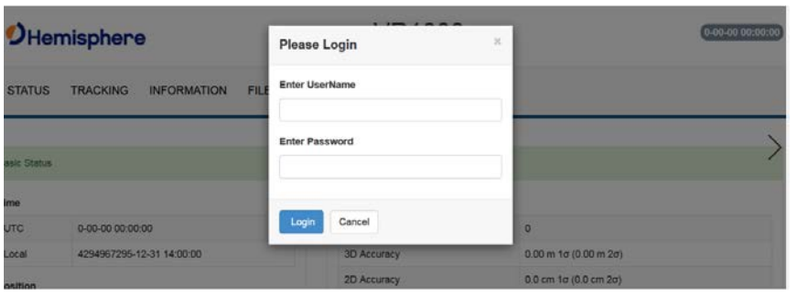
**System**, continued

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."

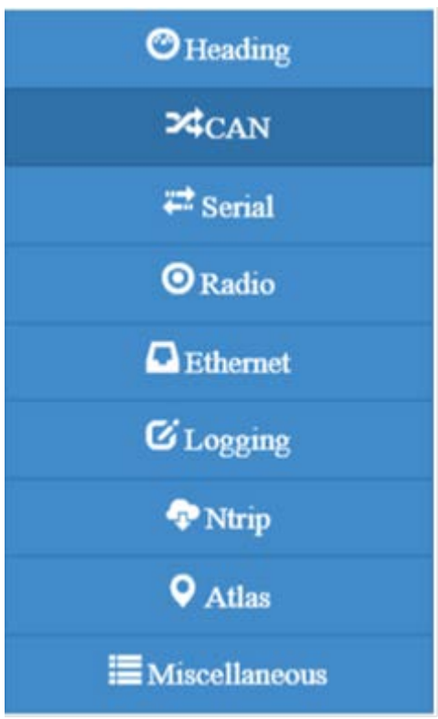
**Settings**

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




You can configure the following using the VR1000 WebUI:

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

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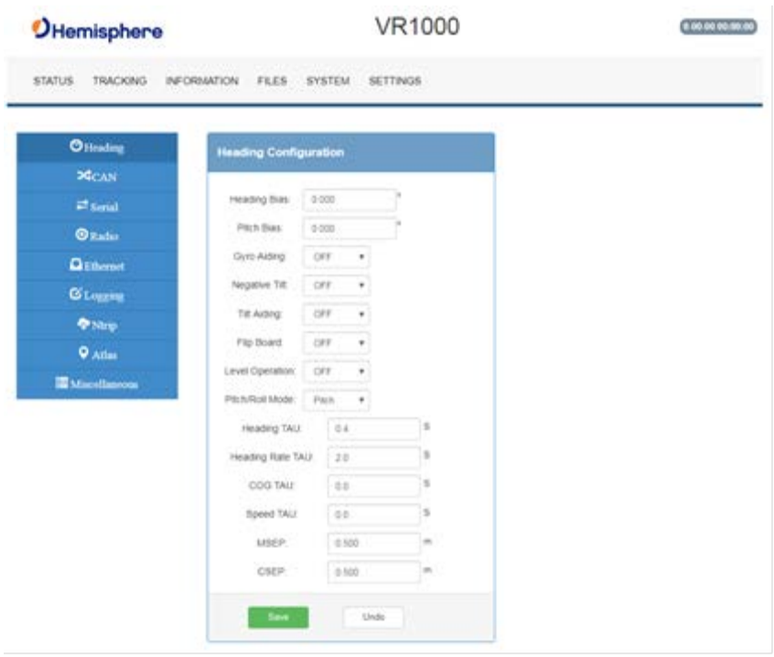
## Configuring the VR1000 Using the WebUI, Continued

**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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**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.<br><br>Heading is defined as the direction of the vector created from the primary to secondary antenna. Heading is measured using true north.<br><br>Range: -180 – +180 |
| Pitch Bias | Add a bias to the pitch value the receiver outputs.<br><br>If the receiver is in “roll” mode, this will add a bias to the roll instead.<br><br>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. |

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**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.<br><br>If the antennas are mounted such that they model roll, set to ROLL.<br><br>**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.<br><br>If the machine is large and unable to turn quickly, increase this value.<br><br>For longer baselines (10 m) HTAU should be between 0.1 and 0.5, since the gyro introduces noise.<br><br>**Default value:** 0.1 s with gyro enabled<br>**Range:** 0.0 to 60 s<br>**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.<br><br>If the machine is large and unable to turn quickly, increase this value.<br><br>**Default value:** 2.0 s with gyro enabled<br>**Range:** 0.0 to 60 s<br>**Formula:** hrtau (s) = 10 / max rate of the rate of turn ($°/s^2$) |

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**Heading menu**, continued

**Table 5: Heading Configurations (continued)**

| Heading Configuration | Description |
|---|---|
| COG TAU | The direction the machine is moving.<br><br>Adjust the responsiveness to the course over ground measurement.<br><br>If the machine is small and dynamic, leave this value at 0.0 s to be conservative.<br><br>If the machine is large and resistant to motion, increase this value.<br><br>**Default value:** 0.0 s .<br>**Range:** 0.0 to 60 s<br>**Formula:** cogtau (s) = 10 / max rate of change of course (°/sec) |
| Speed TAU | Speed of machine in km/h.<br><br>Adjust the responsiveness to speed.<br><br>If the machine is small and dynamic, leave this value at 0.0 s to be conservative.<br><br>If the machine is large and resistant to motion, increase this value.<br><br>**Default value:** 0.0 s<br>**Range:** 0.0 to 60 s<br>**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. |

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**Heading menu**, continued

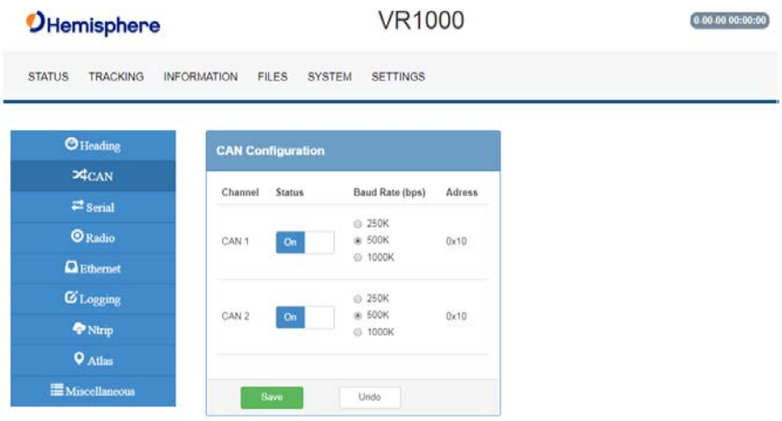
**Table 5: Heading Configurations (continued)**

| 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.<br><br>**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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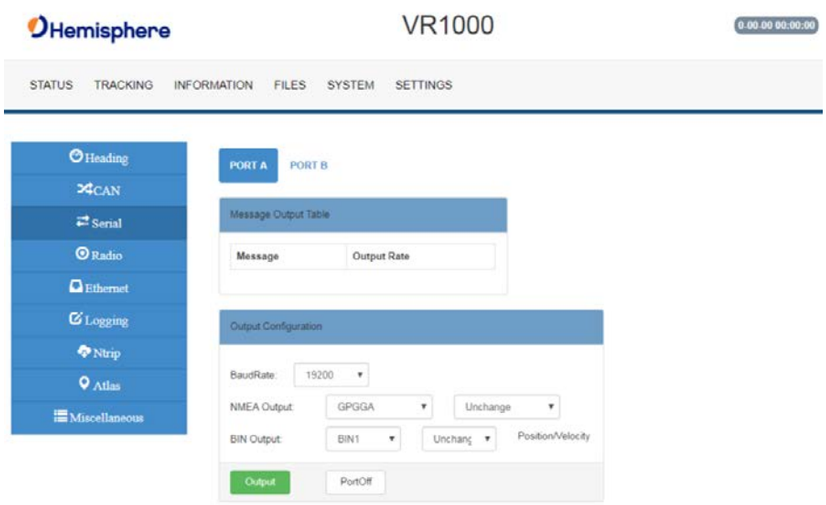
## Configuring the VR1000 Using the WebUI, Continued

**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**

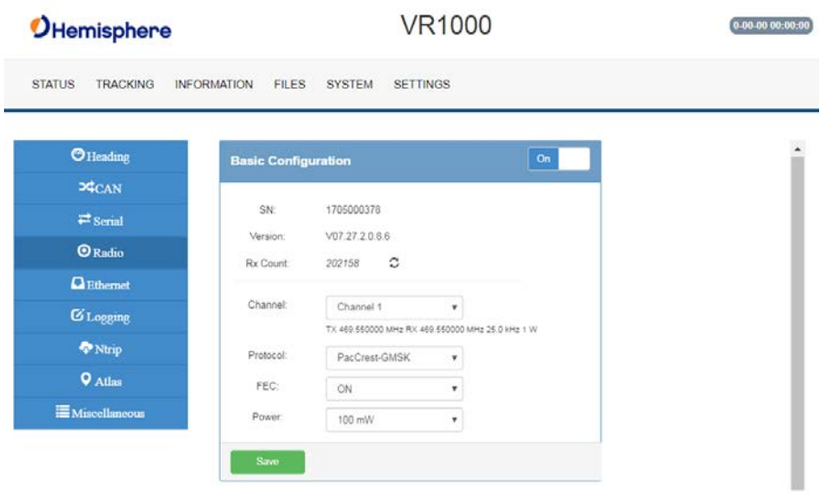
Use Radio Basic to configure the internal UHF radio (protocol, frequency, etc.).

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 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.

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## Configuring the VR1000 Using the WebUI, Continued

**Radio Basic**, continued

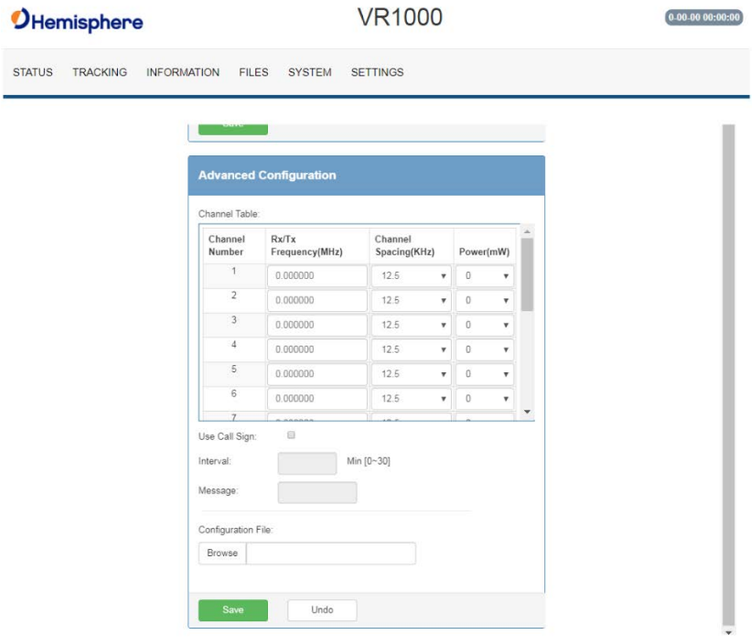
Use the following table to configure Radio settings. You may configure any settings in the blue boxes.

**Table 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.

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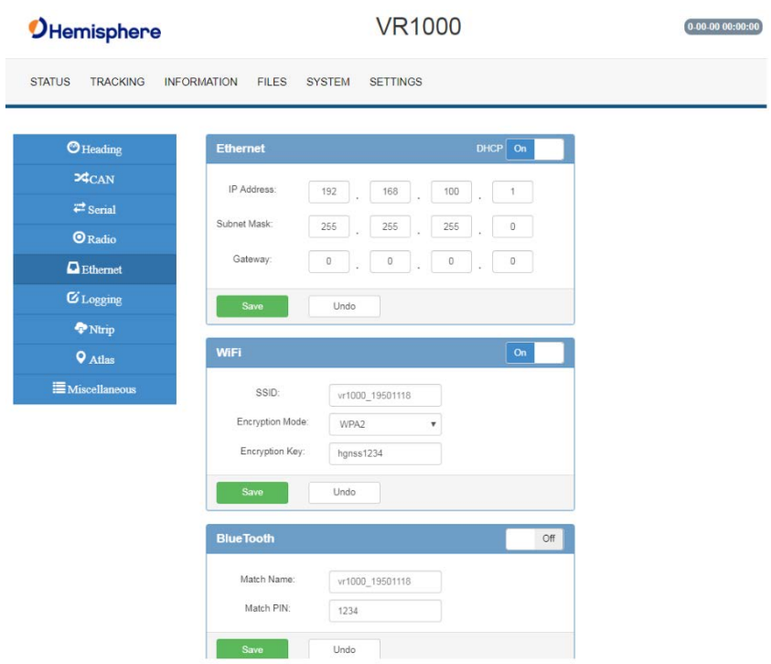
## Configuring the VR1000 Using the WebUI, Continued

**Ethernet**

Use the VR1000 WebUI to configure the Ethernet connection.

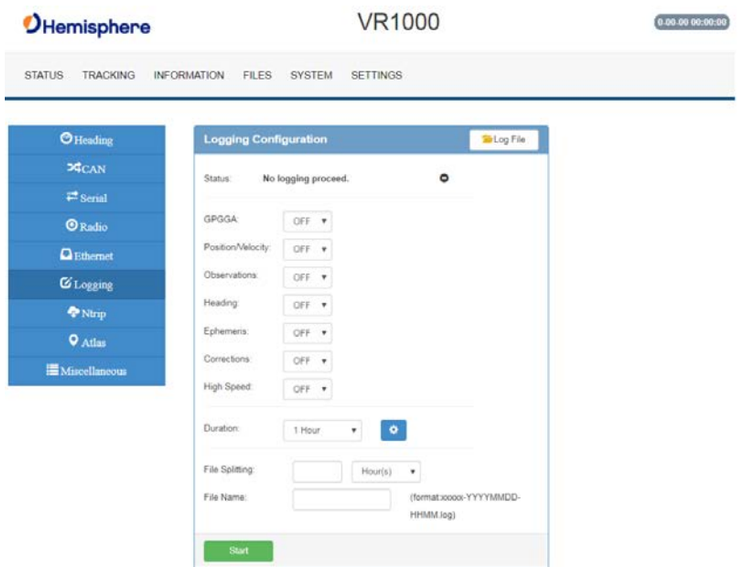
**Wi-Fi Bluetooth configuration**-configure the WiFi access name, encryption mode, and encryption key of the VR1000 in the WiFi/Bluetooth configuration settings. Click to enable Bluetooth options and type the PIN of the VR1000.

**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.

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# 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.<br><br>**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.<br><br>**Note:** 10Hz and 20Hz are only available with activations (some kits may come with 10Hz or 20Hz included). |
| Observations*<br><br>*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.<br><br>**Note:** 10Hz and 20Hz are only available with activations (some kits may come with 10Hz or 20Hz included). |
| Heading | Heading logs the following messages:<br>• GPHDT<br>• GPHDM<br>• GPHDG<br>• HPR<br>• BIN3 |

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**Logging**, continued

**Table 7: Logging configuration (continued)**

| Field | Description |
|---|---|
| Ephemeris*<br><br>*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.<br><br>**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.<br><br>**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.<br><br>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.<br><br>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.**

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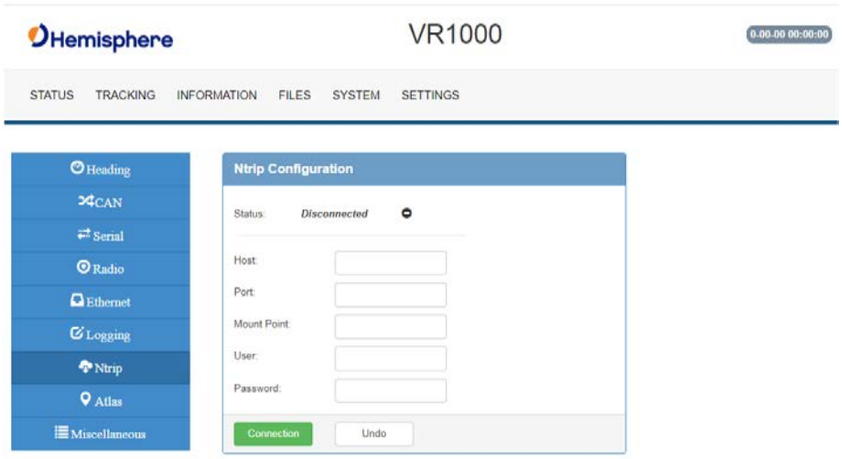
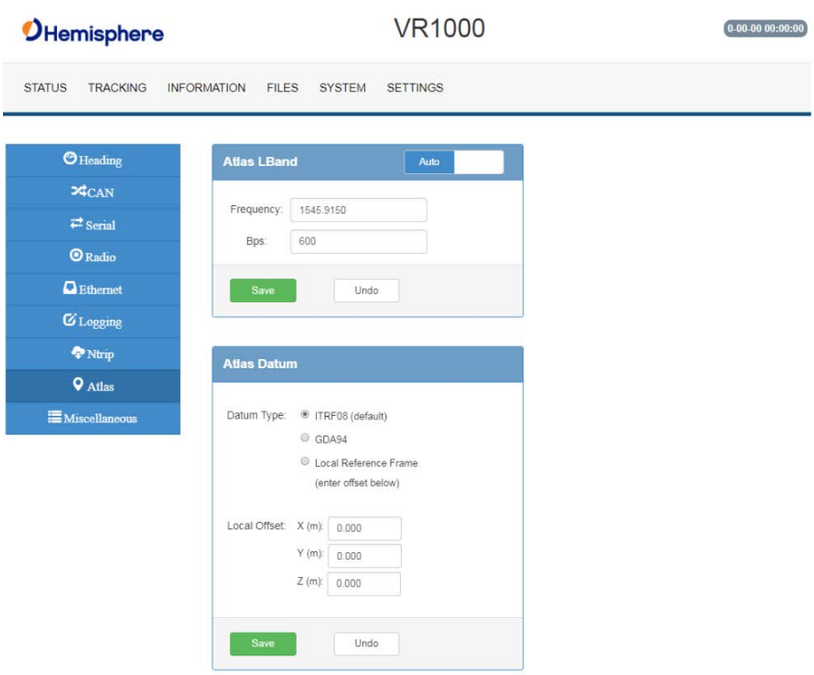
**Ntrip Configuration**

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.

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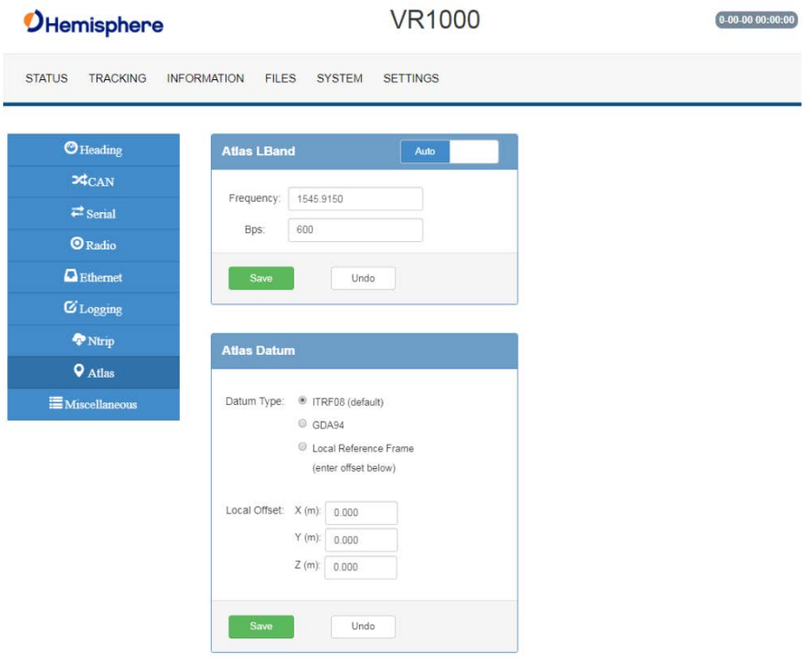
## Configuring the VR1000 Using the WebUI, Continued

**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**

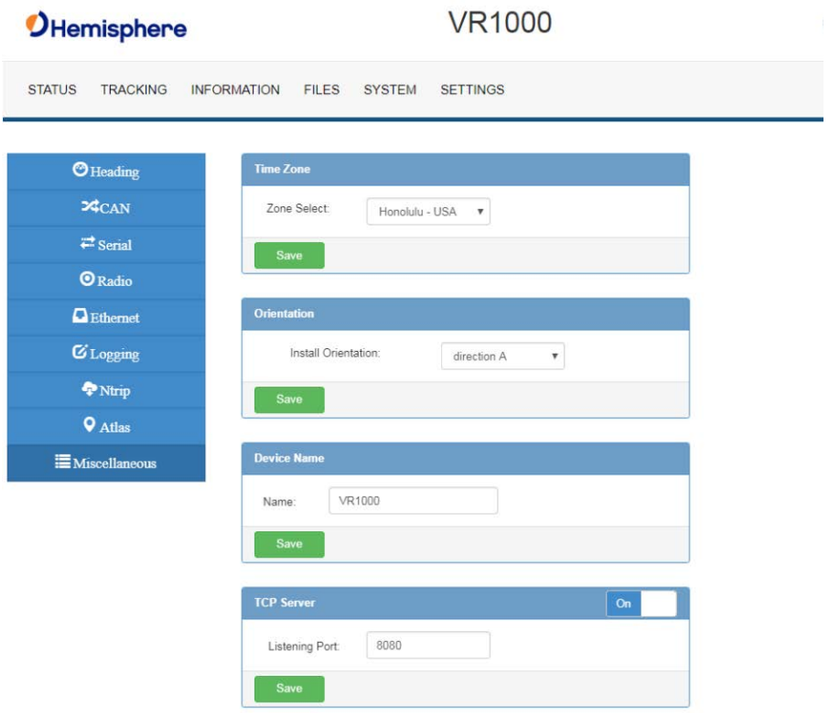
**Time Zone-** In the example below, the Time Zone is set to UTC-10, Honolulu - USA time.

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.

**TCP Server**-use to change the listening port.

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# 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.

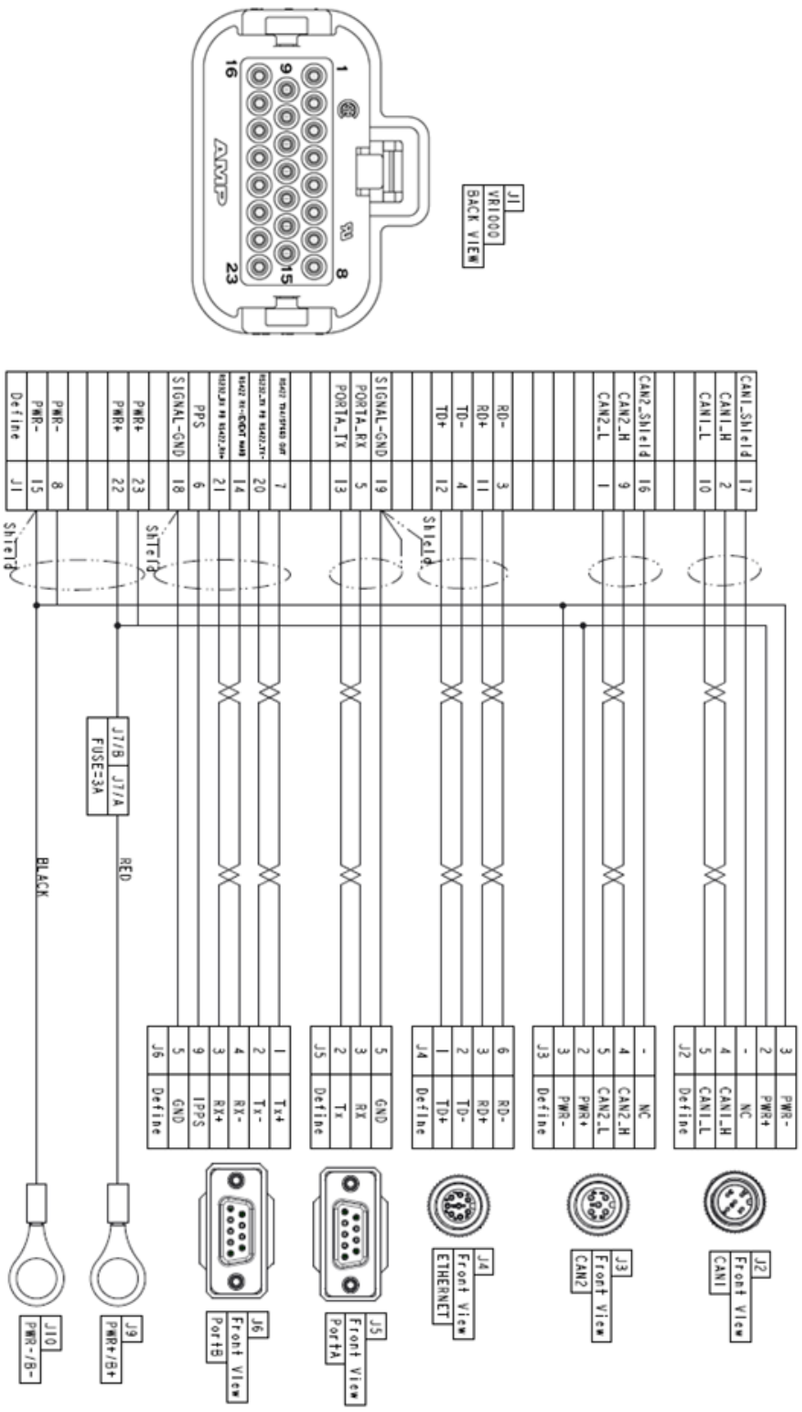


**Figure B-1 Cable Drawing**

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

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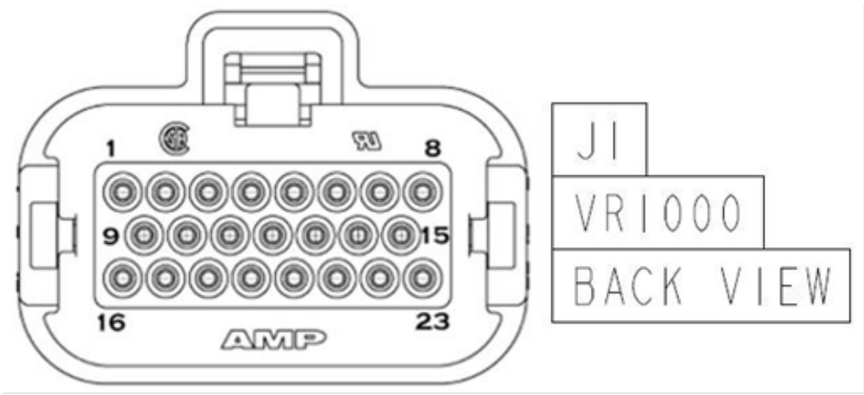
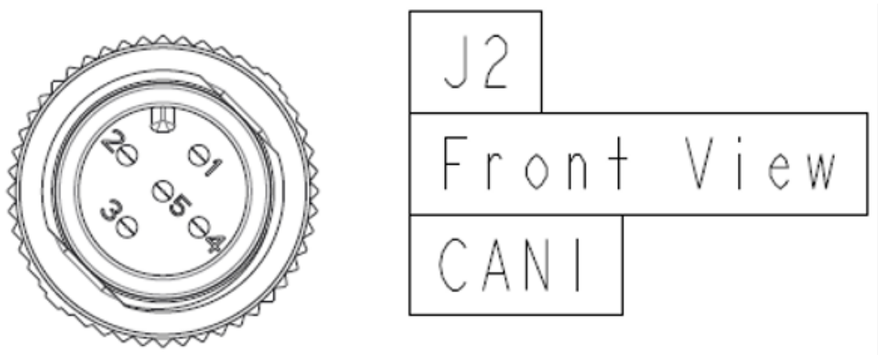
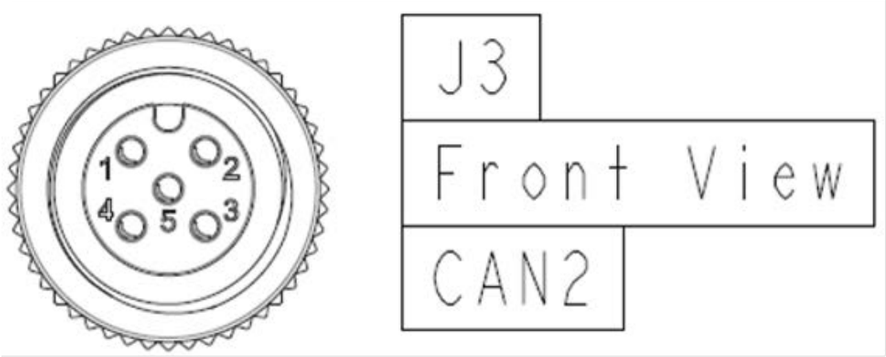
## **Appendix B,** Continued

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





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## **Appendix B,** Continued

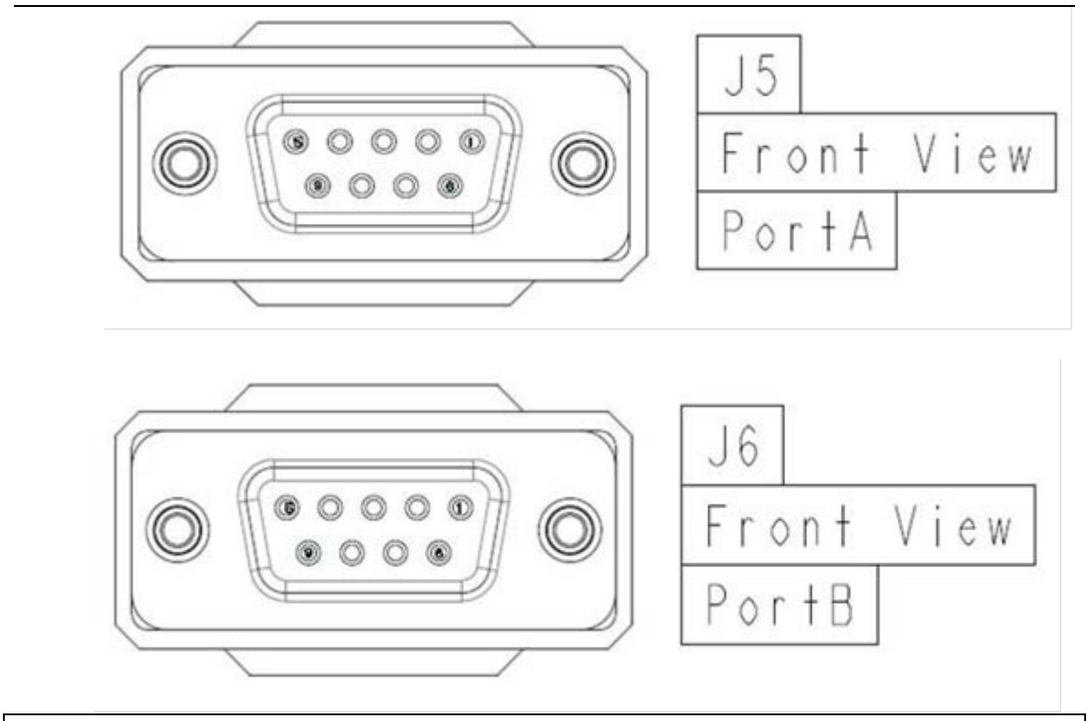


**Figure B2: J1 – J6 Connectors**