R320

User Guide

Part No. 875-0271-000 Rev. A1

Hemisphere GPS

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.

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Hemisphere GPS Precision GPS Applications

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Patents

The Outback S™ and S-Lite™ automated navigation and steering guide system is covered by U.S. Patents No. 6,539,303 and No. 6,711,501. The Outback Hitch™ automated hitch control system is covered by U.S. Patent No. 6,631,916. The Outback eDriveTC™ GPS assisted steering system is covered by U.S. Patent No. 7,142,956. Hemisphere GPS products may be covered by one or more of the following U.S. Patents:

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

Other U.S. and foreign patents pending.

Notice to Customers

Contact your local dealer for technical assistance. To find the authorized dealer near you, contact us at:

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Calgary, Alberta, Canada T2G 3C4
Phone: 403-259-3311
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www.hemispheregps.com

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Contents

Chapter 1: Introducing the R320

What's Included

Parts List

Thank you for your purchase of the R320 GNSS receiver. Built on Hemisphere GPS' Eclipse™ II platform, the R320 boasts the latest GNSS patented technology and offers extremely quick startup and reacquisition times. The feature-rich R320 tracks GPS L1/L2, SBAS, and L-band (OmniSTAR® G2/HP/XP/VBS) signals and can log raw data for post processing to a removable USB flash drive. It also utilizes Hemisphere GPS' exclusive COAST™ technology to provide accurate positioning data during DGPS and SBAS correction outages.

Offering such upgradable features as RTK base station functionality or RTK rover performance as well as GLONASS tracking, the R320 is a cost-effective, multi-GNSS solution compatible with other GNSS products. As a result, R320 fits a wide range of precise positioning applications from land and hydrographic surveying to machine guidance and control.

Improved RTK performance based on Hemisphere GPS' patent-pending SureTrack® technology is scalable on the R320, allowing you to achieve centimeter-level accuracy with L1/L2 GPS or improve performance and reliability with L1/L2 GLONASS signals. SureTrack ensures that the RTK rover receiver makes use of every satellite it is tracking, even satellites not tracked at the base. Additional benefits include fewer RTK dropouts in congested environments, faster requisitions and more robust solutions due to better cycle slip detection, and the ability to process GNSS data from various manufacturers. Even if the base supports only GPS, SureTrack processes GLONASS signals at the rover to deliver complete GNSS performance.

What's Included

You can purchase the R320 receiver as a standalone receiver or as part of a kit, where the kit typically contains the following parts:

- Receiver and related mounting hardware
- Antenna and related mounting hardware
- Cables

Look over the parts shipped with your kit. If any part appears to have been damaged during shipping, contact your freight carrier. If any parts are missing, contact your dealer.

Parts List

Table 1-1 lists available accessories for the R100 Series. The information contained in this table is accurate at time of printing. Contact your Hemisphere GPS dealer to obtain replacement parts or to order accessories.

Table 1-1: R320 parts list

Part Number	Part Name	Qty
050-0011-022	Data cable, DB-9, 3 m	1
052-0005-000	Antenna cable, TNC-TNC, 5 m	1
054-0009-000	Power cable (unterminated), 3 m	1
710-0056-000	Receiver mounting kit	1
720-0033-00A	Antenna mounting kit	1
051-0192-000#	USB cable (USB-A to USB-A), 3 m	1
804-3035-000	Antenna (L1/L2 GPS, L-Band)	1
802-1067-000	R320 receiver	1

Chapter 2: Installing the R320

Mounting the Receiver
Mounting the Antenna
Connecting the Cables
Connecting the R320 to External Devices
Configuring the Receiver
Environmental Considerations

The R320 is designed for easy setup, with the following steps described in this chapter:

- Mounting the receiver
- Mounting the antenna
- Connecting the cables
- Connecting the receiver to other devices

Mounting the Receiver

Note: Although you are not required to mount the receiver, you may want to do so to prevent damage to the receiver and any cables connected to the receiver.

Before mounting the receiver keep the following in mind:

- Menu screen, LEDs, and buttons are visible and accessible
- Top panel is accessible for connecting/switching out cables and powering the receiver on/off
- Mount the receiver inside and away from the elements and in a location that minimizes vibration, shock, extreme temperatures and moisture

Note: There is an option within the menu system to switch (flip 180°) the direction of the display. If it is easier to mount the unit upside down, you can mount it this way and still operate the display.

Figure 2-1: R320 receiver front view

To mount the receiver:

1. Locate the thumb screws, nuts, and brackets included in your R320 kit.
2. Slide the nuts through the openings (grooves) along both sides of the receiver.
3. Place the bracket alongside the receiver and insert the thumbscrews so they screw into the nuts.
4. Screw down the brackets.
5. Install the receiver with brackets in the desired location.

Mounting the Antenna

Antenna placement is crucial to the system's operation. The GPS engine inside the R320 computes a position based on measurements from each satellite to the phase center of the antenna; therefore, mount the antenna at the location where the reference position should be.

When considering the mounting location keep the following in mind:

- Make sure the antenna has a clear view of the sky so that GPS satellites are not masked by obstructions (which may potentially reducing system performance)
- Mount the antenna on, or as close to, the measurement center point
- Position the antenna as high as possible

You have the following options when mounting the antenna:

- Magnetic mount
- Pole mount

Magnetic Mount

The magnetic mount can be screwed into the bottom of the antenna and mounted to metal surfaces. The magnetic mount includes a metal disc and foam adhesive that allow you to bond the metal disc to the desired mounting location if there are no metal surfaces. You then place the magnetic mount on the metal disc.

To attach the antenna using the magnetic mount:

1. Clean and dry the surface where you will attach the metal disc.
2. Remove the backing from one side of the foam adhesive and press the adhesive onto the mounting surface.
3. Remove the backing from the other side of the foam adhesive and press the metal disc onto the mounting surface, applying firm pressure to ensure good adhesion.
4. Place the magnetic mount (with antenna attached) on top of the metal disc.

Pole Mount

The center thread of the antenna is 5/8 inches for compatibility with a survey pole (not included). Simply thread the pole into the antenna.

Connecting the Cables

When connecting the cables from the R320 ensure the following:

- Power cable must reach an appropriate power source
- Antenna cable must reach from the antenna to the R320 receiver
- Data cable may connect to a data storage device, computer, or other device that accepts GPS data

When choosing a route for all R320 cables keep the following in mind:

- Avoid running cables in areas of excessive heat
- Keep cables away from corrosive chemicals
- Do not run the extension cable through door or window jams
- Keep cables away from rotating machinery
- Do not crimp or excessively bend the cables
- Avoid placing tension on the cables
- Remove unwanted slack from the extension cable at the receiver end
- Secure along the cable route using plastic wraps

⚠WARNING: Improperly installed cables near machinery can be dangerous.

Connecting the R320 to External Devices

Communication between the R320 and external devices occurs through two serial ports and two USB ports, as shown in Figure 2-2. You can configure the ports for a combination of NMEA 0183, binary, and/or RTCM SC-104 data.

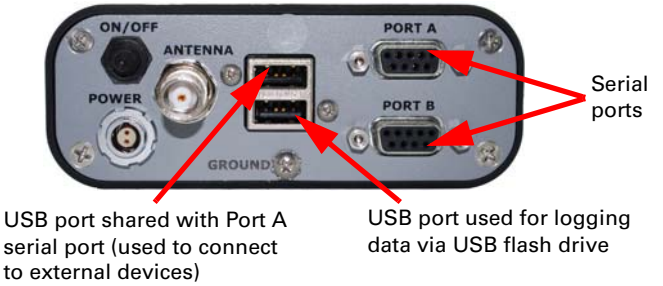


Figure 2-2: R320 serial and USB ports

If you connect a device to Port A, Port B, or the top USB port you can transmit and receive data between the R320 and the device. Similarly, if you connect one device to Port B and another device to the top USB port you can transmit and receive data between the R320 and each device.

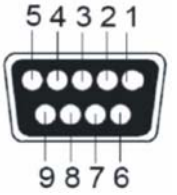
Note: Port A is shared with the top USB port. If you connect a device to Port A and another device to the top USB port the receive functionality on Port A is disabled. Therefore, Hemisphere GPS recommends using Port B and the USB port if want to connect two devices to the R320.

The top USB port is designed to be connected to a host device such as a PC. When you connect a PC to the R320 the PC should recognize it as a serial device and a new COM will appear as a valid connection on the PC. Set the communication software to use this new port to access the R320.

The bottom USB port is used for data logging onto a USB flash drive. If your flash drive has a status LED it should light up when you plug it in. For further data logging options, see “Data Logging Menu” on page 49.

Note: If you connect the supplied USB cable to the bottom USB port (data logging) or connect a USB flash drive to the top USB port (data communication), the USB functionality will not work as the USB ports are not interchangeable.

The serial ports operate at the RS-232 interface level to communicate with external data loggers, navigation systems, and other devices. Either serial port can also be used for firmware updates. The figure to the right illustrates the numbering for the DB9 connector (female). The numbering for each plug connector (male) is a mirror reflection of the scheme to the right.



Note: The baud rate for either R320 serial port and the device to which it is connected must match for successful communication. Table 2-1 provides the pin configuration for the serial ports.

Table 2-1: Port A and Port B serial port pinouts

Port A	
Pin	**Function**
1	Not connected
2	Transmit data Port A
3	Receive data Port A
4	Not connected
5	Signal ground
6	Not connected
7	Not connected
8	Not connected
9	5V output, 350 mA MAX

Port B	
Pin	**Function**
1	Not connected
2	Transmit data Port B
3	Receive data Port B
4	Not connected
5	Signal ground
6	Event marker
7	Not connected
8	Not connected
9	1 PPS

Configuring the Receiver

You can configure many aspects of the R320 through either serial port using Hemisphere GPS commands. Refer to Hemisphere GPS' GPS Technical Reference available from the Hemisphere GPS website for details.

Note: Contact your Hemisphere GPS dealer for more information regarding configuration and the use of Hemisphere GPS commands.

Environmental Considerations

Although it is splash proof in case of accidental exposure the R320 is designed for indoor use. The antenna is designed for outdoor use. See Table B-4 on page 39 for the environmental specifications.

Note: Changes you make to the R320 via either serial port are not automatically saved to memory for subsequent powerups; therefore, you must issue the $JSAVE command to save the changes. However, if you make changes via the menu system, they are automatically saved.

Chapter 3: Operating the R320

Powering the Receiver On/Off

LED Indicators

Using the Menus

USB Data Logging

The R320 is designed for easy operation with LED indicators and a straightforward menu system. This chapter provides information on the following topics:

- Powering the R320 on/off
- LED indicators
- R320 Main menu

Powering the Receiver On/Off

The power (ON/OFF) button of the R320 is located on the top panel.

Figure 3-1: R320 Series power button

The R320 accepts an input voltage of 8 to 36 VDC via the power cable. The supplied power should be continuous and clean for best performance. Table B-5 on page 40 provides the power specifications of the R320.

WARNING: Do not provide a voltage higher than the input range (36 VDC). This will damage the receiver and void the warranty.

WARNING: Do not attempt to operate the R320 with the fuse bypassed. This will void the warranty.

The R320 features reverse polarity protection to prevent damage if the power leads are accidentally reversed. Although the R320 proceeds through an internal startup sequence when you apply power, it will be ready to communicate immediately.

Note: The 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.

Note: The R320 may take up to 5 minutes to receive a full ionospheric map from SBAS. Optimum accuracy is obtained once the R320 is processing corrected positions using complete ionospheric information.

To power on the R320:

1. Connect the ends of the R320 power cable to a clean power source providing 8 to 36 VDC.

   Note: Hemisphere GPS suggests you use a weathertight connection and connector if the connection is located outside.

2. Press the ON/OFF button on the top panel.

To power off the R320:

- Press the ON/OFF button on the top panel.

LED Indicators

The R320 Series uses LEDs to indicate power, GPS lock, and DGPS position. There is a corresponding icon below each LED. Table 3-1 describes each LED indicator.

Table 3-1: LED indicators

LED Indicator	LED Color	Description/Function
	Red	Power indicator Illuminates solid red when the receiver is powered on.
	Yellow	GPS lock indicator Illuminates solid yellow when the receiver achieves a solid GPS lock.
	Green	DGPS position indicator Illuminates solid green when the receiver achieves a differential position and a pseudorange residual of better than the value specified by the $JLIMIT command (default is 10.0 m or 32.8 ft). If the residual value is worse than the current threshold, the LED blinks green indicating differential mode has been attained but the residual has not met the threshold.

Using the Menus

The R320 menu system is designed for easy setup and configuration of the unit in or out of the field and supports multiple languages. You can perform most configuration tasks entirely through the menu without having to connect to a computer or PDA.

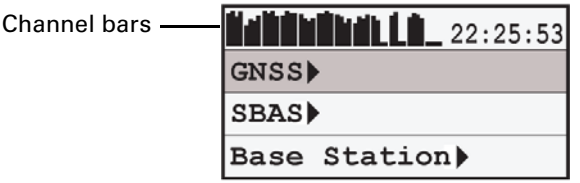


Figure 3-2: R320 menu

The bars along the top left of the display offer a visual representation of each channel's tracking status (one bar section for each channel). Depending on what signals you're tracking, the bars represent something different, where:

- If you're tracking L1 GPS only, each bar represents L1 GPS.
- If you're tracking L1/L2 GPS, each bar is two separate bars (starting from the left, first bar for L1 GPS, second bar for L2 GPS)
- If you're tracking L1/L2 GPS and GLONASS, each bar is four separate bars (starting from the left, first bar for L1 GPS, second bar for L2 GPS, third bar for L1 GLONASS, fourth bar for L2 GLONASS)

Refer to Appendix C, “Menu Maps” for a complete menu map for the following options on the Main menu:

- GPS
- Differential corrections (menu item will be the selected differential source, such as SBAS or Autonomous)
- Configuration Wizard
- System Setup
- Data Logging

The R320 front panel contains three soft buttons: Up, Enter, and Down (see Figure 3-3).

Up button - moves to the previous menu item or to the previous selection within a menu item

Enter button - displays a submenu or selects an option within a menu item

Down button - moves to the next menu item or to the next selection within a menu item

Figure 3-3: Menu buttons

Table 3-2 describes the indicators that appear to the right of specific menu items.

Table 3-2: Menu item indicators

Indicator	Purpose	Example
 Display indicator	Go to the indicated submenu This indicator also appears to the right of the "Back" and "Top Menu" menu items. • Pressing Enter when "Back" is selected returns you to the previous menu. • Pressing Enter when "Top Menu" is selected returns you to the Main menu.	1. On the Main menu press the Down button to highlight System Setup. The Display indicator appears to the right of System Setup. 2. Press Enter to display the System Setup menu. 3. Press the Down button again to highlight the Display Format option and then press Enter. The items on the Display Format menu appear and the Select indicator appears to the right of Disp Update (the first item on the Display Format menu). 4. Press Enter on the Disp Update item. The Display indicator changes to the Select indicator. 5. Press the Up or Down buttons to scroll through the available options (such as 1Hz and 5Hz). 6. Press Enter on the highlighted option to select it. That option is now the setting for the menu item and the Select indicator changes back to the Display indicator.
 Select indicator	Scrolls within a menu to highlight an option to select.	

To return the menu system to the factory default configuration:

- While holding down **Enter** power up the receiver until the splash screen disappears.

Menu and Menu Item Selection in This User Guide

For many instructions in this User Guide the following example illustrates the nomenclature used for making navigating the menus:

"On the Main menu select **Data Logging > Config**" is the equivalent to saying "On the Main menu select **Data Logging** and press **Enter**. Then select **Config** and press **Enter**."

When making selections for a menu item, such as selecting Yes or No for Auto-Name (Data Logging > Config menu), the instructions will indicate to select the menu item and press Enter to allow you to then select an option for that menu item and then press Enter again to select that option.

USB Data Logging

When you insert a USB flash drive into the R320, the Data Logging menu indicates you can start recording (logging data) and displays the free space on the flash drive (see Figure 3-4). When you start logging data the "Start Recording" indicator changes to "End <filename>."

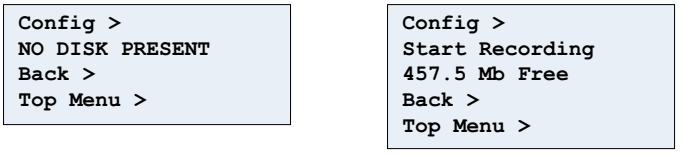


Figure 3-4: USB flash drive indicators on Data Logging menu

WARNING: Stop data logging before removing the USB flash drive from the R320. Failure to do so may result in a loss of data.

Data Logging Formats

You can log the following data types to a USB flash drive:

- RAW - Binary, NMEA, and other data options (see Table 3-3)
- KML - Google Earth KML format with latitude, longitude and height
- CSV - Comma-separated value (CSV) format with time, latitude, longitude, and height

Table 3-3: RAW data log options

Format	Description
Raw (binary)	For raw (binary) data logging, you may also want the receiver configuration to be inserted into the file. If you select this option the file will start with the receiver configuration comprised of the replies to the $JI, $JK, $JT, and $JSHOW queries.

Table 3-3: RAW data log options

Format	Description
NMEA	National Marine Electronics Association (NMEA 0183) - industry standard data transmission format
CMR	Trimble-proprietary data correction format
DFX	Hemisphere GPS-proprietary data correction format
ROX	Hemisphere GPS-proprietary data correction format
RTCM	Radio Technical Commission for Maritime Services - industry standard data correction format

When logging using the RAW data type (File Type > RAW as shown in Figure 3-5) you can select which data to log and at what rate by selecting Data Logs and then making the desired selections on the Data Logs menu.

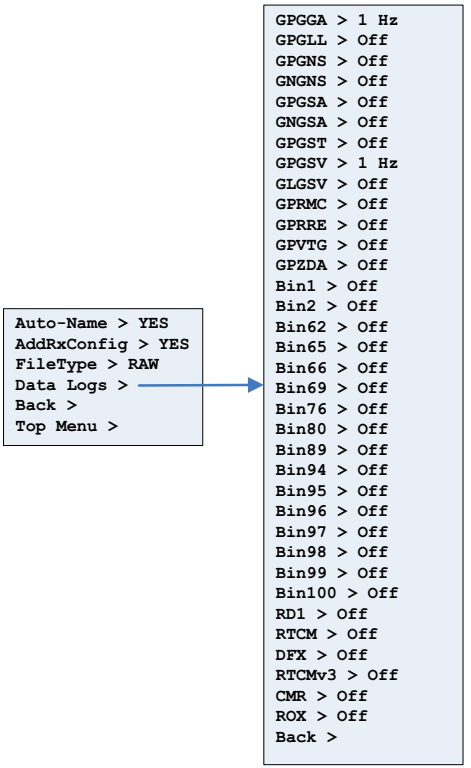


Figure 3-5: Data Logging > Config > Data Logs menu

Note: Logged data options are limited by your receiver subscriptions (certain options may not appear on the Data Logs menu without a specific subscription). For example, GNGNS, GNGSA, GLGSV, Bin62, Bin65, Bin66, and Bin69 only appear on the Data Logs menu if you are authorized to receive GLONASS. To view your subscriptions press **System Setup > Subscription**.

Logging Data to a File

You can log data to a file that the R320 auto-generates or you can manually enter a filename to which to log data. You can append data to or overwrite data on a manually-named file; however, you cannot append data to or overwrite data on an R320-generated file.

To log data to an R320 auto-generate filename:

1. Select **Data Logging > Config**.
2. If Auto-Name displays "No" select **Auto-Name** and then press **Enter**.
3. Select **Yes** and then press **Enter**.
4. Select **Back** to return to the Data Logging menu.
5. Select **Start Recording** to begin logging data. The "Start Recording" option changes to "End <filename>".
6. Select **End <filename>**.

To log data to a manually-created filename:

1. Select **Data Logging > Config**.
2. If Auto-Name displays "Yes" select **Auto-Name** and then press **Enter**.
3. Select **No** and press **Enter**.

   The "Enter Name" and "Mode" menu items appear below "Auto-Name."
4. Enter a filename:
   a. Select **Enter Name** and press **Enter**.
   b. Enter the desired characters for the filename and then scroll to the return character and press **Enter.**
5. Select the mode:
   a. Select **Mode** and press **Enter**.
   b. Select **Append** to log data to new file or to append data to an existing file (based on the filename in step 4) and press **Enter**.

   or

Select **Overwrite** to overwrite an existing file (based on the filename in step 4) and press **Enter**.

WARNING: No warnings are given to confirm overwriting a previous file.

Data Post-Processing

After you log data you can then process the data with a Receiver Independent Exchange (RINEX) format software utility.

To post-process raw data:

1. Log the RAW data (see Table 3-3 for data options) to the USB flash drive that is connected to the R320.
2. Remove the flash drive from the R320 and connect it to a PC with Hemisphere GPS' Rinex conversion software installed.

Note: The Hemisphere GPS Rinex conversion software is available from the Hemisphere GPS website at www.hemispheregps.com.

3. Run the Rinex conversion software.

Note: For the latest information on using the Hemisphere GPS Rinex software see the Hemisphere GPS Technical Reference available from the Hemisphere GPS website at www.hemispheregps.com.

Chapter 4: Using GNSS Differential Corrections

Installing the Base Station

Installing the Rover Radio

Using the Receiver as a Base Station or Rover

RTK Operation

Using OmniSTAR

RTK is a differential options that provides the highest accuracy (see Table B-2 on page 39 for accuracy specifications). A local base station is required, with the base station and rover each typically comprised of the following:

- GNSS receiver
- GNSS antenna
- Radio: transmitter for base station, receiver for rover
- Power source

Installing the Base Station

The base station tracks GNSS signals and broadcasts differential corrections to a radio and rover GNSS receiver. You typically set up the base station near the working area and at a location with no obstructions between the base station and rover radio.

When installing the base station ensure the following:

- Base station is not placed near metal objects
- Base station is at least 50 m (160 ft) from obstructions
- Base station and rover radio have a clear line of sight up to 5 km (3 mi) or less depending on the radio type when operating RTK

Installing the Rover Radio

The rover GNSS system processes the corrections and outputs highly accurate position information.

When installing the rover radio ensure the following:

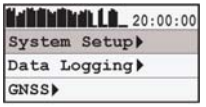
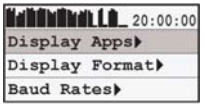
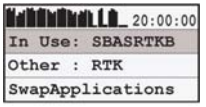
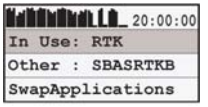
- Rover radio and GNSS antenna are at least 1 m (3 ft) apart
- Rover radio must not block the GNSS antenna
- Rover radio must receive regular corrections from the base station every one to two seconds (differential age) for up to 15 minutes to achieve RTK lock (maximum accuracy) - typically, a lock is achieved in less than five minutes

Using the Receiver as a Base Station or Rover

Using the R320 as a base station or rover receiver requires a subscription and a link between base and rover to transfer differential correction data from base to rover. The link can be wired or wireless (such as a radio modem).

Setting Up the Receiver as a Base Station or Rover

Make sure the current R320 application is set to SBASRTKB for a base station or RTK for a rover.

Step	Button (where applicable)
1. On the Main menu press the **Up** or **Down** arrow until System Setup is highlighted.	
	
2. Press **Enter**. The System Setup menu appears with Display Apps highlighted.	
	
3. With Display Apps highlighted press **Enter**. Make sure **In Use:** displays as either: • SBASRTKB for an RTK base station • RTK for an RTK rover receiver If the RTK application only appears next to **Other:**, scroll down and select **Swap Applications**. The desired application will then be shown as In Use.	
 	

Connecting the Receiver to a PC

You can also select the appropriate application using a terminal program such as Hyper Terminal®, SLXMon, or PocketMAX™.

When using direct commands from a PC, send the $JAPP command to view the current application. A response such as $>JAPP,SBASRTKB,RTK,1,2 will appear, indicating the SBASRTKB application is active and RTK is the secondary application. If the application was different and RTK was first, such as $>JAPP,RTK,SBASRTKB,2,1, then send $JAPP,other to swap applications so the correct application is used.

Step	Button (where applicable)
1. Connect either Port A or the upper USB port (data communication) of the R320 receiver to the serial port of the PC using the 9-pin serial cable.	
2. Configure the port communication parameters on the receiver. a. On the Main menu press the **Up** or **Down** arrows to highlight System Setup and then press **Enter**. b. Press the **Up** or **Down** arrows to highlight 'Baud Rates' and then press **Enter**. c. Press the **Up** or **Down** arrows to highlight the desired baud rate and then press **Enter**.	Up/Down arrows  Enter 
See "System Setup Menu" on page 44 for more information.	
3. Ensure the connected serial port on the PC has matching communication parameters.	

Connecting the Receiver to an External Device or Base/Rover Radio

You can connect the R320 to an external device or a base/rover radio. Before selecting an external device or base or radio system, ensure it meets the following requirements:

- Does not interfere with GPS
- Serial connection, with a minimum of 9600 baud, set to N,8,1
- Over the air throughput of at least 300 bps

Step	Button (where applicable)
1. Connect either Port A or the upper USB port (data communication) of the R320 receiver to the serial port of the device using the 9-pin serial cable.	
2. Configure the port communication parameters on the receiver. a. On the Main menu press the **Up** or **Down** arrows to highlight System Setup and then press **Enter**. b. Press the **Up** or **Down** arrows to highlight 'Baud Rates' and then press **Enter**. c. Press the **Up** or **Down** arrows to highlight the desired baud rate and then press **Enter**.	Up/Down arrows  Enter 
See "System Setup Menu" on page 44 for more information.	
3. Ensure the device has matching communication parameters for the connecting port.	

Note: Hemisphere GPS recommends testing with a wired condition prior to using a radio connection to ensure communication parameters are properly defined. Also, make sure both the rover radio and base station are on the same channel or frequency so the rover radio can receive corrections from the base station.

RTK Operation

After you connect the receiver to the desired devices and are operating using RTK, the status LEDs indicate the following:

- Yellow: tracking GPS
- Flashing green: differential has been attained, but the residual has not met the threshold
- Solid green: RTK lock

The R320 will output standard NMEA messages through Port A as desired. Set the message and port output as desired.

Using OmniSTAR

OmniSTAR is a worldwide terrestrial DGPS service that provides correction data to subscribers of the system with the use of a geostationary transponder. With this service, 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 information broadcast by this service is based upon a network of reference stations placed at geographically strategic locations. The network stations communicate GPS correction data to control centers where it is decoded, checked, and repackaged into a proprietary format for transmission to a geostationary L-band communications satellite. The satellite rebroadcasts the correction information back to earth over a large signal footprint where the R320's L-band differential satellite receiver demodulates the data. The resulting corrections are those that would be calculated if a reference station were set up at the present location. This type of solution ensures a consistent level of accuracy across the entire coverage area.

OmniSTAR Reception

The OmniSTAR service broadcasts at a similar frequency to GPS, and as a result, is a line-of-sight system. There must be a line of sight between the antenna and the OmniSTAR satellite for reception of the service. The OmniSTAR service uses geostationary satellites for communication. The elevation angle to these satellites is dependent upon latitude. For latitudes higher than approximately 55° north or south, the OmniSTAR signal may be blocked more easily by obstructions such as trees, buildings, terrain, or other objects.

OmniSTAR Service Activation

The OmniSTAR service may be activated by contacting the service provider in the your region. Contact OmniSTAR with the unit number and they will activate the subscription over the air. Please have the receiver ready to receive the OmniSTAR signal for subscription validation.

For questions regarding the OmniSTAR service, contact OmniSTAR for further information.

Contacting OmniSTAR

Table 4-1 provides the contact numbers for the various OmniSTAR offices throughout the world.

Table 4-1: OmniSTAR contact information

Location	Telephone Number	Website
North America South America	1-888-883-8476	www.omnistar.com
Europe North Africa Middle East West Asia	31-70-317-0900	www.omnistar.nl
Australia Far East	61-8-9322-5295	http://omnistar.com.au
Southern Africa	27-21-527-8950	www.omnistar.co.za

Appendix A: Troubleshooting

Table A-1 provides a checklist to troubleshoot common issues and their solutions for the R320.

Table A-1: Troubleshooting

Issues	Possible solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connections • Check power input voltage (8 - 36 VDC) • Check current restrictions imposed by power source (maximum is 575 mA @ 12 VDC) • Press the POWER button
No data from R320	• Check receiver power status (red LED) • Check integrity and connectivity of power and data cable connections • The volume of data requested to be output by the R320 could be higher than what the current baud rate supports. Try using 19200 or higher as the baud rate for all devices.
No GPS lock	• Check integrity of cable connections • Verify antenna's clear view of the sky
No SBAS lock	• Check integrity of cable connections • Verify antenna's clear view of the sky • Check SBAS visibility map
No OmniSTAR lock	• Subscription activated and not expired • Check antenna connections • Verify antenna's clear view of the sky

Appendix B: Specifications

Table B-1 through Table B-6 provide the power, mechanical, communication, environmental and DGPS specifications for the R320.

Table B-1: GNSS sensor specifications

Item	Specification
Receiver type	GNSS L1 & L2 RTK with carrier phase
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS 12 L2C GPS 12 L1 GLONASS (with subscription code) 12 L2 GLONASS (with subscription code) 3 SBAS or 3 additional L1CA GPS 1 L-Band
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, 20 Hz available
Timing (1PPS) accuracy	20 ns
Cold start	< 60 s typical (no almanac or RTC)
Warm start	< 30 s typical (almanac and RTC)
Hot start	< 10 s typical (almanac, RTC, and position)
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288 m (60,000 ft)
Differential options	SBAS, Autonomous, External RTCM, RTK, OmniSTAR (G2/HP/XP/VBS)
Satellite reacquisition	< 1 s

Table B-2: Horizontal accuracy specifications

Item	RMS (67%)	2DRMS (95%)
RTK[2,3]	10 mm + 1 ppm	20 mm + 2 ppm
OmniSTAR HP[2,4]	0.1 m	0.2 m
SBAS (WAAS)[2]	0.3 m	0.6 m
Autonomous, no SA[2]	1.2 m	2.5 m

Table B-3: Communication specifications

Item	Specification
Serial ports	2 full-duplex RS-232
USB ports	1 USB host, 1 USB device
Baud rates	4800 - 115200
Correction I/O protocol	Hemisphere GPS proprietary, RTCM v2.3 (DGPS), RTK v3, CMR, CMR+[1]
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Timing output	1 PPS (HCMOS, active high, rising edge sync, 10 kΩ, 10 pF load)
Event marker input	HCMOS, active low, falling edge sync, 10 kΩ

Table B-4: Environmental specifications

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)
Humidity	95% non-condensing
Shock and vibration	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational
EMC	CE (IEC 60945 Emissions and Immunity), FCC Part 15, Subpart B, CISPR22

Table B-5: Power specifications

Item	Specification
Input voltage	8 to 36 VDC
Power consumption	< 4.3 W nominal (using L-Band) < 3.5 W nominal (no L-Band)
Current consumption	355 mA nominal (@ 12 VDC using L-Band) 295 mA nominal (@ 12 VDC no L-Band)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table B-6: Receiver mechanical specifications

Item	Specification
Dimensions	178 L x 120 W x 46 H (mm) 7.01 L x 4.72 W x 1.81 H (in)
Weight	0.64 kg (1.4 lbs)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position, L-Band lock
Power/data connector	2-pin metal ODU connector
Antenna connector	TNC-male, straight

[1]Receive only, does not transmit this format.

[2]Depends on multipath environment, number of satellites in view, satellite geometry and ionospheric activity.

[3]Depends also on baseline length.

[4]Requires a subscription from OmniSTAR.

Appendix C: Menu Maps

GPS/GNSS Menu

Differential Corrections Menu

Base Station Menu

Configuration Wizard Menu

System Setup Menu

Data Logging Menu

This appendix shows the complete menu map for each menu (listed below) on the R320 main screen.

- GPS/GNSS
- Differential Corrections (menu item will be the selected differential source, such as SBAS or Autonomous)
- Base Station
- Configuration Wizard
- System Setup
- Data Logging

GPS/GNSS Menu

Use the GPS menu to view and edit GPS settings. If GLONASS is enabled on your receiver, use the GNSS menu to view and edit your GPS and GLONASS settings. Settings include the data port outputs, specific positioning parameters, UTC time offset, and satellite visibility and positioning information.

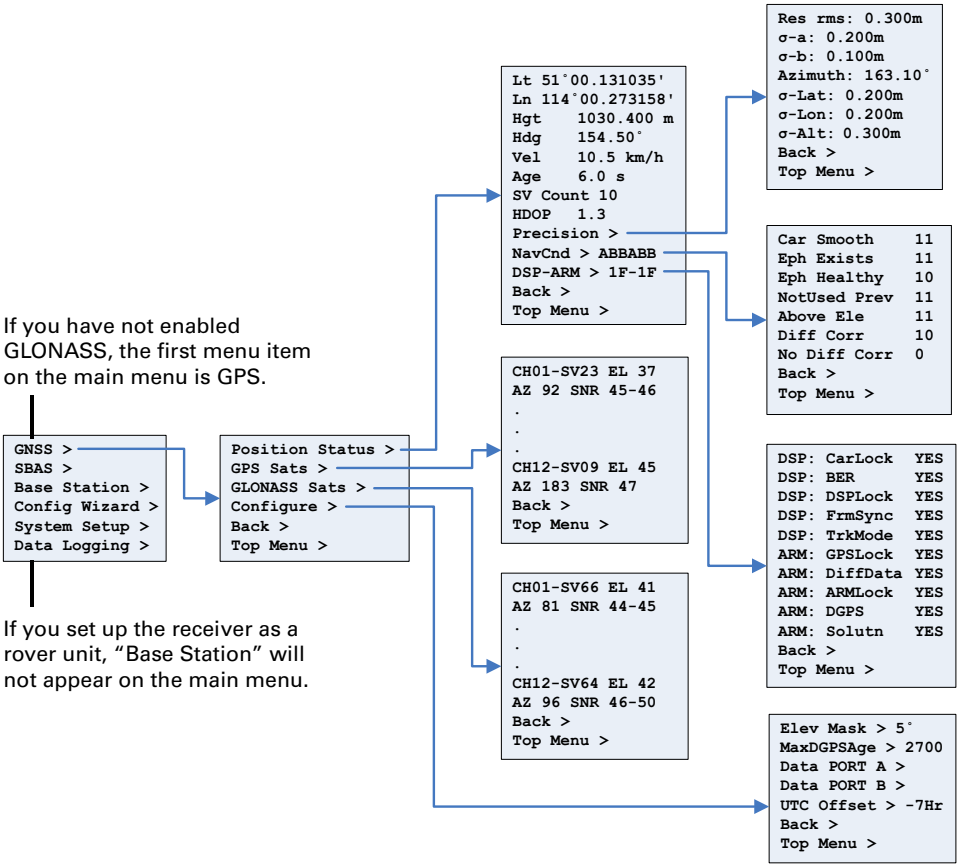


Figure C-1: GPS/GNSS menu

Differential Corrections Menu

Use the differential corrections menu to view your differential settings. The differential name shown on the main menu of the display reflects your current differential source. For example, if you are using SBAS, then “SBAS” appears on the main screen and the associated SBAS submenus are available, as shown in Figure C-2.

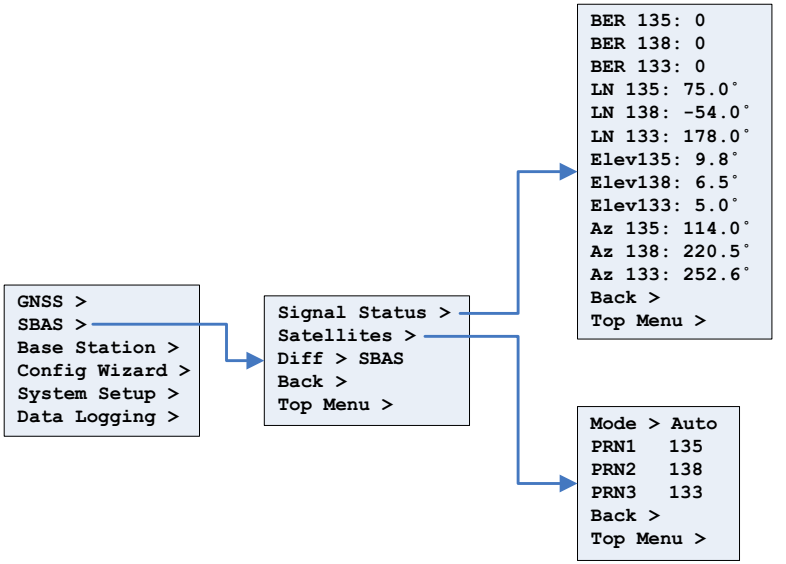


Figure C-2: SBAS menu

The following available differential sources depend on the configuration you purchased:

- SBAS
- L-Band
- External RTCM
- Autonomous

From the differential corrections menu, you can view your current status or adjust satellites tracked.

Figure C-3 through Figure C-5 show the complete menu maps for the L-Band, External RTCM, and Autonomous differential sources, respectively.

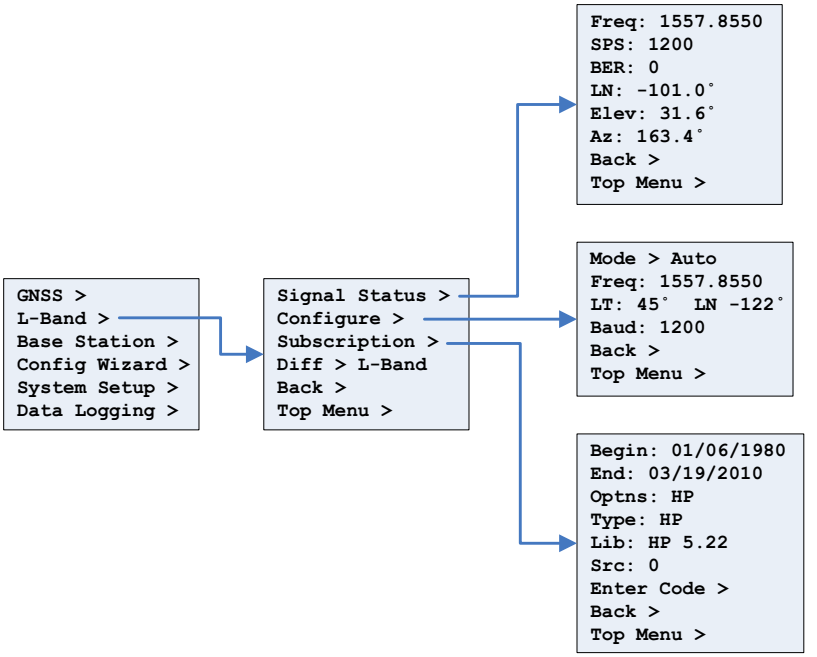


Figure C-3: L-Band menu

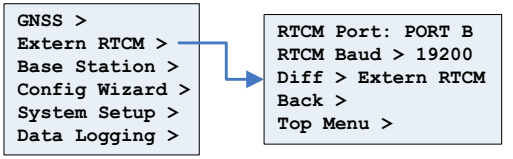


Figure C-4: External RTCM menu

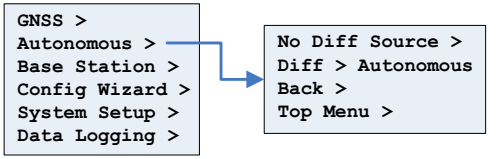


Figure C-5: Autonomous menu

Base Station Menu

The Base Station menu allows you to configure the base station/rover setup.

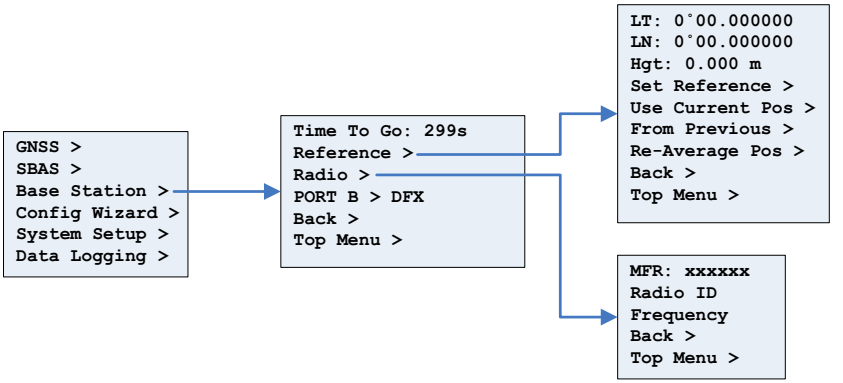


Figure C-6: Base Station menu

Configuration Wizard Menu

The Configuration Wizard walks you through basic settings to get started.

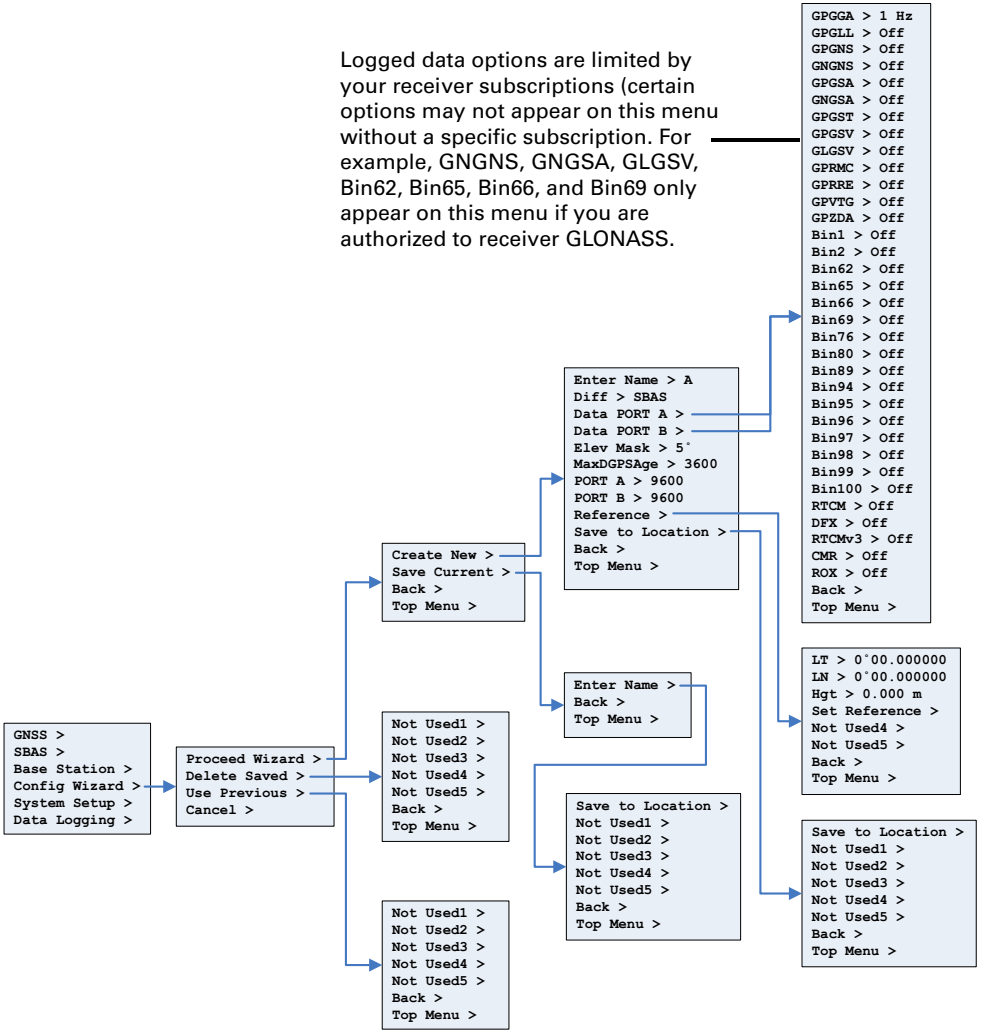


Figure C-7: Config Wizard menu

System Setup Menu

The System Setup menu allows you to view and edit such current system settings as current applications, units, baud rates, logs, LED contrast, subscription code, display orientation (you can flip the display 180° by selecting “YES” under FLIP DISPLAY), and language.

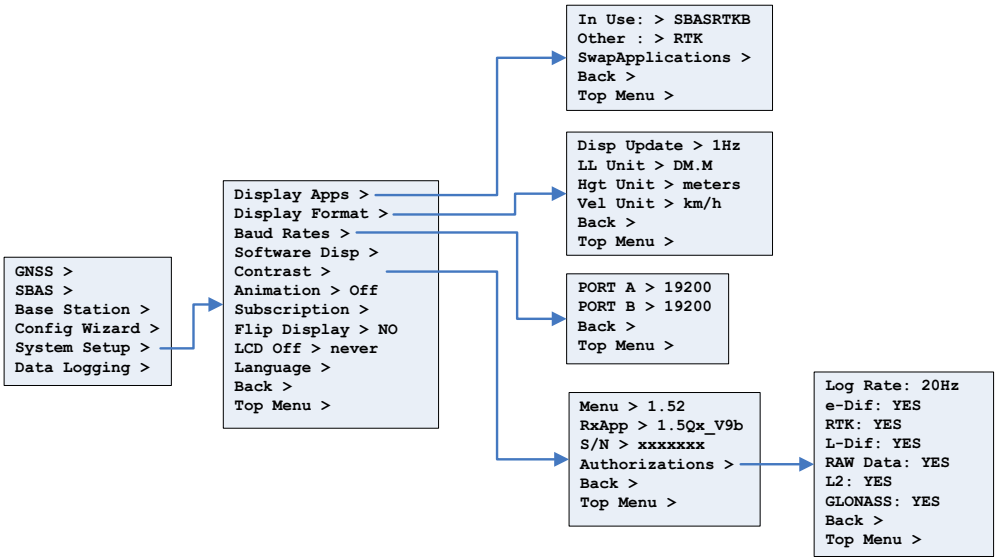


Figure C-8: System Setup menu

Data Logging Menu

The Data Logging menu allows you to log or output job data, view USB flash drive free storage space, set up file auto-naming, and view what type of data you are logging.

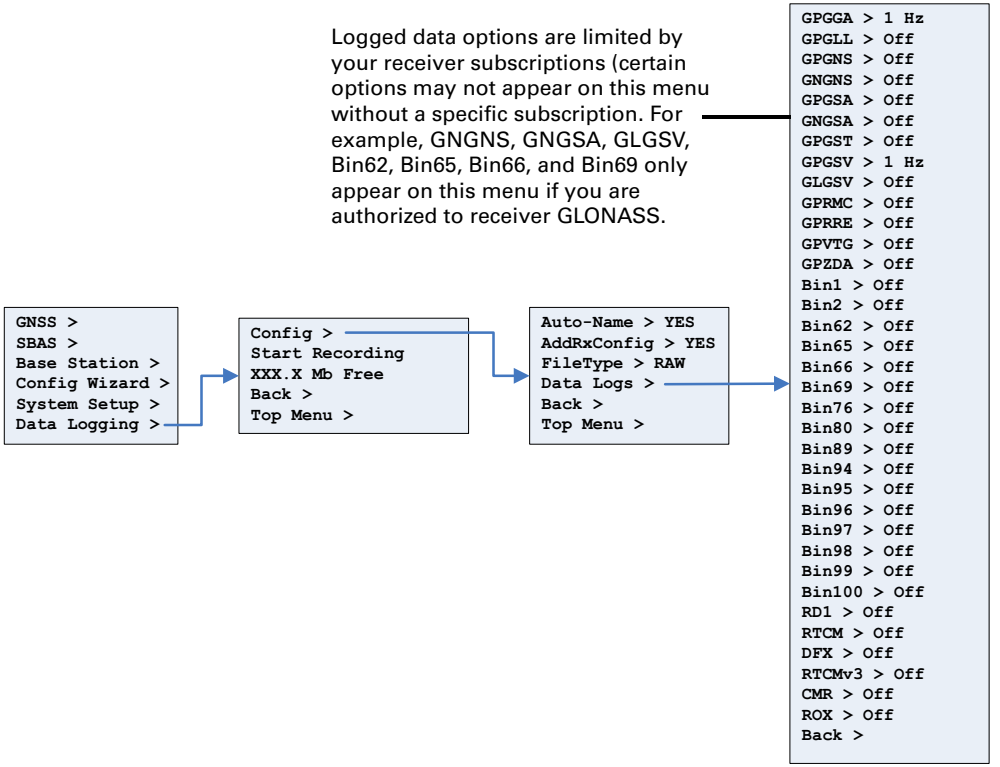


Figure C-9: Data Logging menu

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21. **TERMINATION**. Licensee may terminate this Agreement at any time without cause. Hemisphere may terminate this Agreement on 30 days notice to Licensee if Licensee fails to materially comply with each provision of this Agreement unless such default is cured within the 30 days. Any such termination by a party shall be in addition to and without prejudice to such rights and remedies as may be available, including injunction and other equitable remedies. Upon receipt by Licensee of written notice of termination from Hemisphere or termination by Licensee, Licensee shall at the end of any notice period (a) cease using the Software; and (b) return to Hemisphere (or destroy and provide a certificate of a Senior Officer attesting to such destruction) the Software and all related material and any magnetic or optical media provided to Licensee. The provisions of Sections 6), 7), 8), 9), 10), 15), 21), 26) and 27) herein shall survive the expiration or termination of this Agreement for any reason.

22. **EXPORT RESTRICTIONS**. Licensee agrees that Licensee will comply with all export control legislation of Canada, the United States, Australia and any other applicable country's laws and regulations, whether under the Arms Export Control Act, the International Traffic in Arms Regulations, the Export Administration Regulations, the regulations of the United States Departments of Commerce, State, and Treasury, or otherwise as well as the export control legislation of all other countries.
23. **PRODUCT COMPONENTS.** The Product may contain third party components. Those third party components may be subject to additional terms and conditions. Licensee is required to agree to those terms and conditions in order to use the Product.
24. **FORCE MAJEURE EVENT.** Neither party will have the right to claim damages as a result of the other's inability to perform or any delay in performance due to unforeseeable circumstances beyond its reasonable control, such as labor disputes, strikes, lockouts, war, riot, insurrection, epidemic, Internet virus attack, Internet failure, supplier failure, act of God, or governmental action not the fault of the non-performing party.
25. **FORUM FOR DISPUTES**. The parties agree that the courts located in Calgary, Alberta, Canada and the courts of appeal there from will have exclusive jurisdiction to resolve any disputes between Licensee and Hemisphere concerning this Agreement or Licensee's use or inability to use the Software and the parties hereby irrevocably agree to attorn to the jurisdiction of those courts. Notwithstanding the foregoing, either party may apply to any court of competent jurisdiction for injunctive relief.
26. **APPLICABLE LAW**. This Agreement shall be governed by the laws of the Province of Alberta, Canada, exclusive of any of its choice of law and conflicts of law jurisprudence.
27. **CISG.** The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement or any transaction hereunder.
28. **GENERAL.** This is the entire agreement between Licensee and Hemisphere relating to the Product and Licensee's use of the same, and supersedes all prior, collateral or contemporaneous oral or written representations, warranties or agreements regarding the same. No amendment to or modification of this Agreement will be binding unless in writing and signed by duly authorized representatives of the parties. Any and all terms and conditions set out in any correspondence between the parties or set out in a purchase order which are different from or in addition to the terms and conditions set forth herein, shall have no application and no written notice of same shall be required. In the event that one or more of the provisions of this Agreement is found to be illegal or unenforceable, this Agreement shall not be rendered inoperative but the remaining provisions shall continue in full force and effect.

Warranty Notice

COVERED PRODUCTS: This warranty covers all products manufactured by Hemisphere GPS and purchased by the end purchaser (the "Products"), unless otherwise specifically and expressly agreed in writing by Hemisphere GPS.

LIMITED WARRANTY: Hemisphere GPS 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 GPS'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 GPS'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 GPS's 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 GPS shall be, at Hemisphere GPS's option, the repair or replacement of any defective Product or components thereof. The purchaser shall notify Hemisphere GPS or a Hemisphere GPS's approved service center immediately of any defect. Repairs shall be made through a Hemisphere GPS approved service center only. Repair, modification or service of Hemisphere GPS products by any party other than a Hemisphere GPS 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 GPS'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 GPS has been advised of the possibility of such damages. Without limiting the foregoing, Hemisphere GPS 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 GPS 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 GPS'S RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GPS 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 GPS; (3) the operation of the Product under any specification other than, or in addition to, the specifications set forth in Hemisphere GPS'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. 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 GPS'S RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GPS 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 GPS 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 GPS 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 GPS approved service center along with the end purchaser's proof of purchase. Hemisphere GPS 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 GPS approved service center, contact Hemisphere GPS at the following address:

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