



# **R100 Series Receiver User Guide**

Part No. 875-0173-000 Rev G1



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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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:

Hemisphere GPS  
4110 9th Street S.E.  
Calgary, Alberta, Canada T2G 3C4  
Phone: 403-259-3311  
Fax: 403-259-8866  
[precision@hemispheregps.com](mailto:precision@hemispheregps.com)  
[www.hemispheregps.com](http://www.hemispheregps.com)

## **Technical Support**

If you need to contact Hemisphere GPS Technical Support:

8444 N 90th St, Suite 130  
Scottsdale, AZ 85258 USA  
Phone: (480) 348-9919  
Fax: (480) 348-6370  
[techsupport@hemispheregps.com](mailto:techsupport@hemispheregps.com)

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## **Chapter 1: Introducing the R100 Series**

Receiver Product Matrix

Features Specific to the R131

What's Included

Parts List

The R100™ Series consists of multiple GPS receiver models that track GPS and SBAS, with some models tracking differential radio beacon signals and/or L-band DGPS service.

All R100 Series receivers:

- Utilize Hemisphere GPS' exclusive COAST™ technology that maintains accuracy during temporary loss of differential signal
- Are capable of using Hemisphere GPS' e-Dif® technology

## Receiver Product Matrix

Table 1-1 lists all the available R100 Series receiver models.

**Table 1-1: R100 Series receiver models**

Model	Application	Beacon	L-Band	1 PPS Output	Rack Mount
R100	Marine/GIS/survey	No	No	DB9	No
R110	Marine/GIS/survey	Yes	No	DB9	No
R120	Marine/GIS/survey	No	Yes	DB9	No
R130	Marine/GIS/survey	Yes	Yes	DB9	No
R101	Air	No	No	PWR/data	No
R121	Air	No	Yes	PWR/data	No
R131	Marine/GIS/survey	Yes	Yes	SMA	Yes

---

### Note:

- Any reference to the R100 Series refers to all the receivers listed in Table 1-1.
  - Any reference to "Beacon only" applies to the R110, R130, or R131.
  - Any reference to "L-band DGPS service only" applies to the R120, R121, R130, or R131.
- 

## Features Specific to the R131

The R131 is the only model in the R100 Series that includes the following features:

- Rack-mountable enclosure
- Soft power switch located on the front display - all other R100 Series models have a push-button power switch located on the top of the unit
- 1 PPS output support via an SMA connector on the back of the unit

## What's Included

You can purchase any R100 Series receiver as a standalone receiver or as part of a kit. Although they vary by receiver model R100 Series kits contain the following parts:

- Receiver
- Receiver mounting hardware
- Antenna
- Antenna mounting hardware (Marine/GIS/survey models only)
- Cables
- R100 Series User Guide (Air models only - R101 and R121)

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

## Parts List

Table 1-2 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 1-2: R100 Series parts list**

Part	Models	Qty	Part No.
Receiver (one of models listed at right)	R100	1	803-0055-000#
	R101	1	803-0048-000#
	R110	1	803-0056-000#
	R120	1	803-0057-000#
	R121	1	803-0043-000#
	R130	1	803-0044-000#
	R131	1	803-0053-000#
Receiver mounting hardware kit	R100, R101, R110, R120, R121, R130, R131	1	710-0056-000#
Power cable (circular)	R100, R110, R120, R131	1	054-0118-000#
Power cable (circular)	R130	1	054-0009-000#
Data cable, DB-9 female to DB-9 male, 3 m	R100, R110, R120, R130	1	050-0011-022#
A21 antenna	R100, R101, R120, R121	1	804-3036-000#
A21 antenna mounting hardware kit	R100, R101, R120, R121	1	710-0110-000#
A31 antenna	R110, R130, R131	1	804-3043-000#
A31 antenna mounting hardware kit	R110, R130, R131	1	710-0111-000#
Antenna cable, TNC-TNC, 5 m	R100, R101, R110, R120, R121, R130, R131	1	052-0005-000#





## **Chapter 2: Installing the R100 Series**

Mounting the Receiver

Mounting the Antenna

Connecting and Routing the Cables

Connecting the Receiver to External Devices

Default Settings

Configuring the Receiver

Environmental Considerations

This chapter describes how to mount the receiver and antenna, connect the cables and external devices, configure the receiver, and provides default settings and environmental considerations.

## 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.

When mounting the receiver, adhere to the following guidelines:

- Install the receiver inside and away from the elements and in a location that minimizes vibration, shock, extreme temperatures, and moisture
- Ensure the front panel (menu screen, LEDs, and buttons) is visible and accessible
- Ensure the top panel (R100 Series, except R131) or back panel (R131) is easily accessible to connect/switch out cables and turn power on and off
- **R131 only:** Ensure soft power switch on front panel is accessible

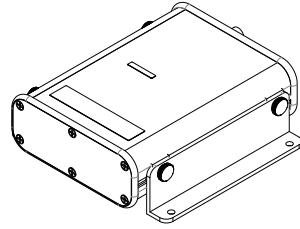
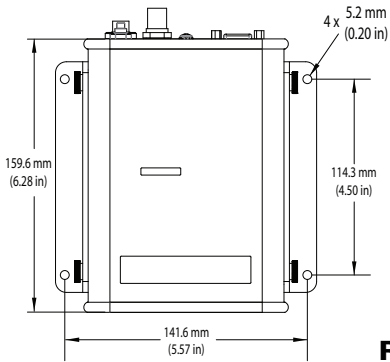
**Note:** There is an option within the menu to switch (flip 180°) the direction of the display. If it is easier to mount the unit upside down, you can mount it this way and still operate the display.

Figure 2-1 illustrates the typical mounting orientation of the R100 Series receivers, indicating that the R131 receiver is rack-mountable.

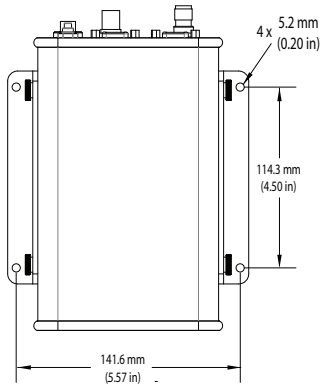
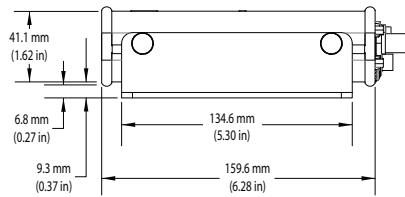
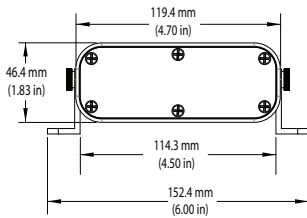


**Figure 2-1: Receiver mounting orientation**

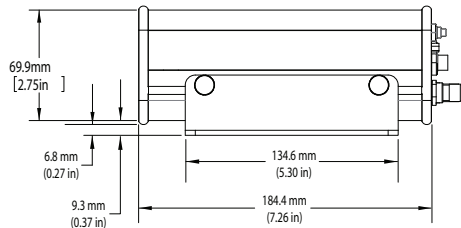
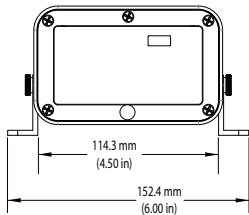
Figure 2-2 shows the dimensions (including attached mounting brackets) of the R100 Series (except R131) and the R131, respectively. Use Figure 2-2 when using the receiver mounting procedure that follows. The connectors differ between different R100 Series models—keep this in mind when installing your receiver. See Figure 2-3 on page 11 for more information.



### R100 Series (except R131)



### R131 Receiver



**Figure 2-2: R100 Series (except R131) and R131 dimensions with mounting brackets**

**Note:** The following procedure shows how to mount the R100 Series receiver (except R131). Instructions are similar for mounting the R131.

---

To mount the receiver:

1. Locate the thumbscrews, nuts, and brackets included in your R100 Series kit.
2. Slide the nuts through the opening along both sides of the receiver (see also Figure 2-1 on page 6 for opening on R131).



3. Place the bracket alongside the receiver and insert the thumbscrews (two thumbscrews per bracket) so they screw into the nuts.



4. Using the remaining holes in the brackets (two holes per bracket) screw down the brackets in the desired location.

Use remaining holes in brackets to secure unit in desired location

---

**Note:** Hemisphere GPS does not provide the screws noted in Step 4.

---

## Mounting the Antenna

Proper antenna placement is critical to positioning accuracy.

When considering the mounting location keep the following in mind:

- Make sure the antenna has a clear view of the sky (an obstructed view of the sky may impair system performance)
- Mount the antenna on, or as close to, the measurement center point (the GPS engine inside the receiver computes a position based on measurements from each satellite to the phase center of the antenna)
- Position the antenna as high as possible

You have three options when mounting the antenna:

- Magnetic mount
- Pole mount
- Surface 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" for compatibility with a survey pole (not included). Simply thread the pole into the antenna.

## Surface Mount

As an alternative to the magnetic mount, you can attach the antenna directly to the mounting surface with four machine screws (no. 8-32).

To attach the antenna directly to the mounting surface:

1. Photocopy the bottom of the antenna and use it as a template to plan the mounting hole locations.

---

**⚠ WARNING:** Make sure the photocopy is scaled one to one with the mounting holes on the bottom of the antenna.

---

2. Mark the mounting hole centers, as necessary, on the mounting surface.
3. Place the antenna over the marks to ensure the planned hole centers align with the true hole centers (adjusting as necessary).
4. Use a center punch to mark the hole centers.
5. Drill the mounting holes with a 3/16" bit appropriate for the surface.
6. Place the antenna over the mounting holes and insert the mounting screws through the bottom of the mounting surface and into the antenna.

---

**⚠ WARNING:** When installing the antenna, hand tighten only. Damage resulting from overtightening the antenna is not covered by the warranty.

---

# Connecting and Routing the Cables

Adhere to the following when connecting and routing R100 Series cables:

- Power cable must reach an appropriate power source
- Antenna cable must reach from the antenna to the receiver
- Data cable may connect to a data storage device, computer, or other device that accepts GPS data
- Do not run cables in areas of excessive heat
- Do not expose cables to corrosive chemicals
- Do not crimp or excessively bend cables
- Do not place tension on cables
- Coil up excess cable near unit
- Secure along the cable route using plastic tie wraps as necessary
- Do not run cables near high Voltage or strong RF noise and transmitter sources

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

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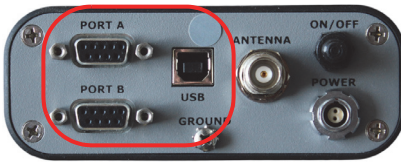
# Connecting the Receiver to External Devices

Communication between the R100 Series and external devices occurs through serial ports and USB ports. Table 2-1 lists these connections for each R100 Series model.

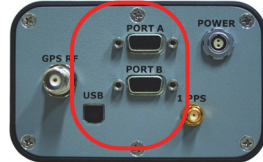
**Table 2-1: R100 Series serial and USB communication**

Model	Serial Communication Through Port A and Port B	USB Communication
R100	External ports connected via DB9 cable	(1) USB-B port
R101	Internal ports connected via power/data connector	None
R110	External ports connected via DB9 cable	(1) USB-B port
R120	External ports connected via DB9 cable	(1) USB-B port
R121	Internal ports connected via power/data connector	None
R130	External ports connected via DB9 cable	(1) USB-B port
R131	External ports connected via DB9 cable	(1) USB-B port

Figure 2-3 shows how the serial and USB ports may appear on your particular R100 Series model.



R100, R110, R120, R130 receivers



R131 receiver (rack mountable)



R101 and R121 receivers (serial, no USB)

**Figure 2-3: Serial and USB ports**

If you connect a device to Port A, Port B, or the USB port you can transmit and receive data between the R100 Series and the device. Similarly, if you connect one device to Port A and another device to the USB port you can transmit and receive data between the R100 Series and each device.

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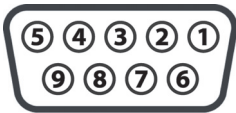
**Note:** For those models that include a USB port (R100, R110, R120, R130, and R131) Port B is shared with the USB port. If you connect a device to Port B and another device to the USB port the receive functionality on Port B is disabled. Therefore, Hemisphere GPS recommends using Port A and the USB port if want to connect two devices to these R100 Series models.

---

The USB port is designed to be connected to a host device such as a PC. When you connect a PC to the R100 Series 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 R100 Series.

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. Figure 2-4 shows the pinout assignment for the DB9 connector (female), Figure 2-5 shows the pinout assignment for the power/data connector, and Table 2-2 and Table 2-3 provide the related pinout descriptions.

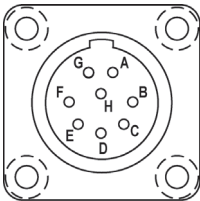
**Note:** For successful communication you must set the baud rate of the R100 Series serial ports to match that of the connected devices.



**Figure 2-4: Serial port pinout assignment**

**Table 2-2: Port A / Port B serial port pinouts (R100/R110/R120/R130/R131)**

Pin	Port A Description	Port B Description
1	Not connected	Not connected
2	Transmit data Port A	Transmit data Port B
3	Receive data Port A	Receive data Port B
4	Not connected	Not connected
5	Signal ground	Signal ground
6	Not connected	Event marker
7	Not connected	Not connected
8	Not connected	Not connected
9	5V output, 350 mA max	1 PPS



**Figure 2-5: Power/data port pinout assignment**

**Table 2-3: Power/data connector pinout for R101 and R121**

Pin	Description
A	Power
B	1 PPS
C	Port A Tx
D	Port A Rx
E	Port B Tx
F	Port B Rx
G	Manual mark
H	Ground

## Default Settings

Table 2-4 through Table 2-6 provide default options/settings for the R100 Series.

**Table 2-4: DGPS options**

DGPS Option
SBAS (WAAS, EGNOS, MSAS, etc)
e-Dif
Beacon (R110, R130, R131 only)
External RTCM
L-Band (R120, R121, R130, R131 only)
L-Dif

**Table 2-5: Serial port settings**

Serial Ports	Baud Rates	Data Bits	Parity	Stop Bits	Interface Level
A and B	4800, 9600, 19200, 38400, 57600, 115200	8	None	1	RS-232

**Table 2-6: GPS message output options**

GPS Message	Update rate	Max DGPS age	Elevation mask
Hemisphere GPS Binary	1 Hz to 20 Hz	259,200 seconds	5°
NMEA 0183 GGA	1 Hz to 20 Hz	259,200 seconds	5°
NMEA 0183 GLL	1 Hz to 20 Hz	259,200 seconds	5°
NMEA 0183 GSA	1 Hz	259,200 seconds	5°
NMEA 0183 GST	1 Hz	259,200 seconds	5°
NMEA 0183 GSV	1 Hz	259,200 seconds	5°
NMEA 0183 RMC	1 Hz	259,200 seconds	5°
NMEA 0183 RRE	1 Hz	259,200 seconds	5°
NMEA 0183 VTG	1 Hz to 20 Hz	259,200 seconds	5°
NMEA 0183 ZDA	1 Hz	259,200 seconds	5°

## Configuring the Receiver

You can configure many aspects of the R100 Series through the serial port using Hemisphere GPS commands. Contact your Hemisphere GPS dealer for more information regarding configuration and the use of Hemisphere GPS commands. You can also refer to the Hemisphere GPS Technical Reference (go to [www.hemispheregps.com/support](http://www.hemispheregps.com/support) and click the GPS Reference icon) for more information on Hemisphere GPS commands.

---

**Note:** Changes you make to the R100 Series via the serial port are not automatically saved to memory for subsequent powerup; therefore, you must issue the \$JSAVE command to save the changes. However, if you make changes via the menu system, they are automatically saved.

---

## Environmental Considerations

Although it is splash proof in case of accidental exposure the R100 Series is designed for indoor use. The antenna is designed for outdoor use. See Table C-5 on page 39 for environmental specifications.



## **Chapter 3: Operating the R100 Series**

Powering the Receiver On/Off

LED Indicators

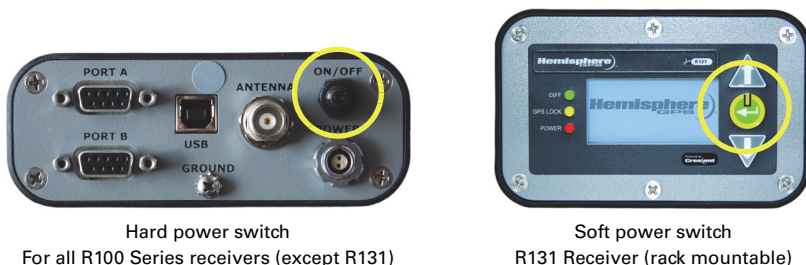
Using the Menus

The R100 Series is designed for easy operation with LED indicators and a straightforward menu system. This chapter provides information on the following topics:

- Powering the R100 Series on/off
- LED indicators
- R100 Series Top menu

## Powering the Receiver On/Off

All R100 Series models, except the R131, have a hard power switch located on the top panel, while the R131 has a soft power switch on the front panel (see Figure 3-1).



**Figure 3-1: R100 Series power switch**

The R100 Series 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 C-6 on page 39 provides the power specifications of the R100 Series.

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**⚠ WARNING:** Do not apply a voltage higher than 36 VDC. This will damage the receiver and void the warranty. Also, do not attempt to operate the R100 Series with the fuse bypassed as this will void the warranty.

---

The R100 Series features reverse polarity protection to prevent damage if the power leads are accidentally reversed. Although the R100 Series proceeds through an internal startup sequence when you apply power, it will be ready to communicate immediately.

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

The R100 Series may take up to 5 minutes to receive a full ionospheric map from SBAS. Optimum accuracy is obtained once the R100 Series is processing corrected positions using complete ionospheric information.

To power on the R100 Series:

1. Connect the ends of the R100 Series power cable to a clean power source providing 8 to 36 VDC.

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**Note:** Hemisphere GPS recommends you use a weather-tight connection and connector if the connection is located outside.

---

2. R100 Series (except R131): Press the Power button on the top panel.  
R131: Press and hold the soft power switch on the front panel until the splash screen appears.

To power off the R100 Series:

- R100 Series (except R131): Press the Power button on the top panel.
- R131: Press and hold the soft power switch on the front panel until the screen goes blank (the screen will display “Power Down in 4...3...2...1” before powering off).




## LED Indicators

The R100 Series uses LEDs to indicate power, GPS lock, and DGPS position.

- On all models except the R131 there is a corresponding icon below each LED
- On the R131 the text to the left of each LED indicates the purpose of the LED

Table 3-1 describes each LED indicator.

**Table 3-1: LED indicators**

LED Indicator	LED Color	Description/Function
 or POWER	Red	Power indicator Illuminates solid red when the receiver is powered on.
 or GPS LOCK	Yellow	GPS lock indicator Illuminates solid yellow when the receiver achieves a solid GPS lock.
 or DIFF	Green	DGPS position indicator Illuminates solid green when the receiver achieves a differential position and a pseudorange residual of better than 10.0 m.  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 R100 Series 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.

Refer to Appendix B, “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

The R100 Series front panel contains three soft buttons: Up Arrow, Enter, and Down Arrow (see Figure 3-2).



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

**Figure 3-2: Menu buttons**



---

**Note:** On the R131 the Enter button also functions as the Power switch. See “Powering the Receiver On/Off” on page 16 for more information.

---

Table 3-2 describes the indicators 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. <ul style="list-style-type: none"> <li>Press Enter when "Back" is selected to return to the previous menu.</li> <li>Press Enter when "Top Menu" is selected to return to the Main menu.</li> </ul>	<ol style="list-style-type: none"> <li>On the Main menu press the <b>Down Arrow</b> button to highlight System Setup. The Display indicator appears to the right of System Setup.</li> <li>Press <b>Enter</b> to display the System Setup menu.</li> <li>Press the <b>Down Arrow</b> button again to highlight the Display Format option and then press <b>Enter</b>. 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).</li> <li>Press <b>Enter</b> on the Disp Update item. The Display indicator changes to the Select indicator.</li> <li>Press the <b>Up Arrow</b> or <b>Down Arrow</b> button to scroll through the available options (such as 1Hz and 5Hz).</li> <li>Press <b>Enter</b> 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.</li> </ol>
 Select indicator	Scrolls within a menu to highlight an option to select.	

To return the menu system to the factory default configuration:

- R100 Series (except R131): Press and hold the Enter and Up Arrow buttons and then power up the receiver until the splash screen disappears.
- R131: Press and hold the Enter and Up Arrow buttons until the splash screen disappears (Enter and Power share the same soft switch).





## **Chapter 4: RTK/L-Dif**

Installing the Base Station

Installing the Rover Radio

Using the Receiver as a Base Station or Rover

RTK Operation

RTK and Local Differential (L-Dif) are R100 Series differential options that provide the highest accuracy (see Table C-1 on page 38 for accuracy specifications). A local base station is required for both options. Most commonly, the base station and rover are each comprised of the following:

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

## **Installing the Base Station**

The base station tracks GPS signals and broadcasts differential corrections to a radio and rover GPS 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 adhere to the following:

- Do not place the base station near metal objects
- Make sure the base station is at least 50 m from obstructions
- Make sure the base station and rover radio have a clear line of sight up to 5 km or less depending on the radio type when operating L-Dif/RTK

## **Installing the Rover Radio**

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

When installing the rover radio adhere to the following:





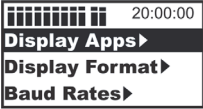



- Ensure the rover radio and GPS antenna are at least 1 m apart
- Rover radio must not block the GPS antenna
- Rover radio must receive regular corrections from the base station every one to two seconds (differential age) for up to 15 minutes to achieve RTK lock (maximum accuracy) - typically, a lock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

## **Using the Receiver as a Base Station or Rover**

Using the R100 Series as a base station or rover receiver requires a link between the base and rover to transfer differential correction data from the base to the 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 R100 Series application is set to RTKBAS for a base station or LOCRTK for a rover.

Step	Button (where applicable)
1. On the Main menu press the <b>Up Arrow</b> or <b>Down Arrow</b> button until System Setup is highlighted.	 
	
2. Press <b>Enter</b> . The System Setup menu appears with Display Apps highlighted.	
	
3. With Display Apps highlighted press <b>Enter</b> . Make sure In Use: displays as either: <ul style="list-style-type: none"><li>• RTKBAS for an RTK or L-Dif base station</li><li>• LOCRTK for an RTK or L-Dif rover receiver</li></ul> 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.	
<div></div> <div></div>	

## 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,RTKBASE,WAAS,1,2 will appear, indicating the RTKBASE application is active and WAAS is the secondary application. If the application was different and WAAS was first, such as \$>JAPP,WAAS,RTKBASE,2,1, then send \$JAPP,other to swap applications so that correct application is used.

Step	Button (where applicable)
1. Connect either Port A or Port B of the R100 Series receiver to the serial port of the PC using the 9-pin serial cable.	
2. Configure the port communication parameters on the receiver. <ol style="list-style-type: none"> <li>On the Main menu press the <b>Up Arrow</b> or <b>Down Arrow</b> button to highlight System Setup and then press <b>Enter</b>.</li> <li>Press the <b>Up Arrow</b> or <b>Down Arrow</b> button to highlight 'Baud Rates' and then press <b>Enter</b>.</li> <li>Press the <b>Up Arrow</b> or <b>Down Arrow</b> button to highlight the desired baud rate and then press <b>Enter</b>.</li> </ol>	Up/Down arrows   Enter 
See "System Setup Menu" on page 35 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 R100 Series 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 Port B of the R100 Series receiver to the serial port of the device using the 9-pin serial cable.	
2. Configure the port communication parameters on the receiver. <ol style="list-style-type: none"> <li>On the Main menu press the <b>Up Arrow</b> or <b>Down Arrow</b> button to highlight System Setup and then press <b>Enter</b>.</li> <li>Press the <b>Up Arrow</b> or <b>Down Arrow</b> button to highlight 'Baud Rates' and then press <b>Enter</b>.</li> <li>Press the <b>Up Arrow</b> or <b>Down Arrow</b> button to highlight the desired baud rate and then press <b>Enter</b>.</li> </ol>	Up/Down arrows   Enter 
See "System Setup Menu" on page 35 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.

Make sure both the rover radio and base station are on the same channel or frequency in order for the rover radio to 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 (see “LED Indicators” on page 17 for more information on R100 Series LED indicators):

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

The R100 Series will output standard NMEA messages through Port A as desired. Set the message and port output as required by the user-supplied interface.



## **Appendix A: Troubleshooting**

Table A-1 provides troubleshooting information for the R100 Series.

**Table A-1: Troubleshooting**

Problem	Possible Solution
Receiver fails to power	<ul style="list-style-type: none"> <li>• Verify polarity of power leads</li> <li>• Check integrity of power cable connections</li> <li>• Check power input voltage (8 - 36 VDC)</li> <li>• Check current restrictions imposed by power source (maximum is 250 mA @ 12 VDC)</li> <li>• Press the Power button</li> </ul>
No data from R100 Series	<ul style="list-style-type: none"> <li>• Check receiver power status (red LED)</li> <li>• Check integrity and connectivity of power and data cable connections</li> <li>• The volume of data requested to be output by the R100 Series could be higher than what the current baud rate supports. Try using 19200 or higher as the baud rate for all devices.</li> </ul>
No GPS lock	<ul style="list-style-type: none"> <li>• Check integrity of cable connections</li> <li>• Verify antenna's clear view of the sky</li> </ul>
No SBAS lock	<ul style="list-style-type: none"> <li>• Check integrity of cable connections</li> <li>• Verify antenna's clear view of the sky</li> <li>• Check SBAS visibility map</li> </ul>
No beacon lock	<ul style="list-style-type: none"> <li>• Check beacon listings to ensure proximity to a beacon station</li> <li>• Ensure there are no sources of interference nearby</li> <li>• Check antenna connections</li> <li>• Verify MSK rate is set correctly</li> <li>• Verify frequency of transmitting beacon</li> <li>• Select alternate antenna position</li> </ul>
No L-band DGPS service lock	<ul style="list-style-type: none"> <li>• Subscription activated and not expired</li> <li>• Check antenna connections</li> <li>• Verify antenna's clear view of the sky</li> </ul>



## **Appendix B: Menu Maps**

GPS Menu

Differential Corrections (Diff) Menu

Configuration Wizard Menu

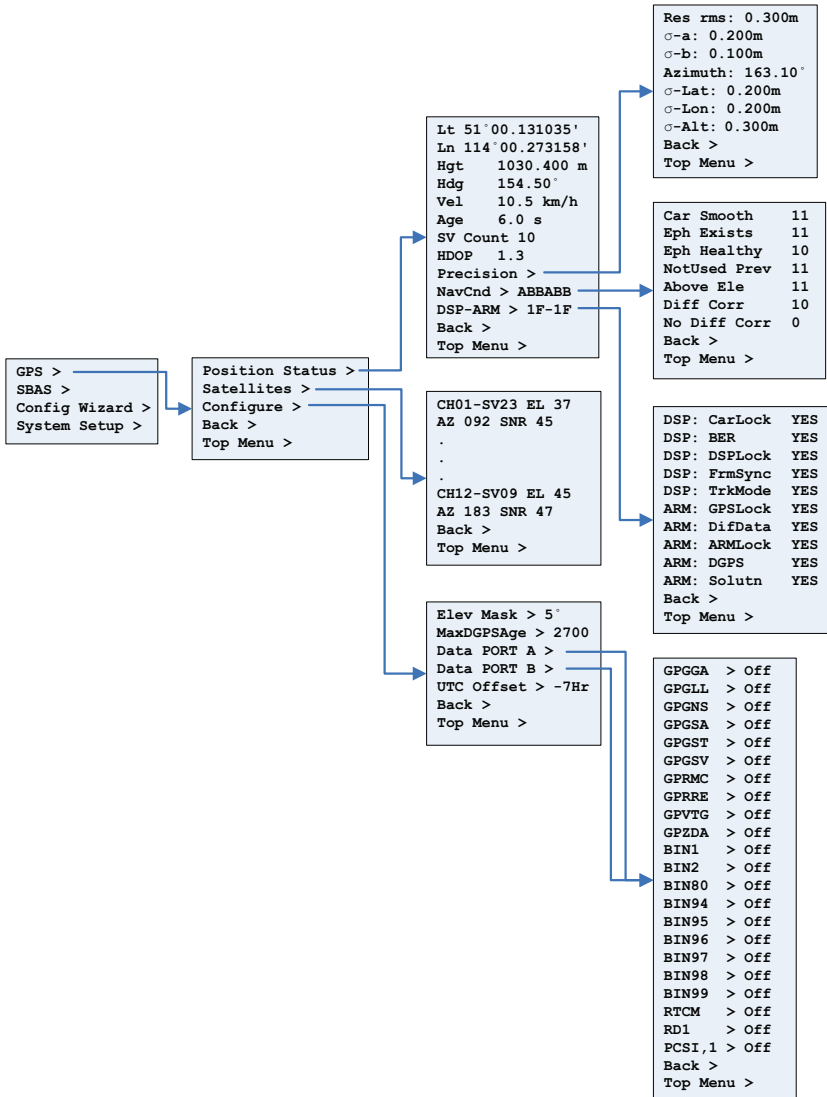
System Setup Menu

This appendix shows the complete menu map for each menu (listed below) on the R100 Series Top menu.

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

## GPS Menu

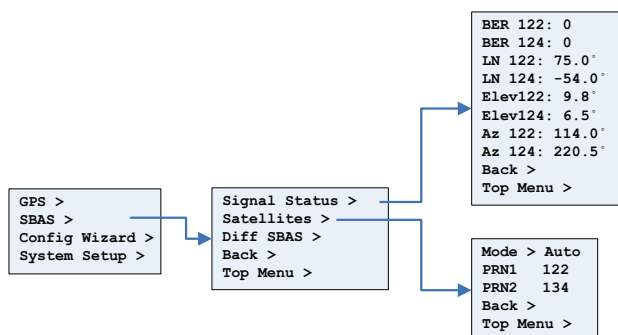
Use the GPS menu to view/edit such settings as data output, positioning parameters, UTC time offset, and satellite visibility/positioning information.



**Figure B-1: GPS menu**

## Differential Corrections (Diff) Menu

Use the Diff (differential) menu to view your differential settings. The name of the differential menu reflects your current differential source. For example, if using SBAS, then SBAS appears as the third menu item on the Top menu and the associated SBAS submenus are available, as shown in Figure B-2.

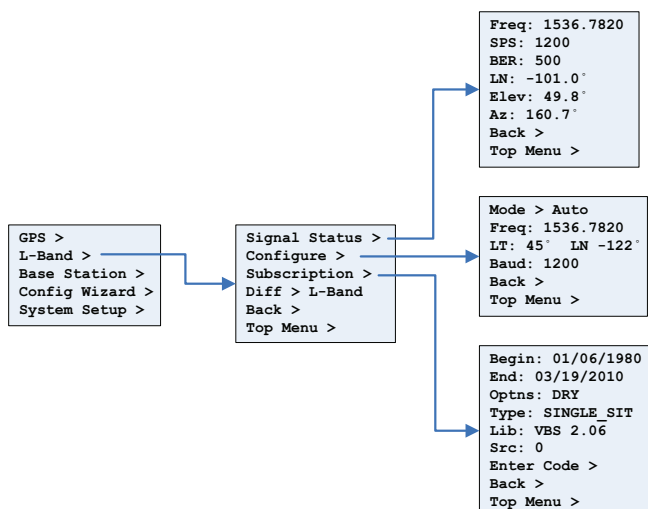


**Figure B-2: SBAS menu**

The following available differential sources depend on the R100 Series model and the configuration you purchased.

- SBAS
- L-Band
- Beacon
- External RTCM
- Autonomous

Figure B-3 through Figure B-6 show the complete menu maps for the L-Band, Beacon, External RTCM, and Autonomous differential sources, respectively.



**Figure B-3: L-Band menu**

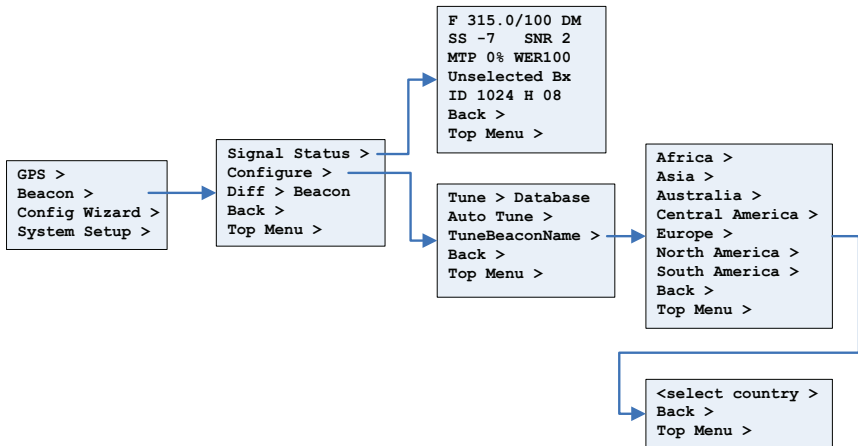


Figure B-4: Beacon menu

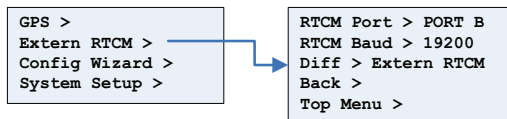


Figure B-5: External RTCM menu

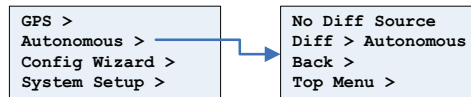
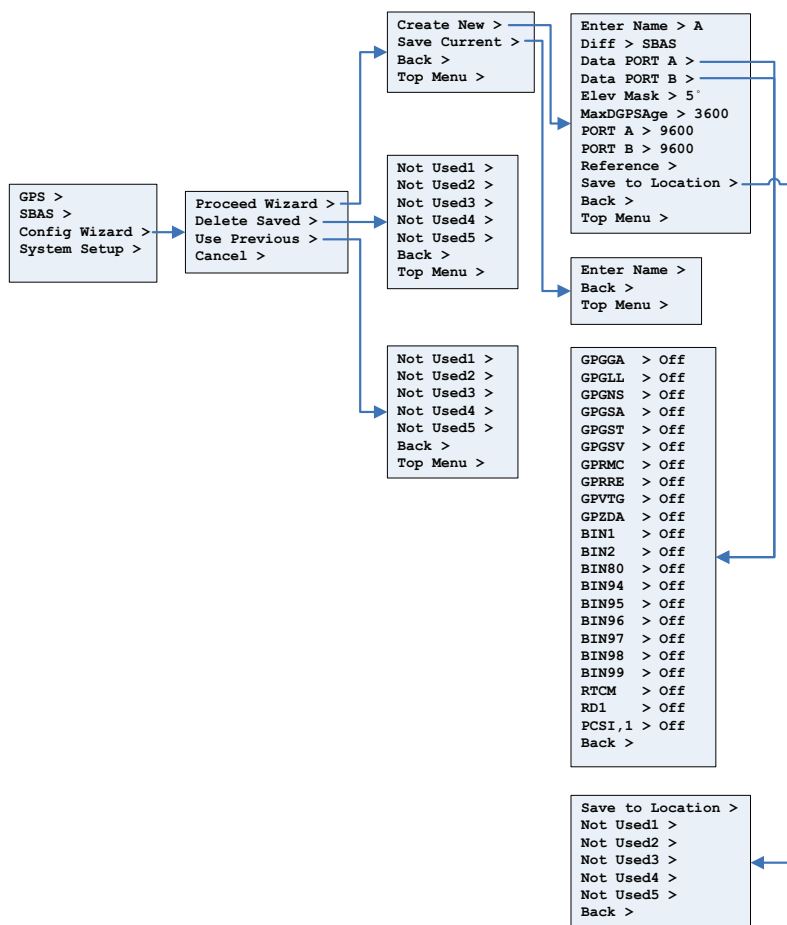


Figure B-6: Autonomous menu

## Configuration Wizard Menu

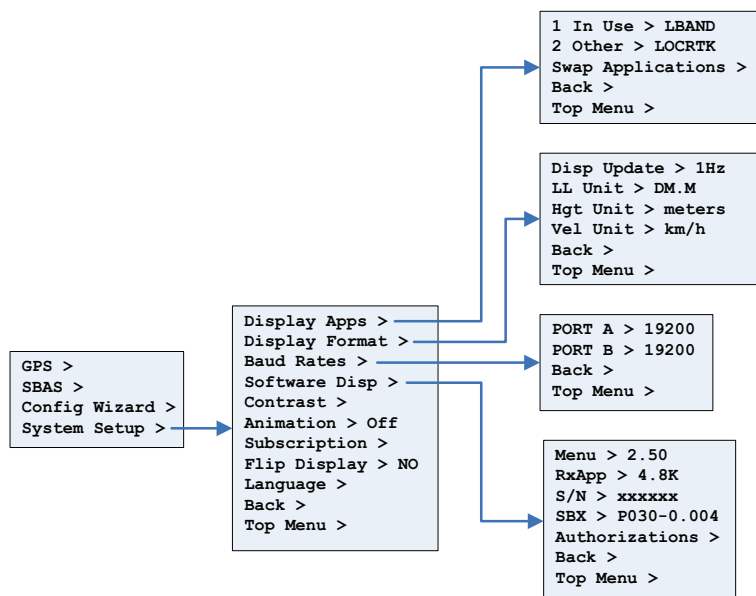
The Configuration Wizard walks you through basic settings to get up and running.



**Figure B-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, screen contrast, subscription code, display orientation (you can flip the display 180° by selecting “YES” under FLIP DISPLAY), and language.



**Figure B-8: System Setup menu**





## **Appendix C: Technical Specifications**

Table C-1 through Table C-7 provide the sensor, communication, environmental, power, and mechanical specifications for the R100 Series.

**Table C-1: R100 Series GPS sensor specifications**

Item	Specification
Receiver type	L1, C/A code, with carrier phase smoothing
Channels	12-channel, parallel tracking (10-channel when tracking SBAS)
SBAS Tracking	2-channel, parallel tracking
Update rate	Standard 10 Hz; optional 20 Hz
Horizontal accuracy	< 0.02 m 95% confidence (RTK <sup>1,2</sup> ) < 0.28 m 95% confidence (L-Dif <sup>1,2</sup> ) < 0.6 m 95% confidence (DGPS <sup>1,3</sup> ) < 2.5 m 95% confidence (autonomous, no SA <sup>1</sup> )
Cold start	60 s (no almanac or RTC)

**Table C-2: L-Band sensor specifications**

Item	Description
Channels	Single channel
Frequency range	1530 to 1560 MHz
Satellite selection	Manual or automatic (based on location)
Startup and satellite reacquisition time	15 seconds, typical

**Table C-3: Beacon sensor specifications**

Item	Description
Channels	2-channel, parallel tracking
Frequency range	283.5 to 325 kHz
MSK bit rates	50, 100, and 200 bps

**Table C-4: Communication specifications**

Item	Description
Serial ports	2 full-duplex RS-232
USB ports	1 USB-B
Baud rates	4800 - 115200
Correction input/output protocol	All R100 Series except R131: RTCM SC-104 R131: Hemisphere GPS RTK, RTCM v2.3 (DGPS)
Data input/output protocol	All R100 Series except R131: NMEA 0183 R131: NMEA 0183, Hemisphere GPS binary
Raw data	All R100 Series except R131: Proprietary binary (RINEX utility available)
Timing output	1 PPS CMOS, active low, falling edge sync, 10 k $\Omega$ , 10 pF load)
Event marker	CMOS, active low, falling edge sync, 10 k $\Omega$

**Table C-5: Environmental specifications**

Item	Specification
Operating temperature	-30°C to +70°C (-22°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95%, non condensing
Shock and vibration	EP 455
EMC	FCC Part 15, Subpart B, CISPR 22, CE

**Table C-6: Power specifications**

Item	Specification
Input voltage	8 - 36 VDC
Reverse polarity protection	Yes
Power consumption	3 W
Current consumption	<250 mA @ 12 VDC
Antenna voltage output	5.0 VDC
Antenna short circuit protection	Yes

**Table C-7: Mechanical specifications**

Item	R100 Series (except R131)	R131
Enclosure	Powder coated aluminum	Powder coated aluminum
Dimensions	16.0 L x 11.4 W x 4.5 H (cm) 6.3 L x 4.5 W x 1.8 H (in)	18.8 L x 11.4 W x 7.1 H (cm) 7.4 L x 4.5 W x 2.8 H (in)
Weight	0.54 kg (1.2 lb)	0.86 kg (1.9 lb)
LED indicators	Power, GPS lock, DGPS position	Power, GPS lock, DGPS position
Power connector	R100,R110,R120: 2-pin metal ODU R101,R121: 8-pin MIL circular R130: 2-pin micro-Conxall	2-pin metal ODU
Data connectors	DB9-female x 2	DB9-female x 2
Antenna connector	TNC-female	TNC-female
1 PPS connector	N/A	SMA

<sup>1</sup>Depends on multipath environment, antenna selection, number of satellites in view, satellite geometry, and ionospheric activity

<sup>2</sup>Up to 5 km baseline length

<sup>3</sup>Depends also on baseline length



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14. **LICENSEE REMEDIES.** In all cases which involve a failure of the Software to conform in any material respect to the documentation during the Warranty Period or a breach of a warranty, Hemisphere's sole obligation and liability, and Licensee's sole and exclusive remedy, is for Hemisphere, at Hemisphere's option, to (a) repair the Software, (b) replace the Software with software conforming to the documentation, or (c) if Hemisphere is unable, on a reasonable commercial basis, to repair the Software or to replace the Software with conforming software within ninety (90) days, to terminate this Agreement and thereafter Licensee shall cease using the Software. Hemisphere will also issue a refund for the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.
15. **LIMITATION OF LIABILITY.** IN NO EVENT WILL HEMISPHERE BE LIABLE TO LICENSEE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES INCLUDING ARISING IN RELATION TO ANY LOSS OF DATA, INCOME, REVENUE, GOODWILL OR ANTICIPATED SAVINGS EVEN IF HEMISPHERE HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH LOSS OR DAMAGE. FURTHER, IN NO EVENT WILL HEMISPHERE'S TOTAL CUMULATIVE LIABILITY HEREUNDER, FROM ALL CAUSES OF ACTION OF ANY KIND, EXCEED THE TOTAL AMOUNT PAID BY LICENSEE TO HEMISPHERE TO PURCHASE THE PRODUCT. THIS LIMITATION AND EXCLUSION APPLIES IRRESPECTIVE OF THE CAUSE OF ACTION, INCLUDING BUT NOT LIMITED TO BREACH OF CONTRACT, NEGLIGENCE, STRICT LIABILITY, TORT, BREACH OF WARRANTY, MISREPRESENTATION OR ANY OTHER LEGAL THEORY AND WILL SURVIVE A FUNDAMENTAL BREACH.
16. **LIMITS ON LIMITATION OF LIABILITY.** Some jurisdictions do not allow for the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply to Licensee and Licensee may also have other legal rights which may vary from jurisdiction to jurisdiction.
17. **BASIS OF BARGAIN.** Licensee agrees and acknowledges that Hemisphere has set its prices and the parties have entered into this Agreement in reliance on the limited warranties, warranty disclaimers and limitations of liability set forth herein, that the same reflect an agreed-to allocation of risk between the parties (including the risk that a remedy may fail of its essential purpose and cause consequential loss), and that the same forms an essential basis of the bargain between the parties. Licensee agrees and acknowledges that Hemisphere would not have been able to sell the Product at the amount charged on an economic basis without such limitations.
18. **PROPRIETARY RIGHTS INDEMNITY.** Hemisphere shall indemnify, defend and hold harmless Licensee from and against any and all actions, claims, demands, proceedings, liabilities, direct damages, judgments, settlements, fines, penalties, costs and expenses, including royalties and attorneys' fees and related costs, in connection with or arising out of any actual infringement of any third party patent, copyright or other intellectual property right by the Software or by its use, in accordance with this Agreement and documentation, PROVIDED THAT: (a) Hemisphere has the right to assume full control over any action, claim, demand or proceeding, (b) Licensee shall promptly notify Hemisphere of any such action, claim, demand, or proceeding, and (c) Licensee shall give Hemisphere such reasonable assistance and tangible material as is reasonably available to Licensee for the defense of the action, claim, demand or proceeding. Licensee shall not settle or compromise any of same for which Hemisphere has agreed to assume responsibility without Hemisphere's prior written consent. Licensee may, at its sole cost and expense, retain separate counsel from the counsel utilized or retained by Hemisphere.
19. **INFRINGEMENT.** If use of the Software may be enjoined due to a claim of infringement by a third party then, at its sole discretion and expense, Hemisphere may do one of the following: (a) negotiate a license or other agreement so that the Product is no longer subject to such a potential claim, (b) modify the Product so that it becomes non-infringing, provided such modification can be accomplished without materially affecting the performance and functionality of the Product, (c) replace the Software, or the Product, with non-infringing software, or product, of equal or better performance and quality, or (d) if none of the foregoing can be done on a commercially reasonable basis, terminate this license and Licensee shall stop using the Product and Hemisphere shall refund the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.

The foregoing sets out the entire liability of Hemisphere and the sole obligations of Hemisphere to Licensee in respect of any claim that the Software or its use infringes any third party rights.
20. **INDEMNIFICATION.** Except in relation to an infringement action, Licensee shall indemnify and hold Hemisphere harmless from any and all claims, damages, losses, liabilities, costs and expenses (including reasonable fees of lawyers and other professionals) arising out of or in connection with Licensee's use of the Product, whether direct or indirect, including without limiting the foregoing, loss of data, loss of profit or business interruption.

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:

**Hemisphere GPS**  
8444 N. 90th Street, Suite 130  
Scottsdale, AZ 85258  
Phone: 480-348-9919 Fax: 480-348-6370  
ground@hemispheregps.com  
www.hemispheregps.com



[www.hemispheregps.com](http://www.hemispheregps.com)