S320 GNSS Survey Receiver

User Guide

Part No. 875-0281-000 Rev C1

Hemisphere GPS

Environmental

Temperature – operating -30C to +65C
Temperature – storage -40C to +85C
Humidity MIL-STD-810F Method 5-7.4
Vibration MIL-STD-810F FIG. 514.5C-1
Loose cargo MIL-STD-810F FIG. 514.5C-5

Regulatory Compliance

CE Compliance

- EN 301 489-1 v1.8.1
- EN 301 489-3 v1.4.1
- EN 301 489-7 v1.3.1

FCC Compliance

- FCC Part 15 Subpart B
- FCC Part 22
- FCC Part 24

IC Compliance

- RSS210
- RSS132 Issue 2
- RSS133 Issue 5

Certifications

- FCC ID: ZC8S320
- IC: 9586A-S320

Contains Bluetooth Module:

- FCC ID: ED9LMX9838
- IC: 1520A-LMX9838

Contains UHF Radio Module:

- If 900MHz
  FCC ID: NS908P24IC: 3143A-08P24
- If 400MHz
  FCC ID: NS909P30IC: 3143A-09P30

WARNING: If your S320 is equipped with a 400 MHz radio you may be required to obtain a valid radio license for your jurisdiction.

Only set the radio to the frequency and power you are licensed to use at your location.

USA- Federal Communication Commission (FCC)

Radiofrequency radiation exposure Information:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

GSM Mode

- *When using the GSM to receive correction data, this equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.*

UHF Radio Mode

- *When using the 900 MHz radio, n920 from Microhard, this equipment should be installed and operated with a minimum distance of 23 cm.*
- *When using the 400 MHz radio, nL400 from Microhard, this equipment should be installed and operated with a minimum distance of 24 cm.*

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Modifications not expressly approved by Hemisphere GPS could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by tuning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the distance between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Caution: Exposure to Radio Frequency Radiation.

This device must not be co-located or operating in conjunction with any other antenna or transmitter.

Canada - Industry Canada (IC)

This device complies with RSS 210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of this device.

L ' utilisation de ce dispositif est autorisée seulement aux conditions suivantes: (1) il ne doit pas produire d'interference et (2) l' utilisateur du dispositif doit étre prêt à accepter toute interference radioélectrique reçu, même si celle-ci est susceptible de compromettre le fonctionnement du dispositif.

Caution: Exposure to Radio Frequency Radiation.

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website http://www.hc-sc.gc.ca/rpb.

Europe – Declaration of Conformity

This device is in compliance with the essential requirements of the R&TTE Directive 1999/5/EC.

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Patents

The Outback S™ and S-Lite™ automated navigation and steering guide systems are 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:

Hemisphere GPS
4110 9th Street S.E.
Calgary, Alberta, Canada T2G 3C4
Phone: 403-259-3311
Fax: 403-259-8866
precision@hemispheregps.com
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

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Chapter 1: Introduction

What's In This Guide?

Product Overview and Features

What's Included

What's In This Guide?

This User Guide provides the following information to get you up and running quickly with your S320™ GNSS Receiver:

- This chapter briefly describes the S320 and the parts in your S320 kit.
- Chapter 2, "Installation" provides a detailed overview of the physical specifications of the S320 and includes such information as attaching the antenna and connecting to a power source.
- Chapter 3, "Setup and Configuration" describes setting up and configuring the S320, performing such basic tasks as using the control panel and swapping and charging the batteries, and GSM functionality regarding NTRIP and SMS.
- Appendix A, "Troubleshooting" provides possible solutions for issues.
- Appendix B, "Technical Specifications" lists the technical specifications of the S320.

Product Overview and Features

The S320 is an integrated GNSS survey and mapping device for mobile data collection providing differential GPS (DGPS) accuracy in a rugged, all-in-one enclosure.

Powered by Hemisphere GPS' powerful dual constellation and dual frequency Eclipse™ II OEM board, the S320 is suitable for GIS, mapping, land surveying, and construction with the following features:

- Can be mounted on a range pole or tripod and carried by a single worker
- Small and lightweight with good pole balance
- Rugged construction
- Hot-swappable batteries
- Data storage
- Fully functional without the need for external cables
- Radio communications

⚠WARNING: If your S320 is equipped with a 400 MHz radio you may be required to obtain a valid radio license for your jurisdiction.

What's Included

The S320 is available as a single unit or two units (base/rover setup). Figure 1-1 shows the parts included in the single unit kit and Table 1-1 lists the parts included in both kits.

Figure 1-1: S320 single unit kit

Table 1-1: S320 parts list

Item	Item	Qty (1 Unit)	Qty (2 Units)	Part Number
A	S320	1	2	804-0079-000 (400 MHz) 804-0090-000 (900 MHz)
B	Antenna bracket (for upward vertical antenna mounting)	1	2	602-1096-000
C	Antenna (model/type depends on region of use)	1	2	150-0021-000 (400 MHz) 150-0022-000 (900 MHz)
D	SD card	1	2	750-1099-000
E	Batteries (rechargeable lithium-ion)	2	4	427-0043-000
F	Power cable, external, 2-pin circular, 3 m (for base station unit)	N/A	1	054-0119-000
G	Battery charger	1	2	427-0044-000
H	Data cable, 9-pin to 9-pin serial, USB connector, and USB receptacle	1	2	051-0258-000
Not shown	Pelican case	1	1	002-0083-000
Not shown	S320 User Guide (this document)	1	1	875-0281-000

Chapter 2: Installation

Ports and Connections

Installing/Connecting the S320

Ports and Connections

All connections and ports are located on the bottom of the unit, as shown in Figure 2-1. Table 2-1 provides additional information about each port/connection.

Figure 2-1: S320 ports and connectors

Table 2-1: S320 ports and connections

Port	What to connect
Data port (ODU 9-pin)	Data cable (Item H in Table 1-1 on page 3)
Power port	External power cable (Item F in Table 1-1 on page 3)
Mounting hole	Pole or tripod mount
Antenna port	External antenna (Item C in Table 1-1 on page 3)
Serial port (DB9 female)	External serial devices

Installing/Connecting the S320

This section describes how to perform the following:

- Attaching the antenna (see below)
- Connecting to a power source (see page 8)
- Setting up the unit (see page 10)

Attaching the Antenna

You can attach the antenna in one of two ways:

- Attaching the antenna directly to the antenna port on the bottom of the unit with the antenna vertical and pointing downward (left photo in Figure 2-2)
- Attaching the antenna bracket to the unit and then attaching the antenna to the port at the end of the bracket with the antenna vertical and pointing upward (right photo in Figure 2-2)

Figure 2-2: Antenna installation options

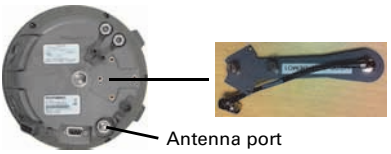
Tip: *The antenna bracket offers an alternative solution in situations where installing the antenna on the bottom of the unit may not provide suitable reception, such as where a small increase in antenna height has a noticeable effect on reception.*

To install the antenna directly into the unit:

1. On the bottom of the unit remove the rubber cap covering the antenna port.
2. Screw the antenna into the antenna port until snug. Do not overtighten.

To install the antenna using the antenna bracket:

1. Align the bracket to fit into the recessed area on the bottom of the unit (as shown at right).
2. Using the two thumbscrews on the bracket secure the bracket to the unit. Do not overtighten.



3. Attach the bracket's antenna cable to the unit's antenna port.
4. Screw the antenna into the bracket's antenna port until snug. Do not overtighten.

Connecting to a Power Source

The S320 power cable has a circular connector (2-pin ODU) at one end and two clamps at the other end (red clamp positive and black clamp negative). Figure 2-3 shows the power port pinout on the S320 and Table 2-2 shows the pin descriptions.

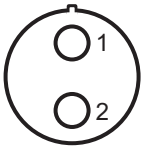


Figure 2-3: Power port pinout assignment

Table 2-2: Power port pinouts

Pin	Description
1	GND
2	VCC

The power supply is a nominal 12 VDC power supply and maximum current consumption is < 1 A at 12 VDC.

Note: The power cable is included with the two-unit base/rover kit; it is not included in the single-unit kit. See Table 1-1 on page 3 for information on the parts in each kit.

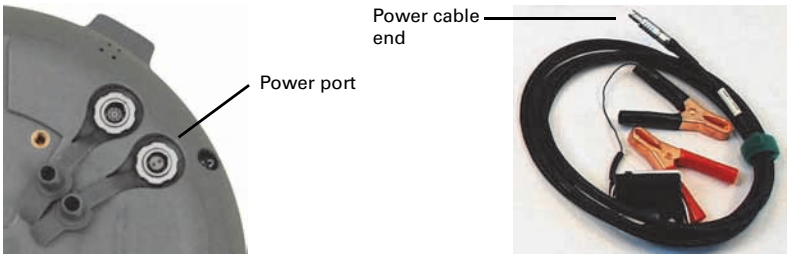


Figure 2-4: Connecting the power cable

Note: Applying external power does not charge the Li-ion batteries in the battery trays. You must use a suitable battery charger to charge the batteries.

To connect the power cable:

- Line up the red dot on the power cable end with the red dot on the power port and press into place.

To disconnect the power cable:

- Slide the cable collar (at the connector end) away from the unit and gently remove the cable.

Connecting to External Devices

You can connect the S320 to external devices via the serial and data ports on the bottom of the unit.

Serial Port Pinout Specifications

Figure 2-5 shows the DB9 serial port (female) pinout, while Table 2-3 shows the serial port pinout specifications.

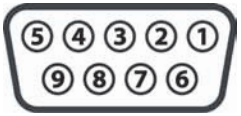


Figure 2-5: Serial port pinout assignment

Table 2-3: Serial port pinouts

Pin	Description
1	Not connected
2	Transmit data port (TXD)
3	Receive data port (RXD)
4	Data terminal ready (DTR)
5	Signal ground (GND)
6	Not connected
7	Request to send (RTS)
8	Not connected
9	Timing output (1 PPS)

Data Port Pinout Specifications

Figure 2-6 shows the data port (ODU 9-pin) pinout, while Table 2-4 shows the data port pinout specifications.

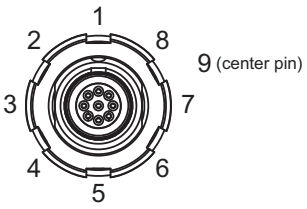


Figure 2-6: Data port pinout assignment

Table 2-4: Data port pinouts

Pin	Description
1	USB host positive
2	USB host VBS
3	Ground
4	Port B receive
5	Port B transmit
6	USB device source
7	USB device negative
8	USB host negative
9	USB device positive

Note: When using the USB device end of the included data cable (Item H in Table 1-1 on page 3) to connect to a USB port on an external device make sure the S320 is already powered on.

To connect the data cable:

- Line up the red dot on the data cable end with the red dot on the data port and press into place.

To disconnect the data cable:

- Slide the cable collar (at the connector end) away from the unit and gently remove the cable.

Setting Up the Unit

Figure 2-7 shows a typical setup for both a base station unit and a rover unit (tripod and pole mount not included, data collector optional).

The antenna in Figure 2-7 is connected to the bottom of the unit; you have the option of attaching the antenna to the antenna bracket so the antenna faces upward. See “Attaching the Antenna” on page 7 for more information on attaching the antenna.

Figure 2-7: Typical base and rover setup

Chapter 3: Setup and Configuration

Control Panel Overview
Powering the S320 On and Off
Modes of Operation
Displaying Current Module Status
Changing Module Status
Tilt Function Control
Alarm/Buzzer
Power and Battery Status/Charge
Replacing/Swapping the Batteries
Removing/Inserting the SD Card / SIM Card
Bluetooth Communication
Upgrading S320 Firmware
GSM Functionality
Restoring Factory Defaults

This chapter describes how to set up and configure the S320 and includes the following sections:

Control Panel Overview

You operate the S320 using the control panel shown in Figure 3-1.

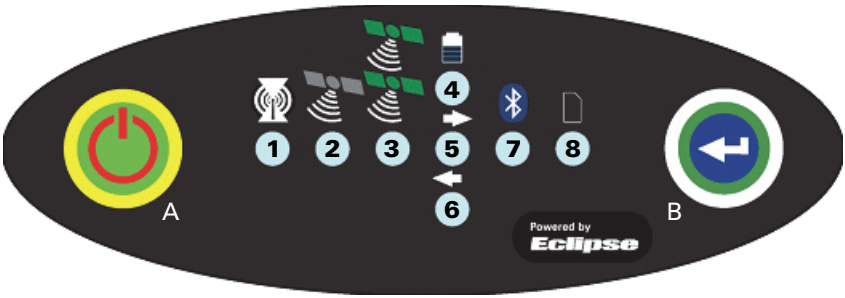


Figure 3-1: S320 control panel

The S320 beeps on any keypress. Table 3-1 describes the each button and LED on the control panel.

Table 3-1: S320 control panel items

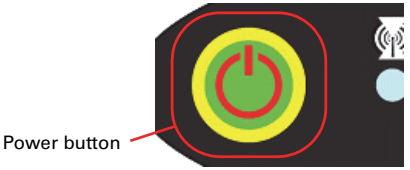
Diagram Item	Name	Description
A	Power button	• If unit is Off, press and hold until unit powers up (until you hear one beep) • If unit is On, press and hold for approximately 3 seconds (until you hear three beeps) to turn unit off

Table 3-1: S320 control panel items (*continued)*

Diagram Item	Name	Description
B	Select button (for Bluetooth/ UHF/GSM/SD modules)	Allows you to review module status or change the status (power on/off) of a module See "Displaying Current Module Status" on page 15 and "Changing Module Status" on page 16 for more information on the Select button.
1	UHF/GSM radio status LED	• Off – UHF radio or GSM module is OFF; or no RTK position computed • On (yellow) – floating point RTK position achieved • On (green) – fixed ambiguity RTK position achieved • Blink (green) – UHF radio or GSM module transmitting/receiving data • Pulse (red) – error condition with UHF radio or GSM module
2	GPS position status LED	• Off – no position • On (yellow) – valid position • Blink (yellow) – operating as a base station and converging on reference coordinates
3	DGPS position status LED	• Off – no differential corrections available • On (green) – differentially corrected position computed
4	External power status LED	• Off – external power not present • On (red) – external power present and in use
5 and 6	Battery status LED	• Off – battery not present • On (green) – battery charge full • On (yellow) – battery charge < 50% • On (red) – battery charge depleted • Blink – battery in use
7	Bluetooth status LED	• Off – Bluetooth inactive • On (blue) – active Bluetooth connection • Blink (blue) - Bluetooth active and transmitting/ receiving data
8	SD logging status LED	• Off – SD card not inserted • On (yellow) – SD card inserted, not logging data • Blink (yellow) - SD card inserted and reading/writing data to SD card • Pulse (yellow) at 5 Hz - SD card inserted and low free space

Powering the S320 On and Off

Use the Power button to power the S320 on and off.



To power on the S320:

- Press and hold the **Power** button until the S320 powers up (until you hear one beep).

To power off the S320:

- Press and hold the **Power** button for 3 seconds (until you hear three beeps).

Note: When you power on the S320 the LEDs go through a 'heartbeat' sequence (each LED lights up in succession); during this time the modules power up and the devices initialize.

Modes of Operation

Table 3-2 lists the modes of operation for the S320.

Table 3-2: S320 modes of operation

Mode Description	Eclipse Software	GSM Mode	UHF Mode	Bluetooth Mode
L-band rover	SBASRTKB	OFF	OFF	ON or OFF
Single point data collection for post processing	SBASRTKB	OFF	OFF	ON or OFF
RTK Base Station	SBASRTKB	OFF	ON	ON or OFF
RTK Rover - UHF	RTK	OFF	ON	ON or OFF
RTK Rover - GSM	RTK	ON	OFF	ON or OFF
RTK Rover - External corrections via Bluetooth	RTK	OFF	OFF	ON (both ports - one monitor, one diff input)
RTK Rover - External serial corrections	RTK	OFF	OFF	ON or OFF

You can quickly review and/or change the GSM, UHF, and Bluetooth states using the Power and Select buttons.

Displaying Current Module Status

The S320 allows you to quickly review the status of each module (UHF/GSM, mode of operation, Bluetooth, and SD card logging).

To display current module status:

- Press the **Select** button.

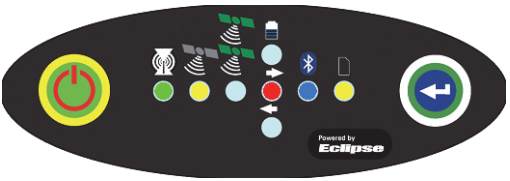
  The external power status LED is red (the unit is displaying its current status) and the LED of each module will be either OFF (LED not illuminated, module powered off) or ON (LED illuminated, module powered on).

Table 3-3 illustrates the colors of the LEDs for each module.

Table 3-3: Module status LED color descriptions

LED	LED Color	S320 Operation
 UHF/GSM	 Off	UHF radio and GSM module both off
	 Green	UHF radio on
	 Yellow	GSM module on
 GPS and DGPS position indicators	 Off (both)	L-band
	 GPS Yellow DGPS None	RTK rover
	 GPS None DGPS Green	RTK base
	 GPS Yellow DGPS Green	e-Dif
 Bluetooth	 Off	Bluetooth off
	 Blue	Bluetooth on
 SD card logging	 Off	SD card logging off
	 Yellow	SD card logging on

For example, in the figure below the UHF radio is on, the unit is in RTK Rover mode, Bluetooth is active, and SD card logging is on.



Changing Module Status

You change module status by using the Select button to select the module and the Power button to change the module status.

To change module status:

1. Press the **Select** button to display the status of all modules (if the LED is on, the module is on; if the LED is off, the module is off).
2. Press the **Select** button again to select the first module (UHF/GSM).

Note: When you press the Select button the LED (for the module status you are changing) remains illuminated for 5 seconds, during which time you can use the Power button to change the module status in step 3.

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3. If you want to change the current module's status, press the **Power** button.

Note: When you press the Power button the LED (for the module status you are changing) blinks 5 times to indicate a status change.

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4. Repeat steps 2 and 3 for each remaining module (if desired).

After a status change, the function of the LEDs return to normal mode.

Tilt Function Control

The S320 includes tilt control functionality that allows you to level your unit using five of the LED indicators. When you activate tilt control you see the changes to the angle of the antenna in real time (similar to a level).

To activate tilt control functionality:

- Press the **Power** button and the **Select** button at the same time. The tilt of the unit is displayed for a period of 1 minute or until you deactivate tilt control functionality.

To deactivate tilt control functionality (return to normal operation):

- Press the **Power** button and the **Select** button at the same time.

When tilt control functionality is activated:

- X-axis tilt is displayed along three horizontal LEDs
- Y-axis tilt is displayed along three vertical LEDs
- Each LED shows a 0.5° tilt (user-configurable)

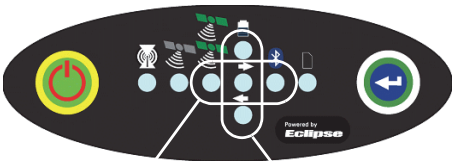


Table 3-4 illustrates the colors of the LEDs depending on the tilt direction of the unit. These LED colors only apply if you have activated tilt control.

Table 3-4: Tilt control LED colors

LED Colors	Meaning
 Middle (right battery) LED is green	Unit is level
  Left LED is green Right LED is green	Unit is off level to the left Unit is off level to the right
  Left LED is green and middle (right battery) LED is red Right LED is green and middle (right battery) LED is red	Unit is off level to the left by more than twice the configurable amount Unit is off level to the right by more than twice the configurable amount
  Top LED is red Bottom LED is red	Unit is tilted backward Unit is tilted forward

Alarm/Buzzer

The S320 beeps under the following conditions:

- Whenever you press a button
- Position is lost
- Differential position is achieved
- Bluetooth device is connected/disconnected
- Low memory for data storage (SD card almost full)
- Both batteries are very low

If an alarm is sounding, you can silence the alarm by pressing the Power button.

Power and Battery Status/Charge

LEDs on the console provide power and battery status/charge information based on the color of the LEDs. For example, Figure 3-2 indicates there is no external power, the right battery is fully charged, and the left battery is not present (not in the unit).

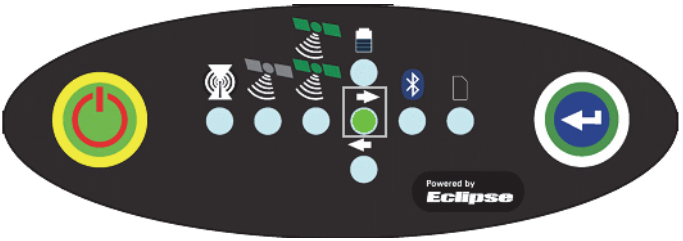


Figure 3-2: No external power, right battery full, left battery not present

Table 3-5 describes what the power/battery LED colors indicate. The S320 prioritizes power usage to use external power when available, regardless of the status of the internal batteries.

Table 3-5: Power/battery LED color descriptions

LED	LED Color	Meaning
Power	Off	No external power
	Red	External power present and in use
Left battery Right battery	Off	Battery not present
	Red	Battery very low or fully discharged (unit will beep when both batteries are very low)
	Yellow	Battery less than 1/2 charged
	Green	Battery fully charged
	Note: A blinking battery light indicates that battery is in use.	

Replacing/Swapping the Batteries

If the S320 is off you can replace both batteries at one time. If you want to keep the unit running while replacing the batteries you must replace them one at a time to ensure the unit is receiving power from at least one battery.

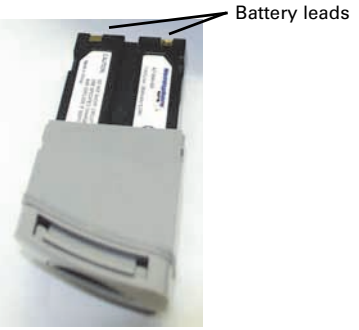
To replace/swap a battery:

1. For the battery you want to replace remove the battery tray by squeezing the thumb lever and pulling.

2. Remove the battery from the tray.

3. Insert the new battery.

Note: When inserting the battery make sure the end with the leads (on top) points away from the tray.



4. Replace the tray, making sure the tray snaps into place.

Removing/Inserting the SD Card / SIM Card

Caution: Use electrostatic discharge (ESD) protection, such as by wearing an ESD strap that is attached to an earth ground, before inserting or removing the SIM card on the S320. If an ESD strap is not available then touch a metal object prior to accessing the SIM card holder.

The SD card and the SIM card are only accessible by first removing the appropriate battery tray, where the:

- Left tray is labeled “SD”
- Right tray is labeled “SIM”

To remove the SD card or SIM card:

1. Remove the appropriate battery tray.
2. Place the S320 upside down (on its top) to get a better view of the card.

3. Gently push the card in; it will then snap back and slightly out.

Note: When you insert either card make sure the contacts on the card are facing the top of the unit and the side of the card with the notch goes in first (see figure in step 2 above).

4. Remove the card.

To insert the SD card or SIM card:

1. Place the card in its appropriate card slot.
2. Gently push the card in until it clicks.
3. Replace the battery tray.

Bluetooth Communication

If you have a Bluetooth-enabled device, such as a data collector, you can wirelessly communicate with the S320.

When you attempt to connect the S320 to a Bluetooth-enabled device, such as a handheld data collector, the following S320 Bluetooth information appears on the device:

`HGPS S320 XXXXXX`

where "`XXXXXX`" is the Eclipse board serial number

To complete the connection you must use the correct PIN/Passkey, which is 0000.

Table 3-6 describes the Bluetooth status LED options.

Table 3-6: Bluetooth LED status

LED Colors	Meaning
 Off	Bluetooth inactive
 Blue	Active Bluetooth connection
 Blue blinking/pulsing	Active Bluetooth connection and transmitting/receiving data

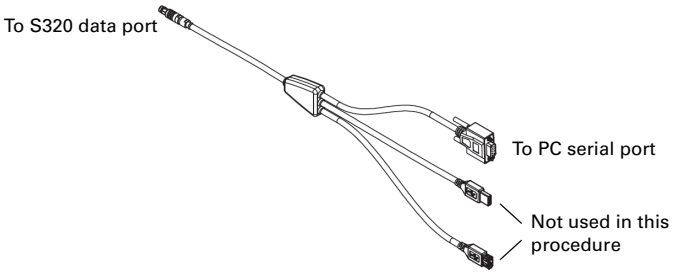
Upgrading S320 Firmware

You can upgrade S320 firmware via serial port or SD card.

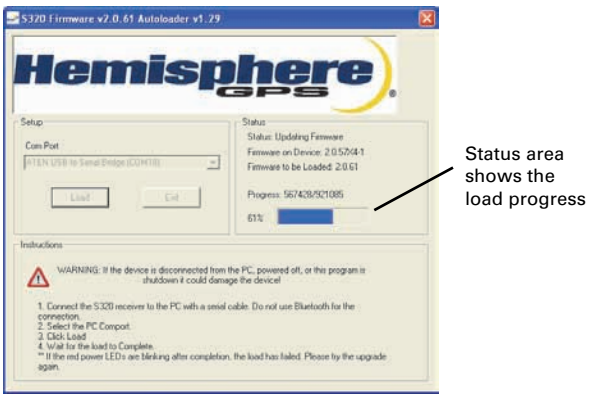
Upgrading S320 Firmware via Serial Port

Before you upgrade verify the S320 is powered off and, if you will not be using external power, both Li-ion batteries are fully charged and inserted into the S320.

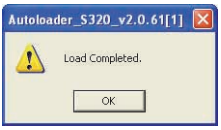
1. Download the Autoloader_S320 executable (.exe file) for the most recent version from the Hemisphere GPS website at www.hemispheregps.com and save it to your PC.
2. Using the data cable included in your S320 kit, connect the DB9 serial port end of the cable to your PC and connect the other end of the cable to the data port on the S320 (see below):



3. Power on the S320.
4. Double-click the Autoloader_S320 file you download in step 1 to start the Autoloader program.
5. In the Com Port drop-down box select the appropriate COM port on your PC and then click **Load**.



The Status area shows the load progress. When loading is complete the following message appears.



6. Click **OK**.
7. In the Autoloader window click **Exit**.

Upgrading S320 Firmware via SD Card

Before you upgrade verify the S320 is powered off and, if you will not be using external power, both Li-ion batteries are fully charged and inserted into the S320.

1. Download the S320_Upgrade.zip file from the Hemisphere GPS website at www.hemispheregps.com and save it to your PC.
2. Unzip the file and extract the contents to the root folder of the SD card, ensuring the same folder structure of the contents on the SD card.
3. Remove the SD card from the PC.
4. If necessary remove the left battery tray from the S320 (the left tray is labeled SD).

5. Insert the SD card into the S320 (see “Removing/Inserting the SD Card / SIM Card” on page 20).
6. Replace the battery tray.
7. Power on the S320.
   a. The LEDs cycle from left to right while the receiver is reading the upgrade file.
   b. After the file has passed all internal verifications, the bottom battery LED illuminates green.
   c. The LEDs cycle from left to right while the file is copied.
   d. All the LEDs flash quickly to indicate the new firmware file is being committed to the receiver.
   e. After committing the new file to internal memory, the LEDs cycle from left to right one more time before resetting the receiver and returning to the heartbeat sequence.

   The upgrade is complete.

GSM Functionality

This section provides advanced GSM information that requires connection to a PC running either Hemisphere GPS' PocketMax utility or a terminal program such as HyperTerminal.

This section covers the following topics:

- GSM overview
- GSM modes
- Configuring GSM for NTRIP
- SMS messaging

GSM Overview

Global System for Mobile Communications (GSM) is a network technology for mobile phone communications. The GSM modem in the S320 is what allows you to connect to a GSM carrier.

The Access Point Name (APN) is a protocol that allows the S320 to access the internet using the mobile phone network. It is a configurable network identifier used when connecting to a GSM carrier. The default APNCFG value is "internet.com". The specific APN required by the S320 depends on your mobile carrier. Check with your mobile provider for details.

GSM Modes

The GSM module operates in four modes:

- IDLE - Default mode for the module. In this state, the GSM module only attempts to register on the network.
- DIRECT IP - For users who have direct access to a server providing differential corrections.
- LINK - For users to establish a link between two S320 modules directly, where the BASE has a dynamic IP address. You should only use this mode on the rover in a base station / rover setup (use IDLE mode for the base station).
- NTRIP - Used to provide differential correction information to the GPS receiver.

Configuring GSM for NTRIP

NTRIP (Networked Transport of RTCM via Internet Protocol) is the protocol for transmitting GNSS data over the internet.

Note: To configure NTRIP you must connect the S320 to a PC running either Hemisphere GPS' PocketMax utility or a terminal program such as HyperTerminal.

To configure NTRIP send the following command:

```
$GSMCFG,NTRIP,[remote host name or IP address],[port number],[mount point name],[[username],[password]]
```

where,

- Remote host name - server name (such as www.igs-ip.net) or an IP address
- Mount point name - caster stream name from NTRIP Caster Source Table (you can download a sample source table from http://www.igs-ip.net:2101/). If you leave this field blank, the S320 will fetch the caster source table and select the mount point closest to its current position.
- User name and password - authentication with a user name and password is required for most NTRIP casters. You can leave both blank to specify that no authentication is required. The user name and password are case sensitive.

For example, to connect to the CALG0 stream on igs-ip.net send the following command:

```
$GSMCFG,NRTIP,www.igs-ip.net,2101,CALG0,Usrnam,passwd
```

Configuring SMS Messaging

The S320 supports Short Message Service (SMS) configuration and event updates for both base and rover operations.

When using SMS messaging keep the following in mind:

- The GSM module must be powered on for SMS commands to work correctly.
- You can send SMS messages to the S320 from up to three numbers and these numbers must be added to the S320 approved numbers list.
- By default the approved numbers list is comprised of the first three entries in the SIM card address book. However, for a typical data-only SIM card, the address book of the SIM card will be empty.
- Use the appropriate country code (the following procedures use the "+1" country code for USA/Canada).

Adding or Overwriting a Number on the Approved Numbers List

You can add a number to an empty slot or overwrite an existing number using the following command:

```
$JSMS,CONFIG,[slot number 1/2/3],[number],[name],[status messages
ON | OFF]
```

For example, to add "Service" (USA phone number 999-555-1212) to slot 1 with status messages OFF (or to replace the current number in slot 1) send the following command:

```
$JSMS,CONFIG,1,+19995551212,Service,OFF
```

The status message state (ON or OFF) allows the S320 to send an SMS message back to the number to report information and events on the operation of the unit.

Displaying the Current List of Approved Numbers

To display the current list of approved numbers send the following command:

```
$JSMS,CONFIG
```

The reply below contains all the information on the configured numbers and may include SIM card address book defaults that you can overwrite with your own information.

```
$>JSMS,CONFIG,1,1,+19995551212,Service,OFF
```

The format of the reply is:

```
$>JSMS,CONFIG,[number of approved numbers],[slot number 1/2/
3],[number],[name],[status messages ON | OFF]
```

Note: The reply contains one line for each number. For example, if there are two approved numbers then the reply will contain a "$>JSMS,CONFIG" line for each number.

Deleting a Number from the Approved Numbers List

To delete a number from the approved numbers list, send the following command:

```
$JSMS,CONFIG,[1/2/3 or keyword ALL],DELETE
```

For example, to delete the number in slot 2 send the following command:

```
$JSMS,CONFIG,2,DELETE
```

And to delete all numbers from the list, send the following command:

```
$JSMS,CONFIG,ALL,DELETE
```

Sending an SMS Message to an Approved Number

To send an SMS message to an approved number, send the following command:

```
$JSMS,SEND,[name or phone number or slot number],[message]
```

For example, to send a "This is a test" message to Customer Support (USA phone number 480-348-9919, slot number 2) you can send any of the following commands:

```
$JSMS,SEND,SERVICE,This is a test
$JSMS,SEND,+14803489919,This is a test
$JSMS,SEND,2,This is a test
```

Restoring Factory Defaults

If you need to restore your factory defaults for any reason you can do this via the Control panel.

To restore factory defaults:

- Press and hold the **Power** button for 10 to 20 seconds and release it while the GPS status and DGPS status LEDs are blinking.

Appendix A: Troubleshooting

Table A-1 provides troubleshooting tips for the S320.

Table A-1: S320 troubleshooting

Issue	Possible Resolution
Receiver fails to power	• External power is low • Check charge on external battery and the fuse on the power cable, if applicable • Internal power: Check charge on internal batteries • Check all power cables and pins • Try other batteries or cables • Make sure to hold the power button down for a minimum of one full second to turn on • Ensure batteries are installed with contacts pointed in the correct direction
No data logged 1. No communication 2. No valid data	• (1) Check receiver power status • (2) Verify it is locked to a valid DGPS signal • (2) Verify that it is locked to 4 or more GPS satellites • (2) Check integrity and connectivity of power and data cable connections • Verify that the baud rate settings match • If trying to connect over Bluetooth, ensure Bluetooth module is powered ON and device is paired prior to opening the port
Random binary data from Eclipse OEM board	• Verify the RCTM or the Bin messages are not being accidentally output (send a $JSHOW command) • Verify the baud rate settings match • Potentially, the volume of data requested to be output could be higher than the current baud rate supports. Try using a higher baud rate for communications.
No GNSS position	• Verify the antenna's view of the sky, especially toward SBAS satellites, south in the northern hemisphere • Verify the bit error rate (BER) and lock status of SBAS satellites (this can often be done on the receiving device or by using SLXMon - monitor BER value) • Verify the proper application is running on the Eclipse (SBASRTKB) • Set the satellite selection to automatic mode $JFREQ,AUTO • Set the differential mode to $JDIFF,WAAS • Ensure there is SBAS coverage in your area
No DGPS position in external RTCM mode	• Verify the baud rate of the RTCM input port matches the baud rate of the external source • Verify the pinout between the RTCM source and the RTCM input port (the "ground" pin and pinout must be connected, and the "transmit" from the source must connect to the "receiver" of the RTCM input port)
Non-DGPS output	• If using RTK, ensure receiver is properly authorized for RTK by sending a $JI command or a $JK command

Appendix B: Technical Specifications

The following tables provide information on the technical specifications of the S320.

Table B-1: GNSS receiver specifications

Item	Specification
Receiver type	Dual frequency GNSS
Channels	All in view L1CA GPS L1P GPS L2P GPS L2C GPS L1 GLONASS L2 GLONASS 3 SBAS or 3 additional L1CA GPS 1 L-band **Note:** Some options may require a subscription.
Positioning modes	RTK, ROX, SBAS, External RTCM, Autonomous, L-band DGPS service, L-band high precision services, L-band high precision service with GLONASS
RTK formats	CMR, CMR+[1], RTCM3
Update rate / recording interval	Selectable from 1, 2, 4, 5, 10 Hz (20 Hz available)
Static performance	Horizontal 5 mm + 0.5 ppm
Cold start time	< 60 s typical (no almanac or RTC)

Table B-2: Performance specifications

Item	Specification
Static performance	Horizontal 5 mm + 0.5 ppm
DGPS performance	< 0.3 m

Table B-3: Horizontal accuracy specifications

Item	Description	
	RMS (67%)	**2DRMS (95%)**
RTK[2,3]	10 mm + 1 ppm	20 mm + 2 ppm
L-band high precision services[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-4: Communication and port specifications

Item	Description
Bluetooth	Dual port

Table B-4: Communication and port specifications

Item	Description
Radio GSM options	Integrated 1 x GSM/GPRS 1 x SS (900 MHz or UHF range: 400 MHz) CDMA capable
Baud rates	4800 - 115200
Serial ports	1 x RS-232 (9-pin circular, multi use) 1 x RS-232 (9-pin DSUB)
Power port	1 x Power input (2-pin circular)
USB	1 USB Host 1 USB Device (9-pin circular)

Table B-5: Environmental specifications

Item	Specification
Operating temperature	-30°C to +65°C (-22°F to +149°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	Up to 100% condensing
Enclosure	IP67
Shock	EP455, 2 m (6.56 ft) pole drop

Table B-6: Power specifications

Item	Specification
Battery	2 x lithium ion, 2.6 Ah each, 5.2 Ah total, 7.2 V
External voltage	9 to 20 VDC
Internal radio power	1 Watt

Table B-7: Mechanical specifications

Item	Description
Dimensions	114 H x 197 D mm (4.49 H x 7.76 D in)
Weight	1.51 kg (3.33 lb)
Material	Plastic

[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 an L-band subscription.

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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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