



Vector H320 OEM Board Integrators Guide

Part No. 875-0312-000 Rev. A1



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- (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
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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.

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Chapter 1: Introduction

- Overview
- What's Included
- H320 Integration
- H320 Features
- Configuring the H320
- NMEA 0183 Message Interface
- Binary Message Interface
- Using PocketMax to Communicate with the H320

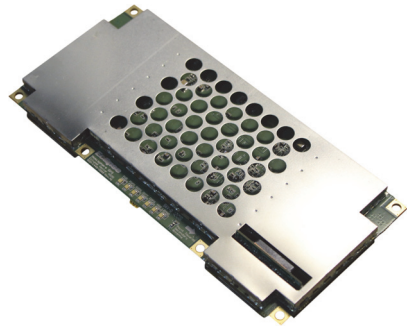
Note: This Integrators Guide does not cover receiver operation, the PocketMax™ utility, or commands and messages (NMEA 0183, NMEA2000® or HGPS proprietary). For information on these subjects refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon).

This chapter provides an overview of the Eclipse™ Vector™ H320™ OEM board and information on board integration and key features of the board.

Note: Throughout the rest of this manual, the Eclipse Vector H320 OEM board is referred to simply as the H320.

Overview

You can use the H320 for any application needing accurate heading or DGPS or RTK positioning. Fitted with Hemisphere GPS' patented Eclipse receiver technology, the H320 computes heading and position using two antennas. This design provides precise heading and GPS sub-meter positioning accuracy while stationary. And with integrated SBAS support, you can receive precision guidance anywhere those services are available.



The H320 provides accurate, reliable heading and position information at high update rates. It does this by using a high performance GNSS engine for signal processing.

The one receiver processes information from both the primary GPS antenna and secondary GPS antenna. Positions computed by the H320 are referenced to the phase center of the primary GPS antenna. Heading data references the vector formed from the primary GPS antenna phase center to the secondary GPS antenna phase center.

What's Included

The H320 is available in two configurations:

- H320 OEM board only - designed for integrators who are familiar with H320 board integration
- H320 OEM board and Universal Development Kit - designed for integrators who are new to H320 board integration

The Universal Development Kit is designed to work with various Hemisphere GPS OEM boards and includes an enclosure with carrier board, adapter boards, and various cables.

For more information on the Universal Development Kit visit www.hemispheregps.com and navigate to the Precision OEM Products page or contact your local dealer.

H320 Integration

Successful integration of the H320 within a system requires electronics expertise that includes:

- Power supply design
- Serial port level translation
- Reasonable radio frequency competency
- An understanding of electromagnetic compatibility
- Circuit design and layout

The Eclipse GPS engine is a low-level module intended for custom integration with the following general integration requirements:

- Regulated power supply input (3.3 VDC \pm 3%) and 490 mA continuous current
- Low-level serial port (3.3 V CMOS) and USB port communications
- Radio frequency (RF) input to the engine from a GPS antenna is required to be actively amplified (10 to 40 dB gain)
- GPS antenna is powered with a separate regulated voltage source up to 15 VDC maximum
- Antenna input impedance is 50 Ω

H320 Features

Features of the H320 include:

- GNSS engine (3 channels dedicated to SBAS tracking)
- 20 mm horizontal accuracy with RTK 95%
- Raw measurement output (via documented binary messages)
- Position and heading update rates of 20 Hz maximum
- Robust RTK with Hemisphere GPS' SureTrack[®] technology
- Long-range RTK baselines up to 50 km
- Fast reacquisition times
- 10 m heading baseline
- COAST[™] technology that provides consistent performance with correction data
- Quick times to first fix
- Four full-duplex serial ports
- Two USB ports (1 USB host and 1 USB device)
- 1 PPS timing output
- Event marker input

Note: For complete specifications of the H320 see Appendix C, "Technical Specifications."

Configuring the H320

The H320 has four communication ports: A, B, C, and D. Ports A, B, and C are fully independent and can have different messages output at different rates. You can configure each of these ports for external correction input or output binary message information or RTCM corrections from an outside source. You can also configure the output of ports A, B, or C through any of these ports. Configure the baud rates if necessary; the default is 19200 for Ports A, B, and C.

Port D is reserved for RTCM differential corrections and may be used by the Hemisphere GPS SBX-4™ board.

Configure the supplementary sensors if necessary. The tilt sensor operates by default and the gyro is disabled but it is recommended that all sensors be turned on once installation is complete.

Configure for your mode of differential operation: SBAS, beacon, or external corrections.

NMEA 0183 Message Interface

The H320 uses a NMEA 0183 interface, allowing you to easily make configuration changes by sending text-type commands to the receiver. For more information on NMEA 0183 commands and messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon).

Binary Message Interface

In addition to the NMEA 0183 interface, the H320 also supports a selection of binary messages. There is a wider array of information available through the binary messages, plus binary messages are inherently more efficient with data. If the application has a requirement for raw measurement data, this information is available only in a binary format. For more information on binary messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon).

Using PocketMax to Communicate with the H320

Hemisphere GPS' PocketMax is a free utility that runs on your PDA or computer and allows you to easily interface with the H320. PocketMax also allows you to:

- Select the internal SBAS or external beacon or RTCM correction sources, if available, and monitor reception
- Configure GPS message output and port settings
- Configure and monitor Vector-related settings
- Record various types of data
- Monitor the H320's status and function

Connect your computer or PDA to the H320 via the COM port and open PocketMax. The menus and tabs within PocketMax allow you to control the H320's settings and monitor its status. PocketMax is available as a free download from the Precision OEM Products Support page of the Hemisphere GPS website at www.hemispheregps.com.



Chapter 2: Board Overview

- Mechanical Layout
 - Connectors
 - Mounting Options
- Header and Pinouts
 - Signals
 - Shielding
- Receiver Mounting
- Thermal Concerns

Mechanical Layout

Figure 2-1 shows the mechanical layout for the H320. Dimensions are in millimeters (inches).

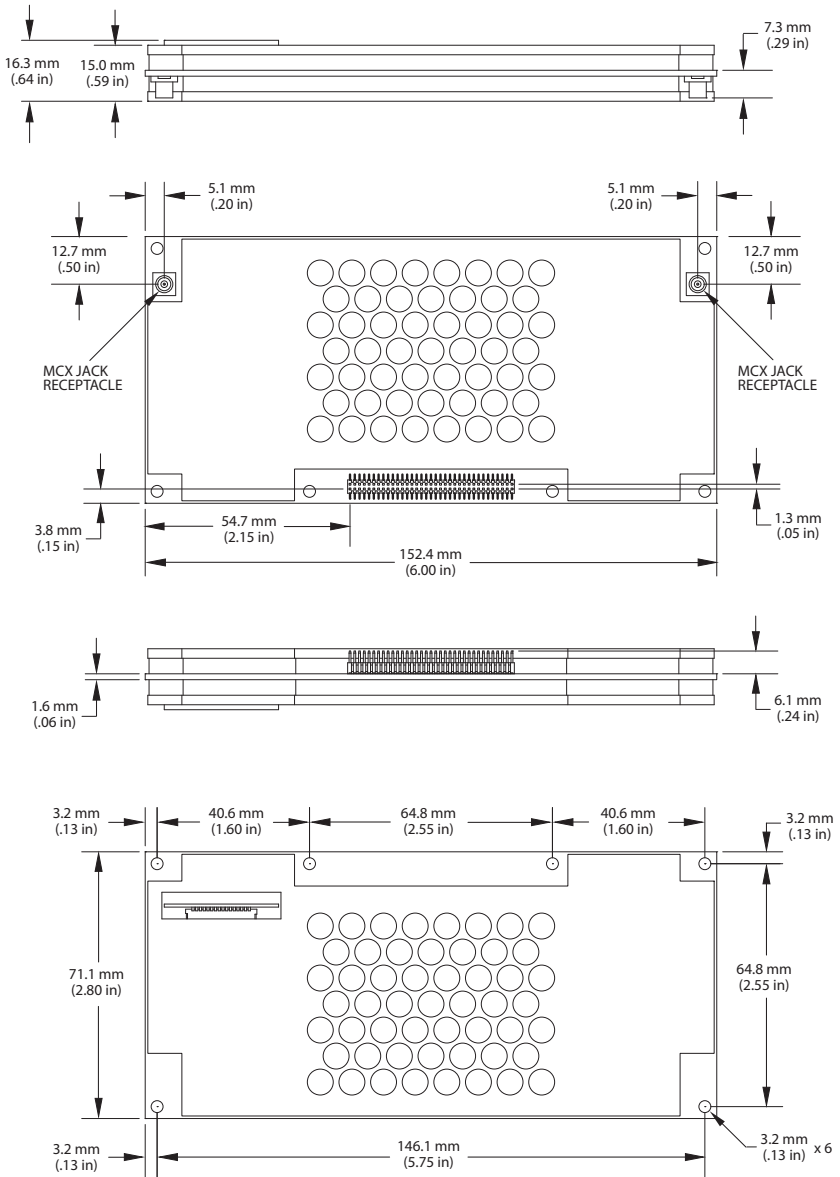


Figure 2-1: H320 mechanical layout

Connectors

Table 2-1 describes the H320's connectors and the mating connectors. You can use different compatible connectors; however, the requirements may be different. The antenna input impedance is 50 Ω .

Table 2-1: H320 connectors

Connector Type	H320 SMT Connector	Mating Connector
RF	MCX, female straight jack Johnson 133-3711-202	MCX, male straight plug Samtec RSP-127824-01
Power/data	70-pin (35x2) male header, 0.05 in (1.27 mm) pitch Samtec FTSH-135-01-L-DV	35x2 female SMT header socket, 0.05 in (1.27 mm) pitch Samtec FLE-135-01-G-DV

Mounting Options

There are two options for mounting the H320:

- Direct Electrical Connection method
- Indirect Electrical Connection (Cable) method

Direct Electrical Connection Method

Place an RF connector, heading connector, and mounting holes on the carrier board and then mount the H320 on the standoffs and RF and header connectors. This method is very cost effective as it does not use cable assemblies to interface the H320.

Note: Be aware of the GPS RF signals present on the carrier board and ensure the correct standoff height to avoid any flexural stresses on the board when you fasten it down.

The H320 uses a standoff height of 7.9 mm (0.3125 in). With this height there should be no washers between either the standoff and the H320 or the standoff and the carrier board; otherwise, you must make accommodations. You may need to change the standoff height if you select a different header connector.

If you want to use a right angle MCX connector, use a taller header than the Samtec part number suggested in this guide. This will provide clearance to have a right angle cable-mount connector and reduce the complexity by not having the carrier board handle the RF signals. See Table 2-1 on page 7 for H320 connector information.

The mounting holes of the H320 have a standard inner diameter of 3.2 mm (0.125 in).

Indirect Electrical Connection (Cable) Method

The second method is to mount the H320 mechanically so you can connect a ribbon power/data cable to the H320. This requires cable assemblies and there is a reliability factor present with cable assemblies in addition to increased expense.

Header and Pinouts

The H320 uses a dual-row header connector to interface with power, communications, and other signals.

To identify the first header pin orient the board so the diamond is to the upper left of the pins; the first pin is on the left directly below the diamond (see Figure 2-2). The pins are then sequentially numbered per row from top to bottom.

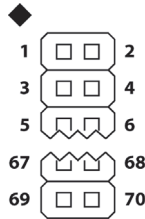


Figure 2-2: H320 header layout

Table 2-2 provides pinout details for the H320 header.

Table 2-2: H320 header pinout descriptions

Pin	Name	Type	Description
1	3.3 V	Power	Receiver power supply, 3.3 V
2	3.3 V	Power	Receiver power supply, 3.3 V
3	3.3 V	Power	Receiver power supply, 3.3 V
4	3.3 V	Power	Receiver power supply, 3.3 V
5	GND	Power	Receiver ground
6	GND	Power	Receiver ground
7	Antenna Pwr	Power	Antenna power, DC, 15 V max
8	Batt Backup	Power	Power, 2.7 to 4.5 V, 500 nA typical
9	n/c	n/c	n/c
10	n/c	n/c	n/c
11	n/c	n/c	n/c
12	Reset	Open collector	Reset, open collector, 3.3 V typical, not required
13	GND	Power	Receiver ground
14	GND	Power	Receiver ground
15	n/c	n/c	n/c
16	USB-DVBS	Input	Device USB bus power monitor
17	Manual Mark	Input	Active low, falling edge, 3.3 V CMOS
18	1 PPS	Output	Active low, falling edge, 3.3 V CMOS
19	Speed Output	Output	0 - 3 V variable clock output

Table 2-2: H320 header pinout descriptions (continued)

Pin	Name	Type	Description
20	Speed Ready	Output	Active low, speed valid indicator, 3.3 V CMOS
21	n/c	n/c	n/c
22	USB-PSW (reserved)	Input	Reserved for possible future USB OTG
23	GND	Power	Receiver ground
24	USB-HVBS	Input	Host USB bus power monitor
25	PATX	Output	Port A serial output, 3.3 V CMOS, idle high
26	PARX	Input	Port A serial input, 3.3 V CMOS, idle high
27	PBTX	Output	Port B serial output, 3.3 V CMOS, idle high
28	PBRX	Input	Port B serial input, 3.3 V CMOS, idle high
29	PCTX	Output	Port C serial output, 3.3 V CMOS, idle high
30	PCRX	Input	Port C serial input, 3.3 V CMOS, idle high
31	PDTX	Output	Port D serial output, 3.3 V CMOS, idle high
32	PDRX	Input	Port D serial input, 3.3 V CMOS, idle high
33	n/c	n/c	n/c
34	n/c	n/c	n/c
35	GND	Power	Receiver ground
36	GND	Power	Receiver ground
37	USB HOST+	I/O	USB host data +
38	USB DEV+	I/O	USB device data +
39	USB HOST-	I/O	USB host data -
40	USB DEV-	I/O	USB device data -
41	GND	Power	Receiver ground
42	n/c	n/c	n/c
43	n/c	n/c	n/c
44	n/c	n/c	n/c
45	n/c	n/c	n/c
46	GND	Power	Receiver ground
47	n/c	n/c	n/c
48	CANRX	Input	CAN, 3.3 V CMOS, receive
49	n/c	n/c	n/c
50	CANTX	Output	CAN, 3.3 V CMOS, transmit
51	GND	Power	Receiver ground
52	n/c	n/c	n/c
53	n/c	n/c	n/c

Table 2-2: H320 header pinout descriptions (continued)

Pin	Name	Type	Description
54	n/c	n/c	n/c
55	n/c	n/c	n/c
56	n/c	n/c	n/c
57	Primary GPS Lock	Output	Status indicator, 3.3 V CMOS, active low
58	Secondary GPS Lock	Output	Status indicator, 3.3 V CMOS, active low
59	Diff Lock	Output	Status indicator, 3.3 V CMOS, active low
60	n/c	n/c	n/c
61	DGPS Lock	Output	Status indicator, 3.3 V CMOS, active low
62	Heading Lock	Output	Status indicator, 3.3 V CMOS, active low
63	GND	Power	Receiver ground
64	GND	Power	Receiver ground
65	Analog GND	Power	Receiver ground
66	n/c	n/c	n/c
67	n/c	n/c	n/c
68	Analog GND	Power	Receiver ground
69	Analog GND	Power	Receiver ground
70	n/c	n/c	n/c
Note: <ul style="list-style-type: none"> • Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted. • Leave any data or I/O pins that will not be used unconnected. 			

Signals

This section provides information on the signals available via connectors.

RF Input

The H320 is designed to work with active GPS antennas with an LNA gain range of 10 to 40 dB. The purpose of the range is to accommodate for losses in the cable system. Essentially, there is a maximum cable loss budget of 30 dB for a 40 dB gain antenna. Depending on the chosen antenna, the loss budget will likely be lower (a 24 dB gain antenna would have a 14 dB loss budget).

When designing the internal and external cable assemblies and choosing the RF connectors, do not exceed the loss budget; otherwise, you will compromise the tracking performance of the H320.

Serial Ports

The H320 has four serial communication ports:

- Port A, Port B, Port C - main ports
- Port D - Exclusively used to interface with Hemisphere GPS' SBX-4 beacon board or an external corrections source. This port will not output normal GPS-related NMEA messages. When communicating into either Port A, B, or C, a virtual connection may be established to the device on Port D using the \$JCONN command. See "Communication Port D" below for more information on Port D.

The H320 serial ports' 3.3 V CMOS signal level can be translated to interface with other devices. For example, if serial Ports A, B, and/or C are used to communicate to external devices such as PCs, you must translate the signal level from 3.3 V CMOS to RS-232.

Communication Port D

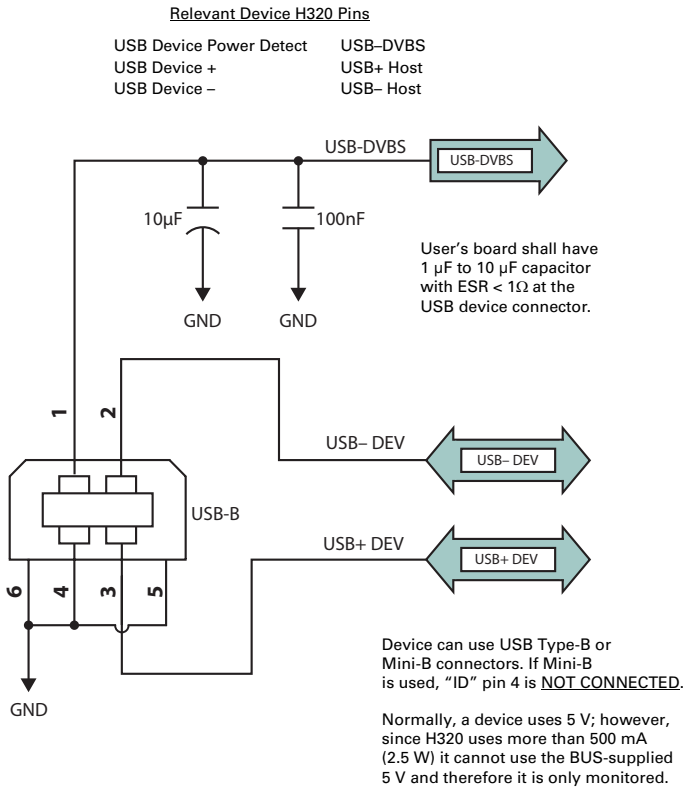
Port D is exclusively for external DGPS correction input to the H320, such as from Hemisphere GPS' SBX-4 beacon board.

USB Ports

The H320 has one USB device port and one USB host port, where:

- USB Device port (data communication) shown in Figure 2-3 on page 13 serves as a high speed data communications port, such as for a PC
- USB Host port (data storage) shown in Figure 2-4 on page 14 serves as a data storage port, such as with a USB flash drive

The USB data lines are bi-directional and are differential pairs. The USB data lines should be laid out on printed wire board (PWB) with $90 \Omega \pm 15\%$ differential impedance. The traces should be over a solid continuous ground plane. Maintain parallel traces and symmetry. There shall be no traces or breaks in the ground plane underneath the D+ and D- traces. It is also recommended to leave a minimum 20 mil spacing between USB signals and other signals. Treat the data lines as if they are RF signals.



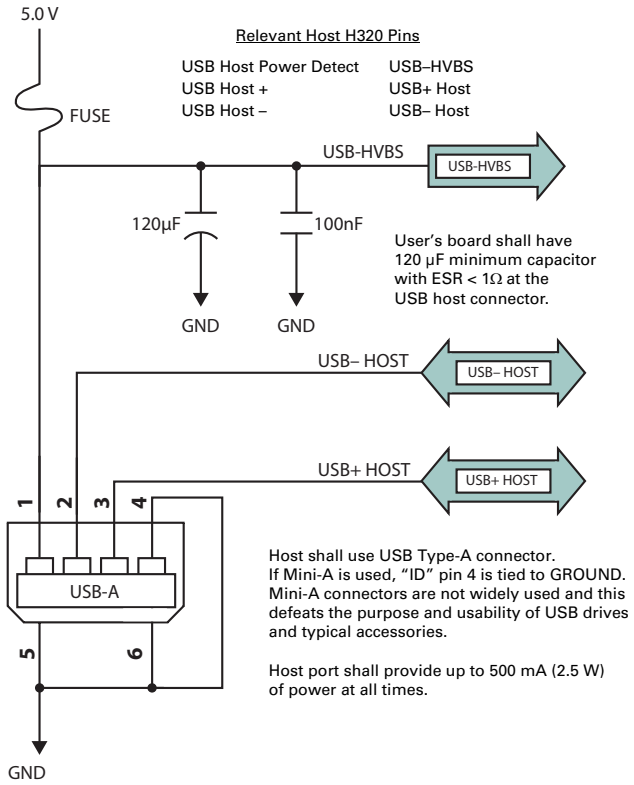


Figure 2-4: H320 USB host design example

LED Indicators

The H320 features the following surface-mounted diagnostic LEDs that indicate board status (see Figure 2-5):

- PWR - Power
- PGPS - Primary GPS lock
- SGPS - Secondary GPS lock
- DIFF - Differential lock
- DGPS - DGPS position
- HDG - Heading lock
- L-BAND - L-band lock



Figure 2-5: Onboard LEDs

With the exception of the power LED the signals that drive the LEDs are available via the header connector. Refer to Table 2-2 on page 9 for pin number descriptions for the H320.

Note: Each signal pin can offer only 1 mA of current and is active low. Since 1 mA of current may be inadequate for the application, you may want to transistor-buffer these signals to provide more current capacity for acceptable LED luminance.

1PPS Timing Signal

The one pulse per second (1 PPS) timing signal is used in applications where devices require time synchronization.

Note: 1 PPS is typical of most GPS boards but not essential to normal receiver operation. Do not connect this pin if you do not need this function.

The 1 PPS signal is 3.3 V CMOS, active low with falling edge synchronization. The 1 PPS signal is capable of driving a load impedance greater than 10 k Ω in parallel with 10 pF. The pulse is approximately 1 ms.

Event Marker Input

A GPS solution may need to be forced at a particular instance, not synchronized with GPS time depending on the application, such as indicating to the GPS receiver when a photo is taken from a camera used for aerial photography.

Note: Event marker input is typical of most GPS boards but not essential to normal receiver operation. Do not connect this pin if you do not need this function.

The event marker input is 3.3 V CMOS, active low with falling edge synchronization. The input impedance and capacitance is higher than 10 k Ω and 10 pF, respectively, with a threshold of lower than 0.7 V required to recognize the input.

Grounds

You must connect all grounds together when connecting the ground pins of the H320. These are not separate analog and digital grounds that require separate attention. Refer to Table 2-2 on page 9 for pinout ground information for the H320.

Speed Radar Output

Note: Speed radar output is not essential to normal receiver operation. Do not connect these pins if you do not need this function.

The following two pins on the H320 relate to the Speed Radar.

- Speed Radar Pulse (pin 19) - Outputs a square wave with 50% duty cycle. The frequency of the square wave varies directly with speed. 97 Hz represents a speed of 1 m/s (3.28 ft/s).
- Speed Radar Ready Signal (pin 20) - Indicates when the speed signal on the 'Speed Radar Pulse' pin is valid. In static situations, such as when the vehicle has stopped, the GPS position may still have slight variations from one moment to the next. During these instances, the signal on the 'Speed Radar Ready Signal' pin is 'high' or +Vcc, indicating the speed coming out of the 'Speed Radar Pulse' pin is erroneous and not truly indicative of the GPS receiver's actual speed. **Therefore, it should not be referred to or be used.** Once the vehicle starts moving again and meets a minimum threshold speed, the output on the 'Speed Radar Ready Signal' pin will go 'low' indicating valid speed information is present on the 'Speed Radar Pulse' pin.

Note: Neither pin 19 nor 20 has any form of isolation or surge protection. If utilizing the Speed Radar Pulse output, Hemisphere GPS strongly recommends incorporating some form of isolation circuitry into the supporting hardware. Contact Hemisphere GPS Technical Support for an example of an optically isolated circuit.

Shielding

The H320 is a sensitive instrument. When integrated into an enclosure, the H320 requires shielding from other electronics to ensure optimal operation. The H320 shield design consists of a thin piece of metal with specific diameter holes, preventing harmful interference from penetrating, while still allowing air circulation for cooling.

Receiver Mounting

The H320 is a precision instrument. To ensure optimal operation, consider mounting the receiver in a way to minimize vibration and shock.

When mounting the H320 immediately adjacent to the GPS antenna, Hemisphere GPS highly recommends shielding the board from the LNA of the antenna. This step can be more complex than some integrators initially estimate. Attempt to confirm the operation in your application as early in the project as possible.

Thermal Concerns

The H320 receiver consumes a few watts of power, which ultimately will generate heat. Since this may raise the ambient temperature inside an enclosure consider managing the heat inside the enclosure to ensure the internal temperature does not exceed the maximum operating temperature for the H320. Some suggestions for heat management are heat sinks, heat conductive foam, or using a small cooling fan possibly using a thermal switch. Air moving over the H320 removes heat very effectively.

Note: Thermal design may only be a concern if the integrated product's maximum design temperature is expected to be close to that of the H320.



Chapter 3: Operation

Powering the H320

Communicating with the H320

Configuring the H320

Firmware

Configuring the Data Message Output

Saving the H320 Configuration

Using Port D for RTCM Input

Configuration Defaults

This chapter provides H320 operation information, such as communicating with the H320, firmware, and configuration defaults.

Note: Install your antenna outdoors so it has a clear view of the entire sky. If you place the antenna indoors near a window, for example, you will likely not track a sufficient number of satellites. With a properly installed antenna the H320 provides a position within approximately 60 sec.

Powering the H320

The H320 is powered by a 3.3 VDC power source. Once you connect appropriate power the H320 is active. Although the H320 proceeds through an internal startup sequence upon application of power, it is ready to communicate immediately.

Communicating with the H320

The H320 features three primary serial ports (Port A, Port B, Port C) that you can configure independently from each other. You can configure the ports for any combination of NMEA 0183, binary, and RTCM SC-104 data. The usual data output is limited to NMEA data messages as these are industry standard.

Note: You may use the three serial ports to separate the different data types and output different rates. If the H320 is required to output different data types simultaneously, ensure data logging and the processing software used can correctly parse the different data from a single stream.

Configuring the H320

You can configure all aspects of H320 operation through any serial port using proprietary commands. These commands are described in detail in the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon).

You can configure the following:

- Select one of the two firmware applications
- Set communication port baud rates
- Select which messages to output on the serial ports and the update rate of each message
- Set various receiver operating parameters

For a complete lists of commands and messages refer to the Hemisphere GPS Technical Reference.

To issue commands to the H320 you will need to connect it to a terminal program such as HyperTerminal or either of Hemisphere GPS' software applications (SLXMon or PocketMax). See "What is the best software tool to use to communicate with the H320 and configure it?" on page 28 for descriptions of HyperTerminal, SLXMon, and PocketMax.

Firmware

The software that runs the H320 is often referred to as firmware since it operates at a low level. You can upgrade the firmware in the field through any serial port as new versions become available.

You can have two firmware applications loaded on the receiver; however, you can only operate one at a time.

The H320 currently ships with the rover RTK application and the base RTK/SBAS application. Refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon) for information on the \$JAPP command, which you use to change between the two H320 applications.

Configuring the Data Message Output

The H320 features three primary bi-directional ports (Ports A, B and C) and a differential-only port (Port D). You can configure messages for all ports by sending proprietary commands to the H320 through any port. For a complete list of commands and messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon).

'THIS' Port and the 'OTHER' Port

Both Port A and Port B use the phrases "THIS" and "OTHER" when referring to themselves and each other in NMEA messages.

'THIS' port is the port you are currently connected to for inputting commands. To output data through the same port ('THIS' port) you do not need to specify 'THIS' port. For example, when using Port A to request the GPGGA data message be output at 5 Hz on the same port (Port A), issue the following command:

```
$JASC,GPGGA,5<CR><LF>
```

The 'OTHER' port is either Port A or Port B, whichever one you are not using to issue commands. If you are using Port A to issue commands, then Port B is the 'OTHER' port, and vice versa. To specify the 'OTHER' port for the data output you need to include 'OTHER' in the command. For example, if you use Port A to request the GPGGA data message be output at 5 Hz on Port B, issue the following command:

```
$JASC,GPGGA,5,OTHER<CR><LF>
```

When using Port A or Port B to request message be output on Port C, you must specifically indicate (by name) you want the output on Port C. For example, if you use Port A to request the GPGLL data message be output at 10 Hz on Port C, issue the following command:

```
$JASC,GPGLL,10,PORTC<CR><LF>
```

Saving the H320 Configuration

Each time you change the H320's configuration you may want to save it so you do not have to reconfigure the receiver each time you power it on. To save the configuration, issue the \$JSAVE command to the Eclipse using a terminal program such as HyperTerminal or either of Hemisphere GPS' applications (SLXMon or PocketMax). The H320 will take approximately five seconds to save the configuration to non-volatile memory and will indicate when the configuration has been saved. Refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon) for more information on the \$JSAVE command.

Using Port D for RTCM Input

Port D has been optimized to interface with Hemisphere GPS' SBX-4 beacon board and operates at 9600 baud (8 data bits, no parity and 1 stop bit – 8-N-1).

To configure the H320 to use Port D, issue the following command:

```
$JDIFF, BEACON<CR><LF>
```

To return to using SBAS as the correction source, send the following command to the H320:

```
$JDIFF, WAAS<CR><LF>
```

For a complete list of commands and messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon).

Configuration Defaults

Below is the standard configuration for the H320. For more information on these commands refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon).

```
$JOFF, PORTA
$JOFF, PORTB
$JOFF, PORTD
```

```
$JAGE, 2700
$JLIMIT, 10
$JMASK, 5
$JNP, 5
$JWAASPRN, AUTO
$JDIFF, WAAS
$JPOS, 51.0, -114.0
$JSMOOTH, LONG
$JTAU, COG, 0.00
$JTAU, SPEED, 0.00
$JAIR, AUTO
$JALT, NEVER
```

```
$JATT, HTAU, 0.1
$JATT, HRTAU, 2.0
$JATT, COGTAU, 0.0
$JATT, MSEP, 1.0
$JATT, GYROAID, YES
$JATT, TILTAID, YES
$JATT, LEVEL, NO
$JATT, EXACT, NO
$JATT, HIGHMP, YES
$JATT, FLIPBRD, NO
$JATT, HBIAS, 0.0
$JATT, NEG TILT, NO
$JATT, NMEAHE, 0
$JATT, PBIAS, 0.0
$JATT, PTAU, 0.5
$JATT, ROLL, NO
$JATT, SPDTAU, 0.0
```

```
$JBAUD, 19200, PORTA
$JASC, GPGGA, 1, PORTA
$JASC, GPHTD, 10, PORTA
$JASC, GPROT, 10, PORTA
$JASC, GP HPR, 1, PORTA
```

```
$JBAUD, 19200, PORTB
$JASC, GPGGA, 1, PORTB
$JASC, GPHTD, 10, PORTB
$JASC, GPROT, 10, PORTB
$JASC, GP HPR, 1, PORTB
```

```
$JSAVE
```




Appendix A: Frequently Asked Questions

Integration
Power, Communication, and Configuration
GPS Reception and Performance
SBAS Reception and Performance
External Corrections
Installation
Support and Repair

Integration

Do I need to use the 1 PPS and event marker?

No, these are not necessary for H320 operation.

What should I do with the 1 PPS signal if I do not want to use it?

This signal will be strobing at 1 Hz, so it should not be connected.

What should I do with the manual mark input if I am not going to use it?

Do not connect the pin because this signal is active low.

Do I need to use the lock indicators?

No, these are present for applications where it is desirable to have an LED visible to the user. These signals need to be transistor-buffered, as these lines can only offer 1 mA. Depending on the product and the application, LEDs can be very useful to the end user. These signals are active low.

Do I need to use a shield-can for the H320?

Not necessarily...but you may need to if there are RF interference issues, such as if the H320 interferes with other devices. A shield-can would be a good start in terms of investigating the benefit. If you are designing a smart antenna system, one is likely needed. Hemisphere GPS recommends that you always conduct an RF prescan when integrating OEM boards.

If my company wishes to integrate this product, what type of engineering resources will I need to do this successfully?

Hemisphere GPS recommends you have sufficient engineering resources with the appropriate skills in and understanding of the following:

- Electronic design (including power supplies and level translation)
- RF implications of working with GPS equipment
- Circuit design and layout
- Mechanical design and layout

What type of assistance can I expect from Hemisphere GPS when integrating the H320?

Integration of a GPS board has such benefits as:

- Lower system cost
- Improved branding (rather than relabeling an existing product)
- Better control of system design

As an integrator, you are responsible for ensuring that the correct resources are in place to technically complete the integration. Hemisphere GPS will provide reasonable assistance; however, Hemisphere GPS does not have dedicated engineering resources for in-depth integration support. Hemisphere GPS will do its best to provide support as necessary, but you should expect to have reasonable expertise to use this Integrators Guide.

Power, Communication, and Configuration

My H320 system does not appear to be communicating. What do I do?

This could be one of a few issues:

- Examine the H320 cables and connectors for signs of damage or offset.
- Ensure the H320 system is properly powered with the correct voltage.
- Ensure there is a good connection to the power supply since it is required to terminate the power input with the connector.
- Check the documentation of the receiving device, if not a PC, to ensure the transmit line from the H320 is connected to the receive line of the other device. Also, ensure the signal grounds are connected.
- If the H320 is connected to a custom or special device, ensure the serial connection to it does not have any incompatible signal lines present that prevent proper communication.
- Make sure the baud rate of the H320 matches the other device. The other device must also support an 8 data bit, 1 stop bit, no parity port configuration (8-N-1). Some devices support different settings that may be user configurable. Ensure the settings match.
- Consult the troubleshooting section of the other device's documentation to determine if there may be a problem with the equipment.

Am I able to configure two serial ports with different baud rates?

Yes, all the ports are independent. For example, you may set one port to 4800 and another port to 19200.

Am I able to have the H320 output different NMEA messages through multiple ports?

Yes, different NMEA messages can be sent to the serial ports you choose. These NMEA messages may also be at different update rates.

A high enough baud rate is needed to transmit all the data; otherwise, some data may not be transmitted.

How can I determine the current configuration of the H320?

The \$JSHOW command will request the configuration information from the H320. The response will be similar to:

```
$>JSHOW,BAUD,19200
$>JSHOW,BIN,1,5.0
$>JSHOW,BAUD,4800,OTHER
$>JSHOW,ASC,GPGGA,1.0,OTHER
$>JSHOW,ASC,GPVTG,1.0,OTHER
$>JSHOW,ASC,GPGSA,1.0,OTHER
```

How can I be sure the configuration will be saved for the subsequent power cycle?

Query the receiver to make sure the current configuration is correct by issuing a \$JSHOW command. If not, make the necessary changes and reissue the \$JSHOW command. Once the current configuration is acceptable, issue a \$JSAVE command and wait for the receiver to indicate the save is complete. Do not power off the receiver until the "save complete" message appears.

How do I change the baud rate of a port from that port?

Connect at the current baud rate of the H320 port and then issue a \$JBAUD command to change the port baud rate to the desired rate. Now change the baud rate in your application to the desired rate.

What is the best software tool to use to communicate with the H320 and configure it?

Hemisphere GPS uses three different software applications:

- HyperTerminal™ - Available on all Windows® 95, 98, ME, and XP. This tool allows you to configure the H320 by directly typing commands into the terminal window. The output from the H320 is simultaneously shown. When using HyperTerminal, ensure it is configured to use the correct PC communication port and baud rate, and that the local echo feature is on (to see what is being typed).
- SLXMon - Available at www.hemispheregps.com. This application is a very useful tool for graphically viewing tracking performance and position accuracy, and for recording data. It can also configure message output and port settings. SLXMon runs on Windows 95 or higher.
- PocketMax - Available at www.hemispheregps.com. Similar to SLXMon, you can use this application to graphically view tracking performance and position accuracy, record data, and configure message output and port settings. PocketMax runs on multiple Windows platforms using the Windows .NET framework.

GPS Reception and Performance

How do I know what the H320 is doing?

The H320 supports standard NMEA data messages. The \$GPGSV and Bin99 data messages contain satellite tracking and SNR information. If available, the computed position is contained in the \$GPGGA message. Additionally, the H320 has surface-mounted status LEDs that indicate receiver status.

Do I have to be careful when using the H320 to ensure it tracks properly?

For best performance, the H320's antenna must have a clear view of the sky for satellite tracking. The H320 can tolerate a certain amount of signal blockage because redundant satellites are often available. Only four satellites are required for a position; however, the more satellites that are used, the greater the positioning accuracy.

SBAS Reception and Performance

How do I know if the H320 has acquired an SBAS signal?

The H320 outputs the \$RD1 message that contains the SBAS bit error rate (BER) for each SBAS channel. The BER value describes the rate of errors received from SBAS. Ideally, this should be zero. However, the H320 performs well up to 150 BER. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.

How do I know if the H320 is offering a differentially-corrected or RTK-corrected position?

The H320 outputs the \$GPGGA message as the main positioning data message. This message contains a quality fix value that describes the GPS status. If this value is 2, the position is differentially corrected; if this value is 5, the position is RTK-corrected. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.

How do I select an SBAS satellite?

By default the H320 will automatically attempt to track the appropriate SBAS satellites. If multiple satellites are available, the one with the lowest BER value is selected to be used to decode the corrections.

You can manually select which SBAS satellites to track (refer to the Hemisphere GPS Technical Reference—go to www.hemispheregps.com/support and click the GPS Reference icon—for more information); however, this is not recommended.

Should I be concerned if the H320 is frequently losing lock on SBAS due to obstructions or low satellite elevation angles at my geographic location?

No, provided that the receiver is receiving a full set of corrections relatively often. Using COAST technology, the H320 is able to perform well for 40 minutes or more with aging correction data. Similar to DGPS corrections, accuracy degrades over time and distance. To obtain a full set of corrections the H320 antenna receives the ionospheric map over a period of a few minutes. This is the minimum amount of time required to get a full set of corrections for SBAS operation. After this, the receiver can coast until the next set of corrections have been received.

Accuracy is a function of correction age and current ionospheric activity, which will increase in the coming years.

Do I need a dual frequency antenna for SBAS?

Hemisphere GPS recommends using a dual frequency antenna with the H320. While some receiver function is possible with an L1-only antenna, full receiver performance will only be realized with a dual frequency antenna.

External Corrections

My H320 system does not appear to be using DGPS or RTK corrections from an external correction source. What could be the problem?

This could be due to a number of factors. To isolate the issue:

- Make sure DGPS corrections are RTCM v2.3 protocol.
- Make sure RTK corrections are either ROX, RTCM v3, CMR, or CMR+ protocol.
- Verify the baud rates used by the H320 match that of the external correction source.
- The external correction should be using an 8 data bit, no parity, 1 stop bit (8-N-1) serial port configuration.
- Inspect the cable connection to ensure there is no damage.
- Check the pinout information for the cables to ensure the transmit line of the external correction source is connected to the receive line of the H320 serial port and that the signal grounds are connected.
- Make sure the H320 has been set to receive external corrections by issuing the \$JDIF command. Refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com/support and click the GPS Reference icon) for more information.

Installation

Does it matter where I mount the H320's antenna?

Yes, the mounting location must provide a clear view of the sky for satellite tracking. Additionally, the position that it computes is based on the center of the antenna. It should be placed in the location for which the user would like a position. Often antennas are mounted on the centerline of a vehicle or on a pole-mount for georeference.

How will the antenna selection and mounting affect H320 performance?

For best results select a multipath-resistant antenna. Ensure the antenna tracks all the available signals for the receiver.

Mount the antenna:

- With the best possible view of the sky
- In a location with the lowest possible multipath

Using a magnetic mount for the antenna will not affect performance.

Support and Repair

How do I solve a problem I cannot isolate?

Hemisphere GPS recommends contacting the dealer first. With their experience with this product, and other products from Hemisphere GPS, they should be able to help isolate a problem. If the issue is beyond the capability or experience of the dealer, Hemisphere GPS Technical Support is available from 8:00 AM to 5:00 PM Mountain Standard Time, Monday through Friday.

See "Technical Support" on page ii (just before the Contents page) for Technical Support contact information.

What do I do if I cannot resolve a problem after trying to diagnose it myself?

Contact your dealer to see if they have any information that may help to solve the problem. They may be able to provide some in-person assistance. If this is not viable or does not solve the problem, Hemisphere GPS Technical Support is available from 8:00 AM to 5:00 PM Mountain Standard Time, Monday through Friday.

See "Technical Support" on page ii (just before the Contents page) for Technical Support contact information.

Can I contact Hemisphere GPS Technical Support directly regarding technical problems?

Yes, however, Hemisphere GPS recommends speaking to the dealer first as they would be the local support. They may be able to solve the problem quickly, due to their closer location and experience with our equipment.



Appendix B: Troubleshooting

Table B-1 provides a list of issues with possible solutions to help you troubleshoot anomalous H320 operation. Refer to Appendix C, “Technical Specifications” if necessary.

Table B-1: Troubleshooting

Issue	Possible Solution
<p>What do I do initially if I have a problem with the operation of the H320?</p>	<p>Try to isolate the source of the problem. Problems are likely to fall within one of the following categories:</p> <ul style="list-style-type: none"> • Power, communication, and configuration • GPS reception and performance • Beacon reception and performance • SBAS reception and performance • External corrections • Installation • Shielding and isolating interference <p>It is important to review each category in detail to eliminate it as a problem.</p>
<p>Receiver fails to power</p>	<ul style="list-style-type: none"> • Verify polarity of power leads • Check 1.0 A in-line power cable fuse connection • Check integrity of power cable connections • Check power input voltage • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
<p>No data from the H320</p> <ol style="list-style-type: none"> 1. No communication 2. No valid data 	<ul style="list-style-type: none"> • (1) Check receiver power status (this may be done with an ammeter) • (2) Verify the H320 is locked to a valid DGPS signal (this can often be done on the receiving device or by using SLXMon) • (2) Verify the H320 is locked to GPS satellites (this can often be done on the receiving device or by using SLXMon) • (2) Check integrity and connectivity of power and data cable connections
<p>Random binary data from the H320</p>	<ul style="list-style-type: none"> • Verify the RCTM or Bin messages are not being accidentally output (send a \$JSHOW command) • Verify the baud rate settings of H320 and remote device match • Potentially, the volume of data requested to be output by the Eclipse could be higher than the current baud rate supports. Try using 19200 or higher for the baud rate for all devices

Table B-1: Troubleshooting

Issue	Possible Solution
No GPS lock	<ul style="list-style-type: none"> • Check integrity of antenna cable • Verify antenna's view of the sky • Verify the lock status and signal to noise ratio (SNR) of GPS satellites (this can often be done on the receiving device or by using SLXMon)
No SBAS	<ul style="list-style-type: none"> • Check integrity of antenna cable • Verify antenna's view of the sky, especially toward SBAS satellites, south in the northern hemisphere • Verify the bit error rate and lock status of SBAS satellites (this can often be done on the receiving device or by using SLXMon - monitor BER value)
No DGPS position in external RTCM mode	<ul style="list-style-type: none"> • Verify the baud rate (BER) 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	<ul style="list-style-type: none"> • Verify H320 SBAS and lock status (or external source is locked)



Appendix C: Technical Specifications

Table C-1 through Table C-6 provide GNSS sensor, L-band, communication, power, environmental, and mechanical specifications of the H320.

Table C-1: GNSS sensor specifications

Item	Specification															
Receiver type	Dual GNSS (GPS/GLONASS) RTK															
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS (with subscription code) 12 L2C GPS (with subscription code) 12 L1 GLONASS 12 L2 GLONASS (with subscription code) 3 SBAS or 3 additional L1CA GPS 1 L-Band SBAS															
GPS sensitivity	-142 dBm															
SBAS tracking	3-channel, parallel tracking															
Update rate	10 Hz standard, 20 Hz available															
Horizontal accuracy	<table border="1"> <thead> <tr> <th></th> <th>RMS (67%)</th> <th>2DRMS (95%)</th> </tr> </thead> <tbody> <tr> <td>RTK^{1,2}</td> <td>10 mm + 1 ppm</td> <td>20 mm + 2 ppm</td> </tr> <tr> <td>L-band high precision services^{2,3}</td> <td>0.08 m</td> <td>0.16 m</td> </tr> <tr> <td>SBAS (WAAS)²</td> <td>0.25 m</td> <td>0.50 m</td> </tr> <tr> <td>Autonomous, no SA²</td> <td>1.2 m</td> <td>2.5 m</td> </tr> </tbody> </table>		RMS (67%)	2DRMS (95%)	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm	L-band high precision services ^{2,3}	0.08 m	0.16 m	SBAS (WAAS) ²	0.25 m	0.50 m	Autonomous, no SA ²	1.2 m	2.5 m
	RMS (67%)	2DRMS (95%)														
RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm														
L-band high precision services ^{2,3}	0.08 m	0.16 m														
SBAS (WAAS) ²	0.25 m	0.50 m														
Autonomous, no SA ²	1.2 m	2.5 m														
Heading accuracy	<p>< 0.17° rms @ 0.5 m antenna separation</p> <p>< 0.09° rms @ 1.0 m antenna separation</p> <p>< 0.04° rms @ 2.0 m antenna separation</p> <p>< 0.02° rms @ 5.0 m antenna separation</p> <p>< 0.01° rms @ 10.0 m antenna separation</p>															
Pitch/roll accuracy	< 1° rms															
Heave accuracy	30 cm rms (DGPS) ⁴ 5 cm rms (RTK) ⁴															
Timing (1PPS) accuracy	20 ns															
Rate of turn	100°/s maximum															
Cold start time	< 40 s typical (no almanac or RTC)															
Warm start time	< 20 s typical (almanac and RTC)															
Hot start time	< 5 s (almanac, RTC, and position)															
Heading fix	< 10 s typical (hot start)															
Maximum speed	1,850 kph (999 kts)															
Maximum altitude	18,288 m (60,000 ft)															

Table C-2: L-band sensor specifications

Item	Description
Sensitivity	-130 dBm
Channel spacing	7.5 KHz
Satellite selection	Manual and Automatic
Reacquisition time	15 seconds (typical)

Table C-2: L-band sensor specifications (continued)

Item	Description
Rejection	15 kHz spacing > 30 dB 300 kHz spacing > 60 dB
Processor	DSP for demodulation and protocol decoding module provides processing for differential algorithms
Command support	Reports L-band region and satellite information Allows input and status of L-band subscription, bit error rate (BER) output for reception quality indication and manual frequency tuning.

Table C-3: Communication specifications

Item	Description
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
USB ports	1 USB host, 1 USB device
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Crescent binary ⁵
Correction I/O protocol	RTCM SC-104, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁶
Timing output	1 PPS CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
Heading warning I/O (Heading Lock)	Pin 62 (see Table 2-2 on page 9 for more information)

Table C-4: Power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 3.2 W at 3.3 V (L1/L2 GPS/GLONASS) < 3.9 W at 3.3 V (L1/L2 GPS/GLONASS; L-band)
Current consumption	< 970 mA at 3.3 V (L1/L2 GPS/GLONASS) < 1180 mA at 3.3 V (L1/L2 GPS/GLONASS; L-band)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-5: Environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)

Table C-6: Mechanical specifications

Item	Description
Dimensions	152.4 L x 71.1 W x 16.3 H mm (6.00 L x 2.80 W x 0.64 H in)
Weight	.105 kg (3.70 oz.)
Status indication (LED)	Power, Primary and Secondary GPS lock, Differential lock, DGPS position, Heading, RTK lock, L-band lock
Power/data connector	70-pin male header, 0.05" (1.27 mm) pitch
Antenna connector	MCX, female, straight

¹ Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for local services), and ionospheric activity.

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

³ Requires an L-band subscription.

⁴ Based on a 40-second time constant.

⁵ Hemisphere GPS proprietary.

⁶ Receive only, does not transmit this format.

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