Vector H200 OEM Board

Integrator Guide

Part No. 875-0340-0 Rev A1

Hemisphere GPS®

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Patents

Hemisphere GNSS products may be covered by one or more of the following patents:

U.S. Patents					Australia Patents
6111549	6876920	7400956	8000381	8214111	2002244539
6397147	7142956	7429952	8018376	8217833	2002325645
6469663	7162348	7437230	8085196	8265826	2004320401
6501346	7277792	7460942	8102325	8271194	
6539303	7292185	7689354	8138970	8307535	
6549091	7292186	7808428	8140223	8311696	
6711501	7373231	7835832	8174437	8334804	
6744404	7388539	7885745	8184050	RE41358	
6865465	7400294	7948769	8190337		

Other U.S. and foreign patents pending.

Notice to Customers

Contact your local dealer for technical assistance. To find the authorized dealer near you:

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Scottsdale, AZ 85258 USA
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Fax: (480) 348-6370
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Technical Support

If you need to contact Hemisphere GNSS Technical Support:

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Documentation Feedback

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Contents

Chapter 1: Introduction

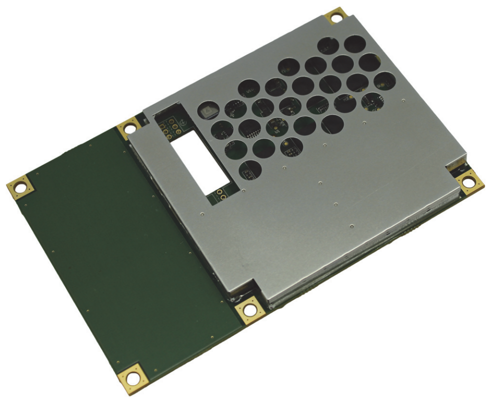
This manual does not cover receiver operation, the VectorPC™ utility, or commands and messages (NMEA 0183, NMEA2000® or Hemisphere GPS proprietary). For information on these subjects refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

This chapter provides an overview of the Crescent® Vector™ H200™ OEM board and information on board integration and key features of the board.

Note: Throughout the rest of this manual, the Crescent Vector H200 OEM board is referred to simply as the H200.

Overview

Fitted with Hemisphere's patented Crescent receiver technology, the H200 computes heading and DGPS position using L1 GPS and GLONASS. Develop robust marine navigation and land solutions in a world full of complex dynamic environments through Hemisphere GPS' advancements in Vector technology. The H200 brings a series of new features to the patented Crescent Vector technology including a more robust heading solution and excellent positioning through RTK. The H200 outputs heading, pitch, and roll.



The H200 also features Hemisphere GPS' exclusive COAST™ technology that enables Hemisphere GPS receivers to utilize aging differential GNSS correction data for 40 minutes or more without significantly affecting positioning quality. The H200 is less likely to be affected by differential signal outages due to signal blockages, weak signals, or interference when using COAST.

What's Included

The H200 is available in two configurations:

- H200 OEM board only - designed for integrators who are familiar with H200 OEM board integration
- H200 OEM board and Universal Development Kit - designed for integrators who are new to H200 integration (assembly required: OEM board and Universal Development kit sold separately)

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

  For more information on the Universal Development Kit go to www.hemispheregps.com and navigate to the Precision OEM Products page.

Integrating the H200

Successful integration of the H200 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 H200 GNSS engine is a low-level module intended for custom integration with the following general integration requirements:

- Regulated power supply input (3.3 VDC ± 5%) and 1.7 mA continuous current
- Low-level serial port (3.3 V CMOS) and USB port communications
- Radio frequency (RF) input to the engine from a GNSS antenna is required to be actively amplified (10 to 40 dB gain)
- GNSS antenna is powered with a separate regulated voltage source up to 15 VDC maximum
- Antenna input impedance is 50 Ω
- Antenna voltage input is 15 VDC maximum
- Antenna gain input range is 10 to 40 dB

Features of the H200

Some notable features of the H200 are:

- Multi-channel GNSS engine (12 L1CA GPS, 12 L1P GPS, 12 L1 GLONASS, and 3 channels dedicated to SBAS tracking)
- Sub-meter horizontal accuracy 95%
- Raw measurement output (via documented binary messages)
- Position and heading update rates of 20 Hz maximum
- Quick times to first fix
- Three full-duplex serial ports, a dedicated RTCM input port, and two USB ports (one USB host, one USB device)
- 1 PPS timing output
- Event marker input
- L-band capable (Hemisphere GPS LX-2™ board required)
- Fast RTK acquisition and reacquisition times
- 10 cm RTK-enabled heave accuracy
- Improved heading accuracy with different baseline lengths (up to 5 m)
- Same form factor as Hemisphere GPS' Crescent® Vector II OEM board

Note: See Appendix B, "Technical Specifications" for complete H200 specifications.

Configuring the H200

The H200 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 (not included with H200).

You can configure the H200 to use the following differential operation modes:

- SBAS
- Beacon (with optional SBX-4 board)
- L-band (with optional LX-2 board)
- External corrections

Message Interface

The H200 uses a NMEA 0183 interface, allowing you to easily make configuration changes by sending text-type commands to the receiver.

The H200 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 NMEA 0183 commands and messages as well as binary messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

Using VectorPC to Communicate with the H200

Hemisphere's VectorPC is a free utility program that runs on your Windows PC or Windows mobile device. Simply connect your Windows device to the H200 via the COM port and open VectorPC. The screens within VectorPC allow you to easily interface with the H200 to:

- Select the internal SBAS, beacon (with optional SBX-4 board), or L-band (with optional LX-2 board) correction source and monitor reception
- Configure NMEA messages, Vector parameters, and port settings
- Monitor Vector performance and tracking information
- Review heading, pitch, and roll visually
- Automatically calculate heading bias

VectorPC is available for download from the Hemisphere GPS website (www.hemispheregps.com).

Chapter 2: Board Overview

Mechanical Layout
Connectors
Mounting Options
Header and Pinout Descriptions
Signals
Shielding
Configuration Defaults

Mechanical Layout

Figure 2-1 shows the mechanical layout for the H200. All dimensions are in millimeters.

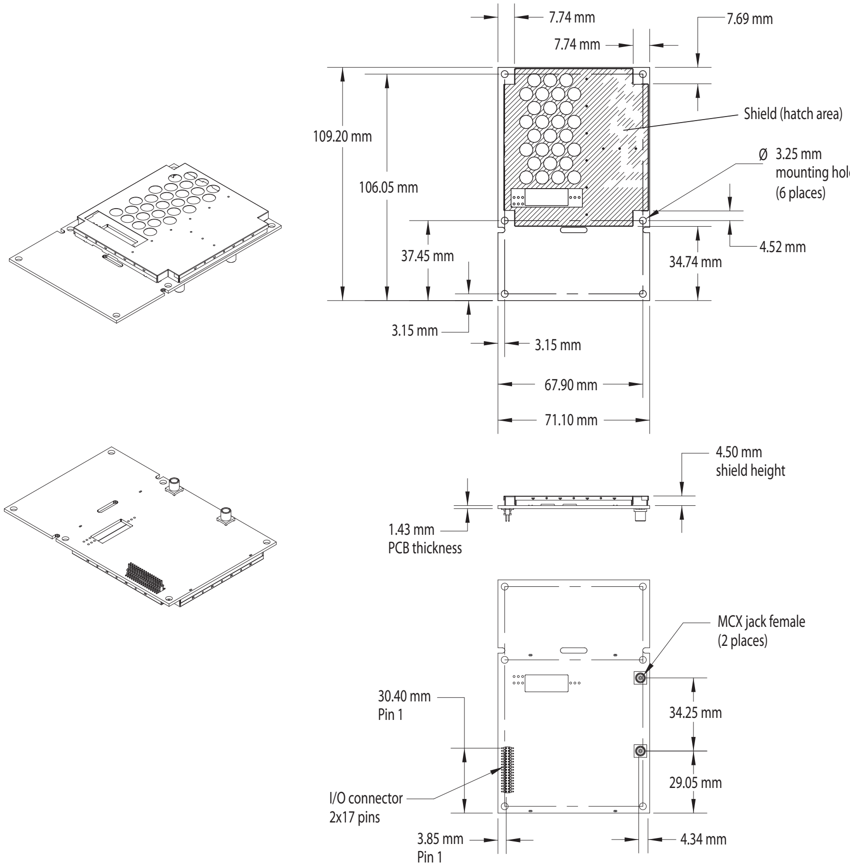


Figure 2-1: H200 mechanical layout

Connectors

Table 2-1 describes the H200'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: H200 connectors

Connector	H200 SMT Connector	Mating Connector
RF	MCX, straight jack (female) (Johnson: 133-3711-201)	MCX, straight plug (male) (AMP: 1061015-1)
Interface	17x2 pin header plug (male) 0.05 in (1.27 mm) pitch (Samtec: FTSH-117-01-L-DV)	17x2, SMT header socket (female) 0.05 in (1.27 mm) pitch (Samtec: FLE-117-01-G DV)

Mounting Options

There are two options for mounting the H200:

- 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 H200 on the standoffs and RF header connectors. This method is very cost effective as it does not use cable assemblies to interface the OEM board.

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

The H200 uses a standoff height of 0.79 cm (0.3125 in). With this height there should be no washers between either the standoff and the H200 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 that Hemisphere suggests. 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 11 for H200 connector information.

The mounting holes of the H200 have a standard inner diameter of 0.32 cm (0.125 in).

Indirect Electrical Connection (Cable) Method

The second method is to mount the H200 mechanically so you can connect a ribbon power/data cable to the H200. This requires cable assemblies and there is a reliability factor present with cable assemblies in addition to increased expense.

Header and Pinout Descriptions

The H200 uses a dual-row 34-pin (17 pins x 2 rows) 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.

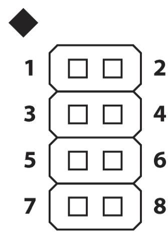


Figure 2-2: Identifying the first pin on the header connector

Table 2-2 provides pinout details for H200 header connector.

Table 2-2: H200 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	Antenna Pwr	Power	Antenna power, DC, 5 V max
4	Batt Backup	Power	Backup power input (1.6 - 3.6 VDC, <5 μA consumption)
5	USB DEV+	I/O	USB device data +
6	USB DEV–	I/O	USB device data -
7	GND	Power	Receiver ground
8	GND	Power	Receiver ground
9	PATX	Output	Port A serial output, 3.3 V CMOS, idle high
10	PARX	Input	Port A serial input, 3.3 V CMOS, idle high
11	PBTX	Output	Port B serial output, 3.3 V CMOS, idle high
12	PBRX	Input	Port B serial input, 3.3 V CMOS, idle high
13	PDTX	Output	Port D serial output, 3.3 V CMOS, idle high
14	PDRX	Input	Port D serial input, 3.3 V CMOS, idle high
15	1 PPS	Output	1 PPS, 3.3 V CMOS, active high, rising edge
16	Manual mark	Input	3.3 V CMOS, active low, falling edge
17	Master (primary) GPS lock	Output	Status indicator (M-GPS LED), 3.3 V CMOS, active low, 1 mA max, optional connection
18	Differential lock	Output	Status indicator (DIFF LED), 3.3 V CMOS, active low, 1 mA max, optional connection

Table 2-2: H200 header pinout descriptions (*continued)*

Pin	Name	Type	Description
19	DGPS position	Output	Status indicator (DGPS LED), 3.3 V CMOS, active low, 1 mA max, optional connection
20	Alarm	Output	RTC alarm output
21	CANTX	Output	3.3 V CMOS
22	Secondary GPS lock	Output	Status indicator (S-GPS LED), 3.3 V CMOS, active low, 1 mA max
23	CANRX	Input	3.3 V CMOS
24	Heading lock	Output	Status indicator (HDG LED), 3.3 V CMOS, active low, 1 mA max
25	Speed radar pulse	Output	0 - 3 V variable clock output
26	Speed radar ready signal	Output	Speed valid indicator, 3.3 V CMOS, active low
27	GND	Power	Receiver ground
28	GND	Power	Receiver ground
29	USB HOST +	Output	USB host data +
30	USB HOST –	Output	USB host data –
31	PCTX	Output	Port C serial output, 3.3 V CMOS, idle high
32	PCRX	Input	Port C serial input, 3.3 V CMOS, idle high
33	L-band	Output	3.3 V CMOS
34	Reset	Open collector	Reset, open collector, 3.3 V typical, not required
Note:	*Leave any data or I/O pins unconnected if not in use.* *The H200 OEM board, the Crescent Vector II OEM board, and the Crescent Vector OEM board differ from their predecessor, the Vector OEM, in that they do not have power supply or communication translation: this must be accomplished by a carrier board.*		

Signals

This section provides more detail on the signals available via connectors.

RF Input

The H200 is designed to work with active GNSS 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, the tracking performance of the H200 will be compromised.

Serial Ports

The H200 has four serial communication ports:

- Port A, Port B, Port C - main ports
- Port D - Exclusively used to interface with Hemisphere's SBX™ beacon board or an external corrections source. This port will not output normal GNSS-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" on page 10 for more information on Port D.

The H200 serial ports' 3.3 V CMOS signal level can be translated to interface to 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

The exclusive function of Port D is for external correction input to the H200. The source of corrections may depend on the geographical use of your final product, market, customer, and positioning performance requirements. If you intend to market products outside of SBAS coverage, you may want to allow your product to be used with external correction input or integrate a second source of corrections along with H200, such as the Hemisphere SBX beacon module. For more information on SBAS refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

If used, Port D will free up the task of Port A, B, or C from being used for external correction input. If you want to support external correction input when the product is in the field, Hemisphere recommends that you offer the facility to the user to input corrections on Port A, B or C, and that Port D remain within the integration only.

Note: DGPS corrections are not required for heading accuracies as specified. External corrections will only affect positioning performance.

LED Indicators

The H200 features the following surface-mounted diagnostic LEDs that indicate board status (see Figure 2-3):

- HDG - Heading lock
- S-GPS - Secondary GPS lock
- DGPS - DGPS position
- DIFF - Differential lock
- P-GPS - Primary GPS lock
- PWR - Power

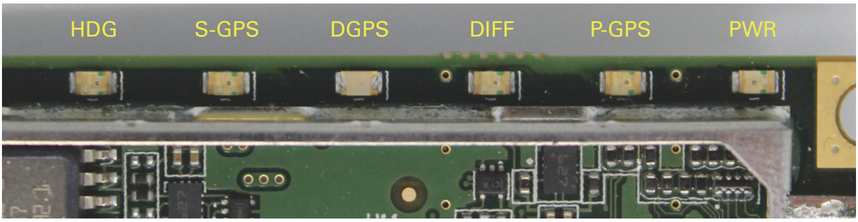


Figure 2-3: Onboard LEDs

With the exception of the PWR LED the signals that drive the LEDs are available via the header connector. Refer to Table 2-2 for pin number descriptions for the H200.

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.

1 PPS 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 GNSS boards but not essential to normal receiver operation. Do not connect the pin if you do not need this function.

The 1 PPS signal is 3.3 V CMOS active high with rising edge synchronization. The 1 PPS signal is capable of driving a load impedance greater than 10 kΩ in parallel with 10 pF. The pulse is approximately 1 ms.

Event Marker Input

A GNSS solution may need to be forced at a particular instance, not synchronized with GNSS time depending on the application, such as identifying features during a bathymetric survey.

Note: Event marker input is typical of most GNSS 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 kΩ 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 H200. These are not separate analog and digital grounds that require separate attention. Refer to Table 2-2 on page 8 for pinout ground information for the H200.

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 H200 relate to the Speed Radar.

- Speed Radar Pulse (pin 25) - 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 26) - Indicates when the speed signal on the "Speed Radar Pulse" pin is valid. In static situations, such as when the vehicle has stopped, the GNSS 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 GNSS 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 25 nor pin 26 has any form of isolation or surge protection. If utilizing the Speed Radar Pulse output, Hemisphere strongly recommends incorporating some form of isolation circuitry into the supporting hardware. Contact Hemisphere Technical Support for an example of an optically isolated circuit.

Shielding

Typically, the H200 does not require shielding for improving immunity to RF noise incident upon the board and its various devices. You may, however, wish to shield the H200 from the rest of the integration if you determine it interferes with other devices or systems.

If you are designing a smart antenna based on the H200 (the H200 and the two GNSS antennas in close proximity), you will likely want to shield the H200 so that it does not interfere with the incoming GNSS signals to the antenna.

Configuration Defaults

The following represents the standard configuration for the H200. For more information on these commands refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

```
$JOFF,PORTA
$JOFF,PORTB
$JOFF,PORTC

$JBAUD,19200,PORTA
$JBAUD,19200,PORTB
$JBAUD,19200,PORTC

$JAGE,2700
$JLIMIT,10
$JMASK,5
$JNP,7
$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,2.0
$JATT,HRTAU,2.0
$JATT,COGTAU,0.0
$JATT,MSEP,0.500
$JATT,GYROAID,YES
$JATT,TILTAID,YES
$JATT,LEVEL,NO
$JATT,EXACT,NO
$JATT,HIGHMP,YES
$JATT,FLIPBRD,NO
$JATT,HBIAS,0.0
$JATT,NEGTILT,NO
$JATT,NMEAHE,0
$JATT,PBIAS,0.0
$JATT,PTAU,0.5
$JATT,ROLL,NO
$JATT,SPDTAU,0.0

$JASC,GPGGA,1,PORTA
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$JASC,GPGSV,1,PORTA
$JASC,GPZDA,1,PORTA
$JASC,GPHDT,1,PORTA
$JASC,GPROT,1,PORTA
$JASC,GPGGA,1,PORTB
$JASC,GPVTG,1,PORTB
$JASC,GPGSV,1,PORTB
$JASC,GPZDA,1,PORTB
$JASC,GPHDT,1,PORTB
$JASC,GPROT,1,PORTB
$JSAVE
```

Chapter 3: Installation

Mounting the Antennas

Connecting the Antennas to the H200

The inclusion of the tilt sensor and gyro in the H200 makes it more complicated to configure than many traditional pieces of GNSS equipment. The following steps summarize the primary installation steps and the things you need to consider to successfully install the H200.

Mounting the Antennas

The H200 is compatible with the following Hemisphere GPS single and dual frequency antennas:

- Single frequency: A21 and A31 (beacon)
- Dual frequency: A42 and A43 (beacon)

When mounting the antennas, consider the following:

- Mounting orientation (parallel or perpendicular)
- Proper antenna placement

Mounting Orientation

The H200 outputs heading, pitch, and roll readings regardless of the orientation of the antennas. However, the relation of the antennas to the boat's axis determines whether you will need to enter a heading, pitch, or roll bias. The primary antenna is used for positioning and the primary and secondary antennas, working in conjunction, output heading, pitch, and roll values.

Note: Regardless of which mounting orientation you use, the H200 provides the ability to output the heave of the machine via the $GPHEV message. For more information on this message refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

Parallel Orientation: The most common installation is to orient the antennas parallel to, and along the centerline of, the axis of the boat. This provides a true heading. In this orientation:

- If you use a gyrocompass, you can enter a heading bias in the H200 to calibrate the physical heading to the true heading of the vessel.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.

Perpendicular Orientation: You can also install the antennas so they are oriented perpendicular to the centerline of the boat's axis. In this orientation:

- You will need to enter a heading bias of +90° if the primary antenna is on the starboard side of the boat and -90° if the primary antenna is on the port side of the boat.
- You will need to configure the receiver to specify the GNSS antennas are measuring the roll axis using $JATT,ROLL,YES.
- You will need to enter a roll bias to properly output the pitch and roll values.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.

Planning the Optimal Antenna Placement

Proper antenna placement is important to obtain a high-precision GNSS reading. Place the antennas:

- With a clear view of the horizon
- Away from other electronics and antennas
- Along the vessel's centerline

⚠WARNING: You must install the primary antenna along the vessel's centerline; you cannot adjust the position readings if the primary antenna is installed off the centerline. Positions are computed for the primary antenna.

- On a level plane
- With a 5.0 m maximum separation (default of 1.0 m)
- Away from radio frequencies
- As high as possible
- For optimal performance, orient the antennas so the antennas' connectors face the same direction.

Figure 3-1 below through Figure 3-3 on page 18 provide examples of mounting orientation.

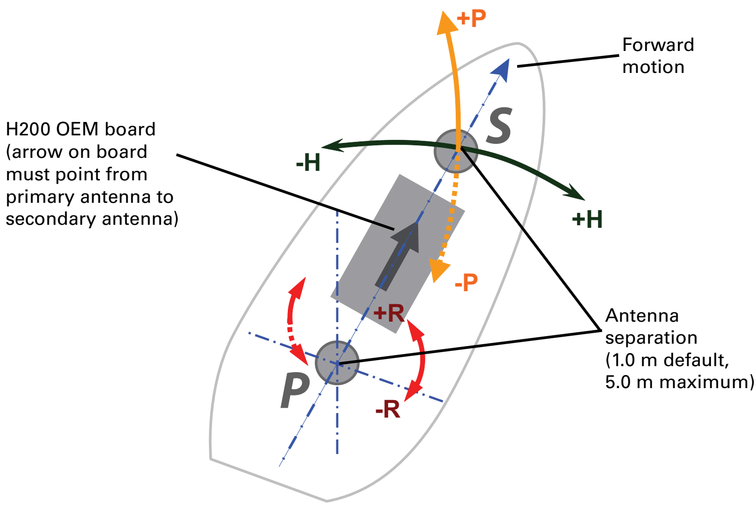


Figure 3-1: Recommended orientation and resulting signs of HPR values

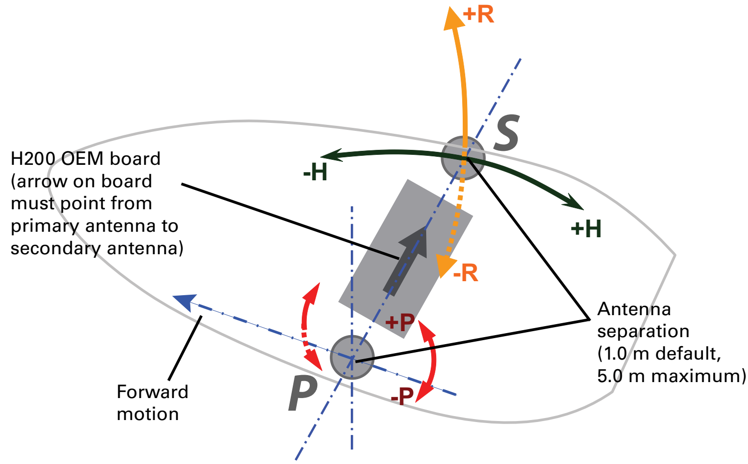


Figure 3-2: Alternate orientation and resulting signs of HPR values

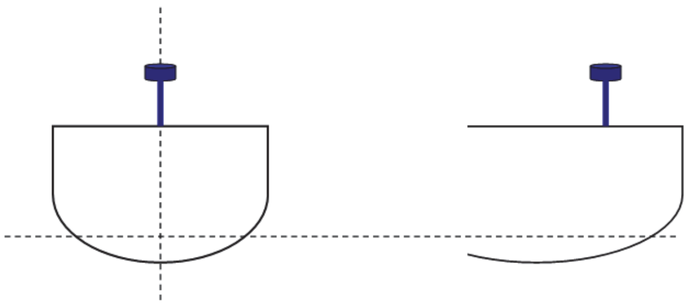
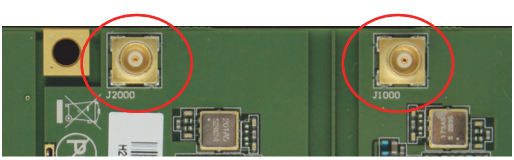


Figure 3-3: Antenna installation: Cross-section of boat

Connecting the Antennas to the H200

Connect the following:

- Primary antenna to J1000 port on the H200
- Secondary antenna to J2000 port on the H200



Appendix A: Troubleshooting

Use the following checklist to troubleshoot anomalous H200 receiver operation. Table A-1 provides a problem symptom, followed by a list of possible solutions.

Table A-1: Troubleshooting

Symptom	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connections • Check power input voltage (3.3 VDC +/-5%) • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from H200	• Check receiver power status LED to ensure that the receiver is powered • Verify the H200 is locked to a valid DGPS signal through the LEDs or with the use with VectorPC running on a PC) • Verify the H200 is locked to GNSS satellites (this can often be done on the receiving device or with VectorPC) • Check integrity and connectivity of power and data cable connections
Random data from H200	• Verify that the RTCM or the Bin95 and Bin96 messages are not being output accidentally (send a $JSHOW command) • Verify baud rate settings of the H200 and remote device match correctly • Potentially, the volume of data requested to be output by the H200 could be higher than the current baud rate supports, so try using 38400 as the baud rate for all devices or reduce the amount of data being output
No GNSS lock	• Check integrity of the antenna cable • Verify antennas have unobstructed view of sky • Verify the lock status of GNSS satellites (you can do this through the board's LEDs or with the use of VectorPC)
No SBAS lock	• Check antenna connections • Verify antennas have unobstructed view of sky • Verify the lock status of SBAS satellites (you can do this through the board's LEDs or with the use of VectorPC - monitor BER value) • SBAS corrections are only applied to the position, not to the heading. If SBAS lock is lost, you will still have the same heading accuracy, but your position accuracy may be degraded.

Table A-1: Troubleshooting (*continued)*

Symptom	Possible Solution
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 (transmit from the source must go to receive of the RTCM input port and grounds must be connected) • There is only differential positioning enabled for the primary antenna and RTCM corrections should be input to the primary receiver (either Port A or B) • Ensure corrections are being transmitted to the correct port. Using the $JDIFF,OTHER command on Primary Port A will cause the receiver to expect the corrections to be input through Primary Port B
Non-differential GNSS output	• Verify SBAS and beacon lock status (or external source is locked) • Confirm baud rates match an external source correctly • Issue a $JDIFF command and see if the expected differential mode is in fact the current mode • Differential corrections are only applied to the position, not to the heading. If differential lock is lost, you will still have the same heading accuracy, but your position accuracy may be degraded

Table A-1: Troubleshooting (*continued)*

Symptom	Possible Solution
No heading or incorrect heading values	• Ensure the antennas are connected to the proper ports: J1000 and J2000 are for the primary and secondary antennas • Heading is from primary to secondary antenna, so the secondary antenna should be toward the bow and primary toward the stern • Check the measurement of the antenna separation. The Measured (MSEP) and Calculated (CSEP) values are in meters and should agree to within 1 cm. CSEP continuously changes, so average this reading over several minutes to obtain an approximate value • Check CSEP value is fairly constant without varying more than 1 cm. Larger variations may indicate a high multipath environment and require moving the antenna locations • Reduce antenna separation - Hemisphere GPS recommends that the separation between the antennas remain below 5 m for accurate and timely heading reading output • $JATT,SEARCH command forces the H200 to acquire a new heading solution. This should also be used after entering a new MSEP value • Enable gyroaid as this will give heading for up to 3 minutes in times of GNSS signal loss • Enable tiltaid to reduce heading search times • Check the applications receiver using the $JAPP query; the receiver should answer $JAPP,ATTITUD2,ATTITUD2,1,2 • Monitor the number of satellites and SNR values for both antennas within VectorPC; at least 3 satellites should have SNR values > 20 • Antenna connectors should both be facing the same direction

Appendix B: Technical Specifications

Table B-1 through Table B-5 provide the internal GNSS sensor, communication, power, mechanical, and environmental specifications of the H200.

Table B-1: GNSS sensor specifications

Item	Specification
Receiver type	GNSS L1 RTK
Channels	540
GPS sensitivity	-142 dBm
SBAS tracking	2-channel, parallel tracking
Update rate	Standard 10 Hz, optional 20 Hz (position and heading)
Horizontal accuracy	< 0.02 m 95% confidence (RTK[1,2]) < 0.6 m 95% confidence (DGPS[1]) < 2.5 m 95% confidence (autonomous, no SA[3])
Heading accuracy	< 0.17° rms @ 0.5 m antenna separation < 0.09° rms @ 1.0 m antenna separation < 0.04° rms @ 2.0 m antenna separation < 0.02° rms @ 5.0 m antenna separation
Pitch/roll accuracy	< 1° rms
Heave accuracy	30 cm[4]
Timing (1PPS) accuracy	20 ns
Rate of turn	145°/s maximum
Cold start	< 40 s typical (no almanac or RTC)
Warm start	< 20 s typical (almanac and RTC)
Hot start	< 5 s typical (almanac, RTC, and position)
Heading fix	< 10 s typical (valid position)
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288 m (60,000 ft)

Table B-2: Communications specifications

Item	Specification
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]
Corrections I/O protocol	RTCM SC-104, L-Dif™ [5], RTCM v2 (DGPS), RTCM v3 (RTK), CMR (RTK), CMR+ (RTK)[6]
Timing output	1PPS, CMOS, active high, rising edge sync, 10 kΩ, 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 kΩ, 10 pF load
Heading warning I/O	Pin 62

Table B-3: Power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 2.1 W nominal GPS (L1) and GLONASS (L1)
Current consumption	< 1.7 A nominal GPS (L1) and GLONASS (L1)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table B-4: 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)
Shock and Vibration	Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized) Vibration: EP455 Section 5.15.1 Random
EMC	CE (IEC 60945 Emissions and Immunity), FCC Part 15, Subpart B, CISPR 22

Table B-5: Mechanical specifications

Item	Specification
Dimensions	10.9 L x 7.1 W x 0.5 H (cm) 4.3 L x 2.8 W x 0.2 H (in)
Weight	~ 50 g (~ 1.8 oz)
Status indicators (LEDs)	Power, master GPS lock, secondary GPS lock, differential lock, DGPS position, and heading lock
Power/data connector	34-pin male header, 0.05" pitch
Antenna connectors	MCX, female, straight (x2)

Table B-6: Aiding devices

Device	Description
Gyro	Provides smooth heading, fast heading reacquisition, and reliable < 3° heading for periods up to 3 minutes when loss of GPS has occurred.[7]
Tilt sensors	Provide pitch and roll data and assist in fast startup and reacquisition of heading solution.

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

[2]Up to 5 km baseline length

[3]Depends on multipath environment, number of satellites in view, and satellite geometry

[4]Based on a 40 second time constant

[5]Hemisphere GNSS proprietary

[6]Receive only, does not transmit this format

[7]Under static conditions

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