Crescent Vector II OEM Board

Integrators Guide

Part No. 875-0257-000 Rev C2

Hemisphere GPS

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

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

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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.

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

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Contents

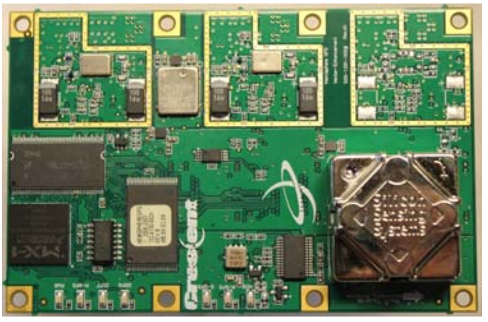
Chapter 1: Introduction

Note: This manual does not cover in any detail receiver operation, the PocketMax utility, nor commands and messages (NMEA 0183, NMEA 2000® or HGPS proprietary messages). For information on these subjects refer to the Hemisphere GPS Technical Reference available from the Hemisphere GPS website at www.hemispheregps.com.

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

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

Overview



You can use the Crescent Vector II for any application needing accurate heading or DGPS positioning. Fitted with Hemisphere GPS' patented Crescent receiver technology, the Crescent Vector II 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 Crescent Vector II provides accurate, reliable heading and position information at high update rates. It does this by using a high performance GPS engine for GPS signal processing.

The one receiver processes information from both the primary GPS antenna and secondary GPS antenna. Positions computed by the Crescent Vector II 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 Crescent Vector II is available in two configurations:

- Crescent Vector II OEM board only - designed for integrators who are familiar with Crescent Vector II OEM board integration
- Crescent Vector II OEM board and Universal Development Kit - designed for integrators who are new to Crescent Vector II 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.

Crescent Vector II Integration

Successful integration of the Crescent Vector II 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 Crescent Vector II GPS engine is a low-level module intended for custom integration with the following general integration requirements:

- Regulated power supply input (3.3 VDC ± 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

Features of the Crescent Vector II

Some notable features of the Crescent Vector II are:

- 12-channel GPS engine (2 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
- COAST™ technology that provides consistent performance with correction data
- Quick times to first fix
- Three full-duplex serial ports, a dedicated RTCM input port, and a USB port

- 1 PPS timing output
- Event marker input
- Compact form-factor

Note: For complete specifications of the Crescent Vector II see Appendix B, "Specifications".

Configuring Crescent Vector II

The Crescent Vector II 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 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 Crescent Vector II 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 available from the Hemisphere GPS website at www.hemispheregps.com.

Binary Message Interface

In addition to the NMEA 0183 interface, the Crescent Vector II 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 available from the Hemisphere GPS website at www.hemispheregps.com.

Using PocketMax to Communicate with the Crescent Vector II

Hemisphere GPS' PocketMax is a free utility program that runs on your PDA or computer and allows you to easily interface with the Crescent Vector II. 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 Crescent Vector II's status and function

Connect your computer or PDA to the Crescent Vector II via the COM port and open PocketMax. The menus and tabs within PocketMax allow you to control the Crescent Vector II'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

Figure 2-1 shows the mechanical layout for the Crescent Vector II. All dimensions are in millimeters.

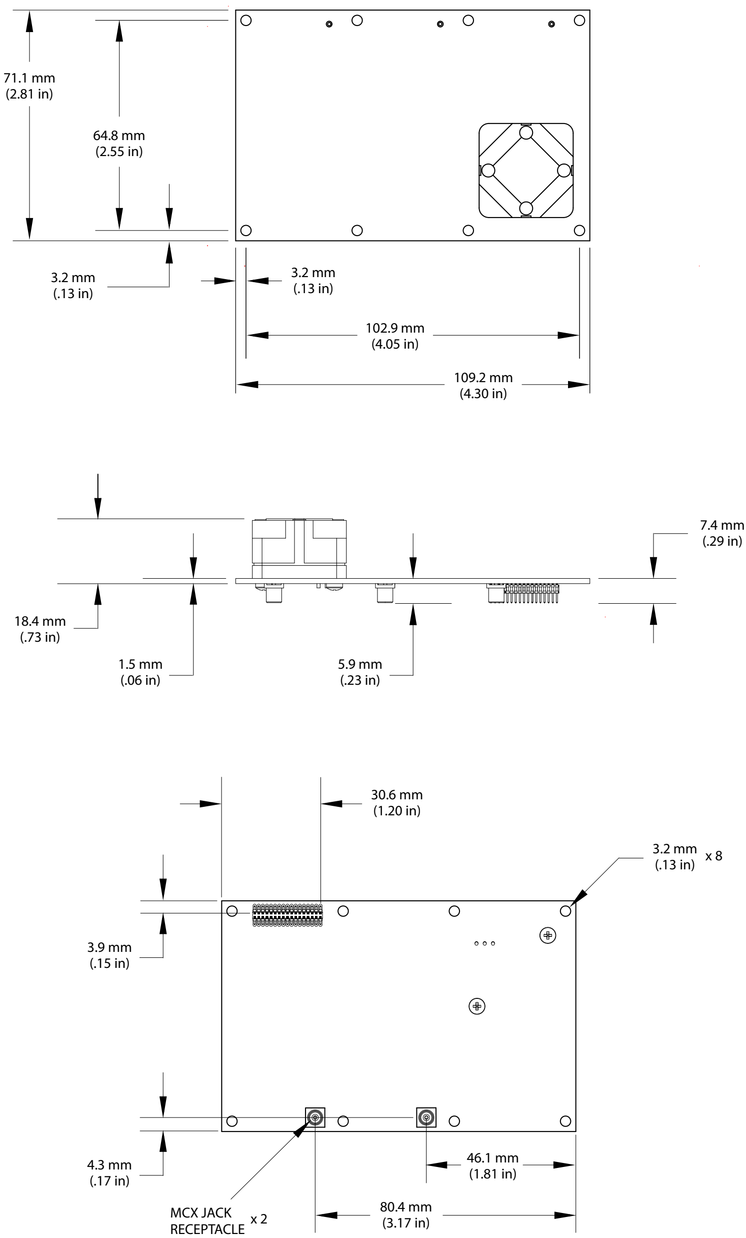


Figure 2-1: Crescent Vector II mechanical layout

Connectors

Table 2-1 describes the Crescent Vector II'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: Crescent Vector_II connectors

Connector	Crescent Vector II 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 Crescent Vector II:

- 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 Crescent Vector II 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 GPS 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 Crescent Vector II 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 Crescent Vector II 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 GPS 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 Crescent Vector II connector information.

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

Indirect Electrical Connection (Cable) Method

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

Header and Pinout Descriptions

The Crescent Vector II 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.

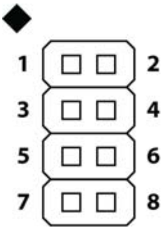


Figure 2-2: Identifying the first pin on the header connector

Table 2-2 provides pinout details for Crescent Vector II header connector.

Table 2-2: Crescent Vector II 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, 15 V max
4	Batt Backup	Power	Backup power input (1.6 - 3.5 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 low, falling 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: Crescent Vector II 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	n/c	n/c	n/c
21	GPIO0	I/O	General purpose input/output
22	Secondary GPS lock	Output	Status indicator (S-GPS LED), 3.3 V CMOS, active low, 1 mA max
23	Auxiliary GPS lock	Output	Status indicator (A-GPS LED), 3.3 V CMOS, active low, 1 mA max
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	n/c	n/c	n/c
30	Alarm	Output	RTC Alarm Output
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	GPIO4	Output	General purpose input/output
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 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 Crescent Vector II 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, the tracking performance of the Crescent Vector II will be compromised.

Serial Ports

The Crescent Vector II has four serial communication ports:

- Port A, Port B, Port C - main ports
- Port D - Exclusively used to interface with the SBX 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” on page 13 for more information on Port D.

The Crescent Vector II 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 Crescent Vector II. 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 Crescent Vector II, such as the Hemisphere GPS SBX beacon module. Refer to the Hemisphere GPS Technical Reference available at www.hemispheregps.com for more information on SBAS.

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 GPS 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 Crescent Vector II features the following surface-mounted diagnostic LEDs that indicate board status (see Figure 2-3):

- PWR - Power
- M-GPS - Master GPS lock
- DIFF - Differential lock
- DGPS - DGPS position
- S-GPS - Secondary GPS lock
- A-GPS - Auxiliary GPS lock (not in use)
- HDG - Heading lock

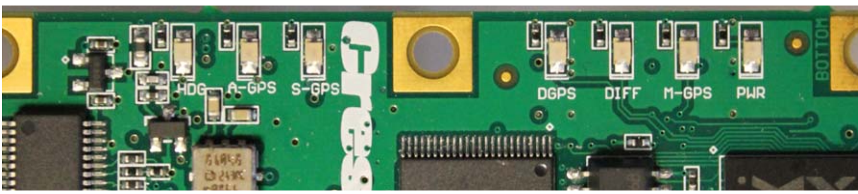


Figure 2-3: Onboard LEDs

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 Crescent Vector II.

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.

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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 GPS 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 low with falling 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 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 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 Crescent Vector II. These are not separate analog and digital grounds that require separate attention. Refer to Table 2-2 on page 11 for pinout ground information for the Crescent Vector II.

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 Crescent Vector II 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 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 25 nor pin 26 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

Typically, the Crescent Vector II 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 Crescent Vector II 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 Crescent Vector II (the Crescent Vector II and the two GPS antennas in close proximity), you will likely want to shield the Crescent Vector II so that it does not interfere with the incoming GPS signals to the antenna.

Configuration Defaults

Below is the standard configuration for the Crescent Vector II. For more information on these commands refer to the GPS Technical Reference available from the Hemisphere GPS website at www.hemispheregps.com.

```
$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
$JASC,GPVTG,1,PORTA
$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 Crescent Vector II

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

Mounting the Antennas

When mounting the antennas you need to consider the following:

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

Mounting Orientation

The Crescent Vector II 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 Crescent Vector II 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 available at www.hemispheregps.com.

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 Crescent Vector II 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 GPS 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 GPS 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 2.0 m maximum separation*
- Away from radio frequencies
- As high as possible

For the best results, orient the antennas so the antennas' connectors face the same direction.

** For separations between 2.0 m and 4.0 m the receiver will perform as specified except for the time required to obtain a heading solution may exceed 60 seconds.*

Figure 3-1 through Figure 3-3 provide examples of mounting orientation.

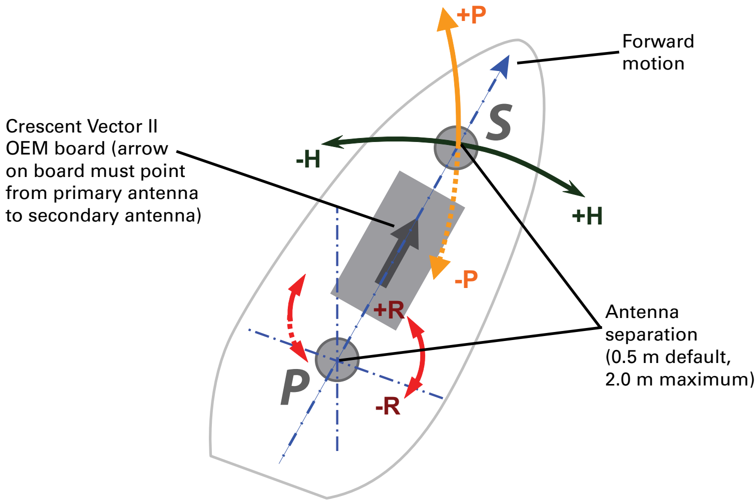

Figure 3-1: Recommended orientation and resulting signs of HPR values

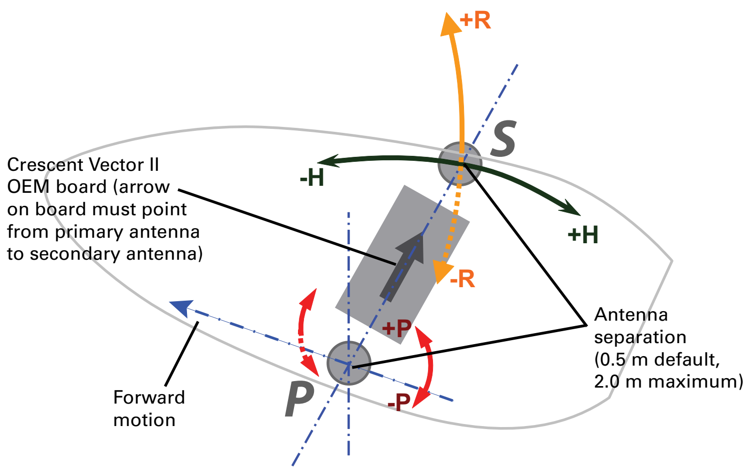

Figure 3-2: Alternate orientation and resulting signs of HPR values

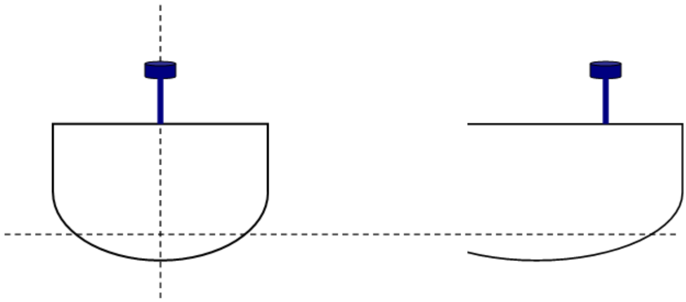

Figure 3-3: Antenna installation: Cross-section of boat

Connecting the Antennas to the Crescent Vector II

Connect the following:

- Primary antenna to J1000 port on the Crescent Vector II
- Secondary antenna to J2000 port on the Crescent Vector II

Appendix A: Troubleshooting

Use the following checklist to troubleshoot anomalous Crescent Vector II 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 +/-3%) • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from Crescent Vector II	• Check receiver power status LED to ensure that the receiver is powered • Verify the Crescent Vector II is locked to a valid DGPS signal through the LEDs or with the use with PocketMax running on a PC) • Verify the Crescent Vector II is locked to GPS satellites (this can often be done on the receiving device or with PocketMax PC) • Check integrity and connectivity of power and data cable connections
Random data from Crescent Vector II	• 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 Crescent Vector II and remote device match correctly • Potentially, the volume of data requested to be output by the Crescent Vector II 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 GPS lock	• Check integrity of the antenna cable • Verify antennas have unobstructed view of sky • Verify the lock status of GPS satellites (you can do this through the board's LEDs or with the use of PocketMax PC)
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 PocketMax PC - 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 beacon lock	• Check beacon antenna connected to J410 port • Verify the receiver is tuned to the correct frequency and bit rate • Ensure that beacon signal coverage is expected in your area • Beacon corrections are only applied to the position, not to the heading. If beacon lock is lost, you will still have the same heading accuracy, but your position accuracy may be degraded.
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 GPS output	• Verify SBAS and beacon lock status (or external source is locked) • Confirm baud rates match an external source correctly • Issue a $JDIFF<CR><LF> 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, while J410 is for an optional beacon antenna connection • 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 2 m for accurate and timely heading reading output • $JATT,SEARCH command forces the Crescent Vector II 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 GPS 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 PocketMax; at least 3 satellites should have SNR values > 20 • Antenna connectors should both be facing the same direction

Appendix B: Specifications

Table B-1 through Table B-5 provide the internal GPS sensor, communication, power, mechanical, and environmental specifications of the Crescent Vector II.

Table B-1: GPS sensor specifications

Item	Specification
Receiver type	L1, C/A code with carrier phase smoothing
Channels	Two 12-channel, parallel tracking (Two 10-channel when tracking SBAS)
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[1,4]) < 0.6 m 95% confidence (DGPS[1]) < 2.5 m 95% confidence (autonomous, no SA[2])
Heading accuracy	< 0.30° rms @ 0.5 m antenna separation < 0.15° rms @ 1.0 m antenna separation < 0.10° rms @ 2.0 m antenna separation
Pitch/roll accuracy	< 1° rms
Heave accuracy	30 cm
Timing (1PPS) accuracy	50 ns
Rate of turn	90°/s maximum
Cold start	< 60 s typical (no almanac or RTC)
Warm start	< 30 s typical (almanac and RTC)
Hot start	< 10 s typical (almanac, RTC, and position)
Heading fix	< 10 s typical (valid position)
Antenna input impedance	50 Ω
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288 m (60,000 ft)

Table B-2: Communications specifications

Item	Specification
Serial ports	3 full-duplex 3.3 V CMOS
USB ports	1 USB device
Baud rates	4800 - 115200
Corrections I/O protocol	RTCM SC4-104, L-Dif[3], RTK[3]
Data I/O protocol	NMEA 0183, Crescent binary[3], L-Dif[3], RTK[3]
Timing output	1PPS, CMOS, active low, falling edge sync, 10 kΩ, 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 kΩ, 10 pF load

Table B-3: Environmental specifications

Item	Specification
Operating temperature	-30°C to +70°C (-22°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Vibration[5]	IEC 60945 (when mounted in an enclosure with screw mounting holes utilized)
EMC[5]	FCC Part 15, Subpart B, CISPR22, CE

Table B-4: Power specifications

Item	Specification
Input voltage	3.3 VDC +/- 3%
Power consumption	1.6 W nominal
Current consumption	490 mA @ 3.3 VDC nominal
Antenna voltage	~ 5 VDC
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table B-5: Mechanical specifications

Item	Specification
Dimensions	109.2 L x 71.1 W x 24.3 H mm (4.30 L x 2.81 W x 0.96 H in)
Weight	~ 55 g (~ 1.9 oz)
Status indicators (LEDs)	Power, primary 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)

[1]*Depends on multipath environment, antenna selection, 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, and satellite geometry*

[3]*Hemisphere GPS proprietary*

[4]*Up to 5 km baseline length*

[5]*When installed in conjunction with the recommended shielding and protection as outlined in this manual.*

[6]*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 assist in fast startup of heading solution*

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