USER AND INSTALLATION GUIDE

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PRONAV V200N

GPS COMPASS

PRONAV AS, Hovlandsveien 52, 4374 EGERSUND - TLF 51 46 43 00 - mail@pronav.no - www.pronav.no

Index

Device Compliance, License and Patents

Device Compliance

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

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

This product complies with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be consulted at HTTPS://HEMISPHEREGNSS.COM/ABOUT-US/QUALITY-COMMITMENT.

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

Australia Patents	
2002244539	2002325645
2004320401	

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Device Compliance, License and Patents, Continued

Notice to Customers

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

Hemisphere GNSS, Inc
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
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WWW.HGNSS.COM

Technical Support

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ProNav Norge AS / JRC Nord Europa
Hovlandsveien 52
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Terms and Definitions

Introduction

The following table lists the terms and definitions used in this document.

Term	Definition
Activation	Activation refers to a feature added through a one-time purchase.
Atlas	Atlas is a subscription-based service provided by Hemisphere that enables the V200n to achieve sub-meter accuracy without a base station or datalink.
BeiDou	BeiDou is a Chinese satellite-based navigation system.
DGPS/DGNSS	Differential GPS/GNSS refers to a receiver using Differential Corrections.
Differential Corrections	A method of improving precision of a GNSS rover. Two GNSS receivers placed in a nearby area will have similar error. A base station is placed over a known point.
Firmware	Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.
GALILEO	Galileo is a global navigation satellite system implemented by the European Union and European Space Agency.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System deployed and maintained by Russia.
Heading	The vector created from the primary to secondary antenna. It points to the direction that the receiver is facing.
Vector Receiver	A Hemisphere GNSS receiver capable of providing heading.

Chapter 1: Introduction

Overview

Introduction

This User Guide provides information to help you quickly set up your ProNav V200n. You can download this manual from the Hemisphere GNSS website at WWW.HGNSS.COM.

Contents

Product Overview

Product overview

The ProNav V200n GNSS Compass supports GPS, GLONASS, Galileo, QZSS, and BeiDou satellites using Hemisphere GNSS' Crescent Vector H220™ GNSS module. This User Guide is available for download from www.HGNSS.com.

Note: When referring to the ProNav V200n GNSS Compass, this manual uses the term V200n.

The multi-GNSS V200n supports GPS, GLONASS, BeiDou, Galileo, and QZSS and offers an amazing world-wide 30 cm (RMS) accuracy via Hemisphere's Atlas GNSS global correction service.

The V200n offers an incredible combination of simple installation, small form factor, and amazing performance. The compass - measuring only 35 cm in length - mounts easily to a flat surface or pole. The stability and maintenance-free design of the V200n provides simple integration into autopilots, chart plotters, and AIS systems.

There are no mechanical parts such as gimbals or a rotating motor, so the V200n Compass is free from routine maintenance. Heading is determined from GNSS, and there is no need to wait for settling time, gyrocompass calibration and speed corrections. Vector performance is not affected by geomagnetism, making it the perfect solution for any marine application.

The V200n is an integrated system that houses the following:

- Crescent Vector H220 module
- Dual mGNSS, multipath-resistant antennas
- Power supply
- Six-axis sensor

The sensor is present to improve system performance and to provide backup heading information in the event a GNSS heading is not available due to signal blockage. The sensor provides a substitute heading, accurate to within 1º per minute for up to three minutes.

Continued on next page

Overview, Continued

Product overview, continued

The V200n's GNSS antennas are separated by 20 cm between phase centers, resulting in a heading performance of better than 0.75° RMS (with High Accuracy Heading activated). The V200n can provide heading and positioning updates of up to 50 Hz and delivers positioning accuracy of 0.6 m 95% of the time when using differential GPS corrections from Satellite Based Augmentation Systems (SBAS) or Atlas.

The V200n also features Hemisphere GNSS' exclusive Tracer™ technology, which provides consistent performance with correction data. The V200n is less likely to be affected by differential signal outages due to signal blockages, weak signals, or interference when using Tracer.

If you are new to GNSS and SBAS, refer to the Hemisphere GNSS Technical Reference Manual (for further information on these services and technologies before proceeding.

Figure 1-1: V200n

Continued on next page

Overview, Continued

Atlas L-band	Atlas L-band is Hemisphere's industry leading correction service, which can be added to the V200n as a subscription. Atlas L-band has the following benefits: • **Positioning accuracy -** Competitive positioning accuracies down to 30 cm RMS in certain applications • **Positioning sustainability -** Cutting edge position quality maintenance in the absence of correction signals, using Hemisphere's patented technology
For more information	For more information about Athena RTK, see: https://www.hemispheregnss.com/technology/#athena For more information about Atlas L-band, see: https://www.hemispheregnss.com/technology/#atlas

Key Features

Key features of the V200n include:

- L1 GPS, GLONASS, Galileo, BeiDou, QZSS
- 30 cm RMS world-wide positioning accuracy with Atlas corrections
- Standard 1.5° and optional 0.75° heading accuracy in small form factor
- Excellent in-band and out-of-band interference rejection
- Integrated gyro and tilt sensors help deliver fast start-up times and provide heading updates during temporary loss of satellites
- Provides heading, positioning, heave, pitch and roll

What's Included in Your Kit

V200n kit

Table 1-1 lists the parts included with your V200n. The V200n GNSS Compass and a NMEA 2000 cable are the only two required components.

Note: The V200n's parts comply with IEC 60945 Section 4.4: "Exposed to the weather."

V200n Parts list

The following table lists the part numbers with description of the V200n.

Table 1-1: V200n Parts list

Part No.	Description
804-0163-30	ProNav V200n GNSS Compass
710-0166-10	ProNav V200 Pole Mounting Kit

Refer to 875-0394-10_A3 V200n GNSS Compass User Guide for units with part number 804-0163-10 or 804-0163-20.

All of the following are accessory items available for purchase separately from your V200n.

Table 1-2: V200n Accessory list

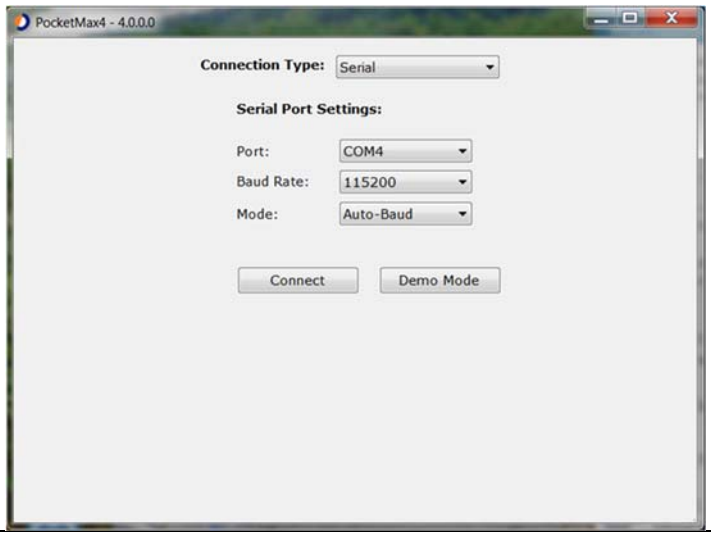
Part No.	Description
710-0162-10	V200 Surface Mounting Kit

Using PocketMax to Communicate with the V200n

Using PocketMax to communicate with the V200n

Use the following steps to set up the V200n communication with PocketMax.

Table 1-3: PocketMax Communication

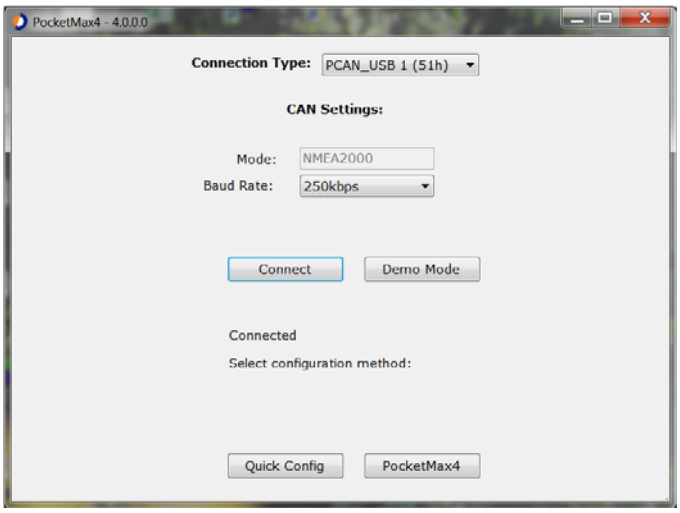
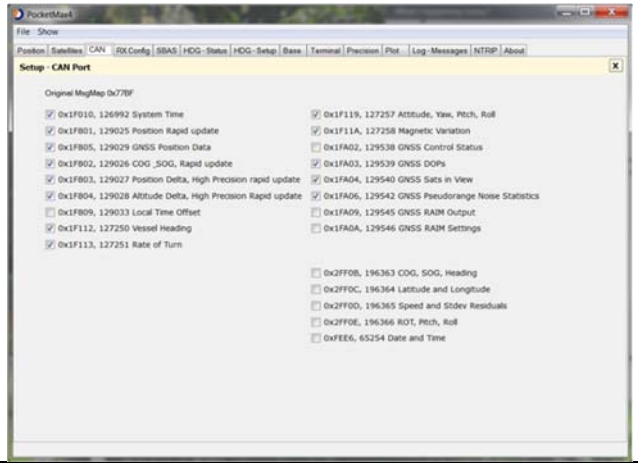
Step	Action
1	Open PocketMax. 
2	Change **Connection Type** from **Serial** to **CAN** using the drop-down arrow, and set the baud rate to 250kbps. 

Continued on next page

Overview, Continued

Using PocketMax to communicate with the V200n, continued

Table 1-3: PocketMax Communication (continued)

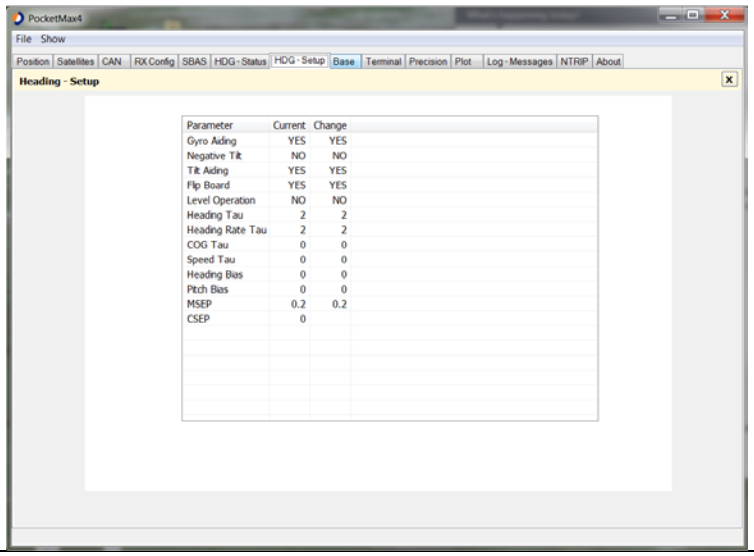
Step	Action
3	Click **Connect**.  **Quick Config** configures your receiver only. **PocketMax** configures the receiver and shows your position and heading status.
4	Turn **ON/OFF** messages in the **CAN** tab. 

Continued on next page

Overview, Continued

Using PocketMax to communicate with the V200n, continued

Table 1-3: PocketMax Communication (continued)

Step	Action
5	The **Heading-Setup** screen features the following tabs: • **Position**-displays your position • **Satellites**-displays satellites tracking • **HDG-Status**-displays your heading • **HDG-Setup**-adjust your TAU values 

Firmware Upgrades

Overview

Periodically, Hemisphere GNSS releases firmware updates to improve performance, fix bugs, or add new features to a product. To update the firmware on the V200n, use Hemisphere Upgrade Suite.

Hemisphere Upgrade Suite

Use Hemisphere Upgrade Suite by performing the following steps:

Table 1-4: Hemisphere Upgrade Suite

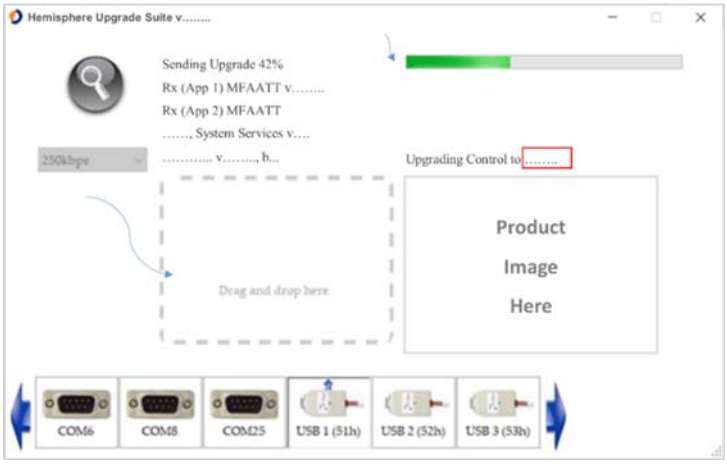
Step	Action
1	Connect the V200n to your computer with either a GridConnect PCAN-USB adapter or a Kvaser CAN to USB adapter.
2	Open Upgrade Suite. and verify that the version is **v.9.1.3.10** or later. 
3	Ensure the baud rate is set to 250kbps, then click the “USB 1 (51h)” icon to open the USB port. 

Continued on next page

Overview, Continued

Hemisphere Upgrade Suite, continued

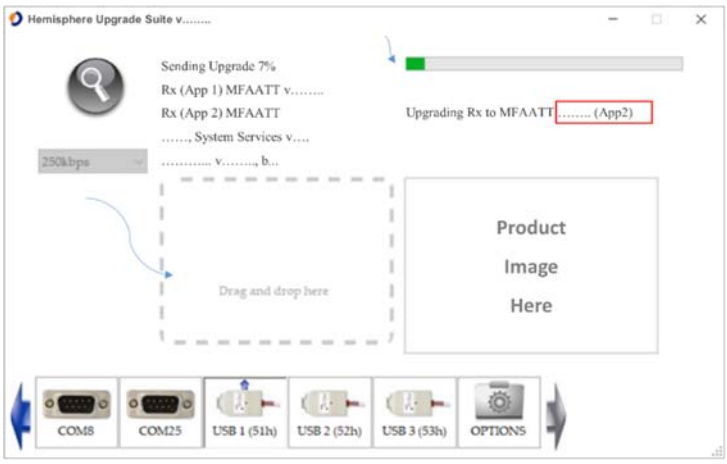
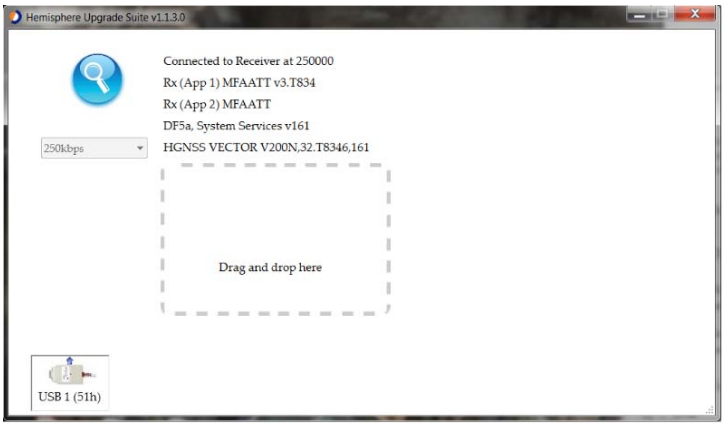
Table 1-4: Hemisphere Upgrade Suite (continued)

Step	Action
4	If you need to update the **N2K/Menu firmware**, click on the magnifying glass to find and select the **N2K/Menu firmware file**, then drag and drop the file into the "Drag and drop here" section. The progress bar and text below will indicate the status of the upload. 
5	Verify the right **N2K/Menu firmware** has been loaded in the last line of text above the "Drag and drop here" section. 

Overview, Continued

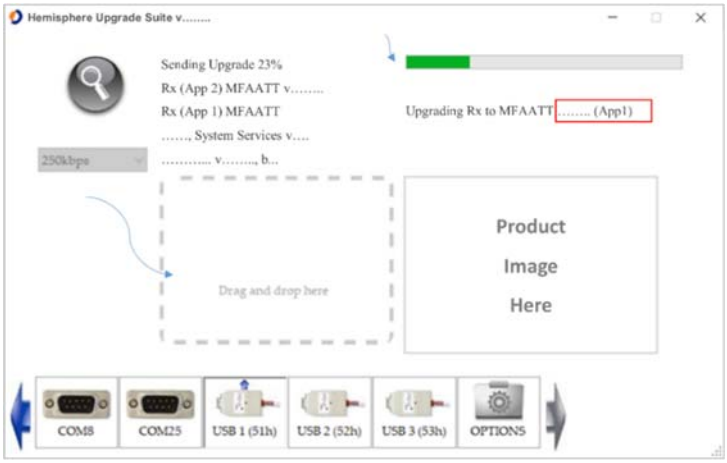
Hemisphere Upgrade Suite, continued

Table 1-4: Hemisphere Upgrade Suite (continued)

Step	Action
6	If you need to update the **GNSS firmware**, click on the magnifying glass to find and select the **GNSS firmware file**, then drag and drop the file into the "Drag and drop here" section. The progress bar and text below will indicate the status of the upload.  Once completed, the "Rx (App1)" will be listed below "Rx (App2)", and "Rx (App2)" will indicate that App2 still needs to be updated to the correct GNSS firmware version. Drag and drop the FW file to the box. 

Overview, Continued

Hemisphere Upgrade Suite, continued

Step	Action
7	If the App1 update doesn't automatically start, after the app swap, again drag and drop the **GNSS firmware** file into the "Drag and drop here" section. The progress bar and text below indicate the status of the upload. 
8	Once completed, the "Rx (App1)" is again listed above "Rx (App2)" and shows the correct firmware version. 

Chapter 2: Mounting the V200n

Overview

Introduction

This chapter provides instructions on how to mount your V200n receiver.

Contents

Mounting the V200n

Introduction

This section provides information on mounting the V200n in the optimal location, orientation considerations, environmental considerations, and other mounting options.

GNSS satellite reception

When deciding where to mount the V200n, consider the following satellite reception recommendations:

- Ensure there is a clear view of the sky available to the V200n, so the GNSS and L-band satellites are not masked by obstructions that may reduce system performance.
- Position is based off the primary GNSS antenna located on located on the end opposite the recessed arrow on the underside of the enclosure.
- Locate any transmitting antennas away from the V200n by at least a few meters to ensure tracking performance is not compromised.
- Ensure cable length is adequate to route into the vessel to reach a breakout box or terminal strip.
- Do not locate the antenna where environmental conditions exceed those specified in Appendix B, Technical Specifications of this document.

Figure 2-1: V200n Underside with recessed arrow

Continued on next page

Mounting the V200, Continued

VHF interference

VHF interference from such devices as cellular phones and radio transmitters may interfere with GPS operation, however the Vector compass can still track other constellations, maintaining heading and position.

For example, if installing the V200n near marine radios, consider the following:

- VHF marine radio working frequencies (Channels 1 to 28 and 84 to 88) range from 156.05 to 157.40 MHz. The L1 GPS working center frequency is 1575.42 MHz. The bandwidth is +/- 2MHz to +/- 10 MHz, which is dependent on the GNSS antenna and receiver design.
- VHF marine radios emit strong harmonics. The 10th harmonic of VHF radio, in some channels, falls into the GPS working frequency band, which may cause the SNR of GNSS to degrade significantly.
- The radiated harmonic signal strength of different brands/models varies.
- Follow VHF radio manufacturers' recommendations on how to mount their radios and what devices to keep a safe distance away.
- Handheld 5W VHF radios may not provide suitable filtering and may interfere with the V200n's operation if too close.

Before installing the Vector Compass, use the following diagram to ensure there are no nearby devices that may cause VHF interference.

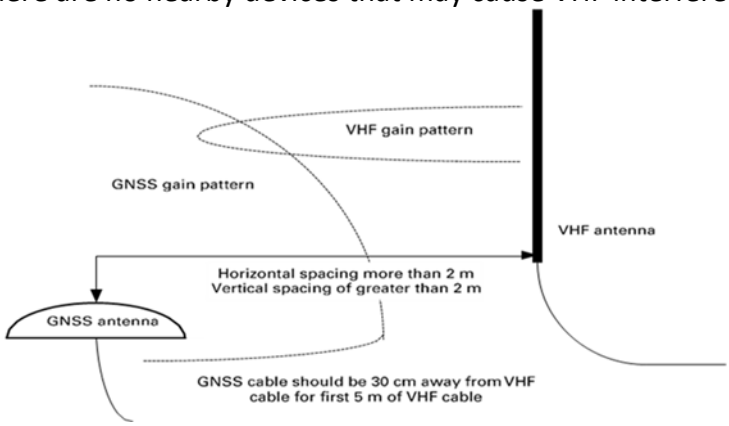


Figure 2-2: V200n distance from nearby VHF radios

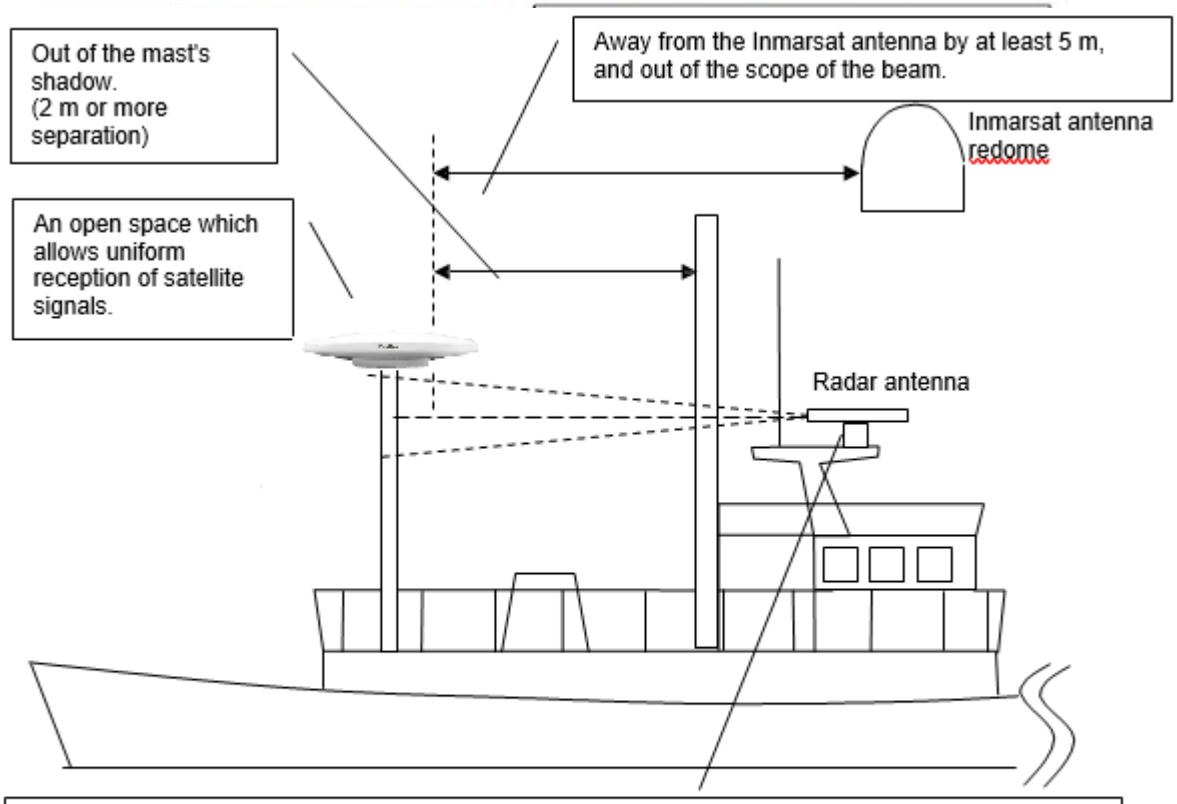
Continued on next page

Mounting the V200, Continued

Do not bend the cables included with this equipment excessively, or twist them or subject them to other strong forces. Doing so may result in damage to the interior or exterior of the cables, and may result in fire or electrocution.

Do not install the equipment in places subject to vibration or shock.
Doing so may result in the equipment failure due to reception problems.

This equipment uses GPS satellite signals to determine the bearing of the ship. Install the sensor where there are no impediments to electrical signal reception, and no signal reflection. If the sensor installation location environment is unsatisfactory, ship bearing calculations is repeatedly interrupted.
If selection of the optimal installation location is difficult, and some concessions must be made, place the sensor in the desired installation location and test the acceptability of the sensor results before permanently installing the sensor. Installing the sensor in an inappropriate location may result in decreased accuracy and equipment failure.
Poor visibility and the high occurrence of reflected waves may result in a decrease in bearing accuracy or the interruption of bearing measurement.
Whenever possible, select a place having the following characteristics.



2 m or more outside of any radar beams.
Installation near radar antennas may result in multipath wave interference, which decreases the accuracy of the equipment.
Whenever possible, install the equipment above or below any beams and keep it out of the scope of the beams.

Overview, Continued

Environmental considerations

Hemisphere Vector Smart Antennas are designed to withstand harsh environmental conditions; however, adhere to the following limits when storing and using the V200n:

- 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

Mounting orientation

The V200n outputs heading, pitch, and roll readings regardless of the orientation of the antennas. The relation of the antennas to the vessel's axis determines if you 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.

The top of the V200n enclosure incorporates a sight design feature to help you align the enclosure on your vessel. Alignment accuracy is approximately +/- 2°.

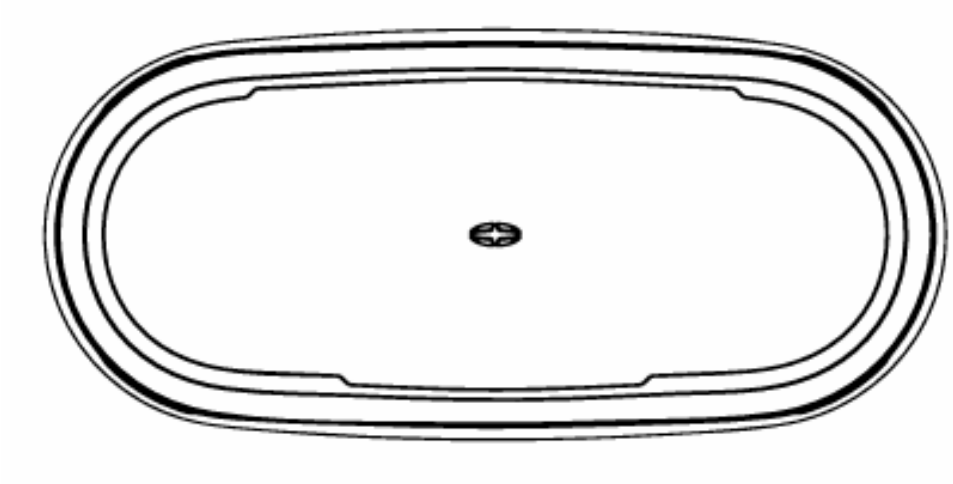


Figure 2-3: Shorter design element

Note: Regardless of which mounting orientation you use, the V200n provides the ability to output the heave of the vessel. This output is available using either MSGID 0x0031 (NMEA 2000) or $GPHEV (using the PocketMax Terminal window). For more information on this message refer to the Hemisphere GNSS Technical Reference Manual.

Continued on next page

Overview, Continued

Parallel orientation

Parallel installation orients the V200n parallel to, and along the centerline of, the axis of the vessel. **This provides a true heading**. In this orientation:

- If you use a gyrocompass and there is a need to align the Vector smart antenna, you can enter a heading bias in the V200n 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 vessel's axis. In this orientation:

- Enter a heading bias of +90° if the primary antenna is on the starboard side of the vessel and -90° if the primary antenna is on the port side of the vessel.
- Configure the receiver to specify the GNSS smart antenna is measuring the roll axis using either MSGID 0x003D (NMEA 2000) or $JATT,ROLL,YES (using the PocketMax Terminal window).
- 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.

Continued on next page

Overview, Continued

Mounting orientation example

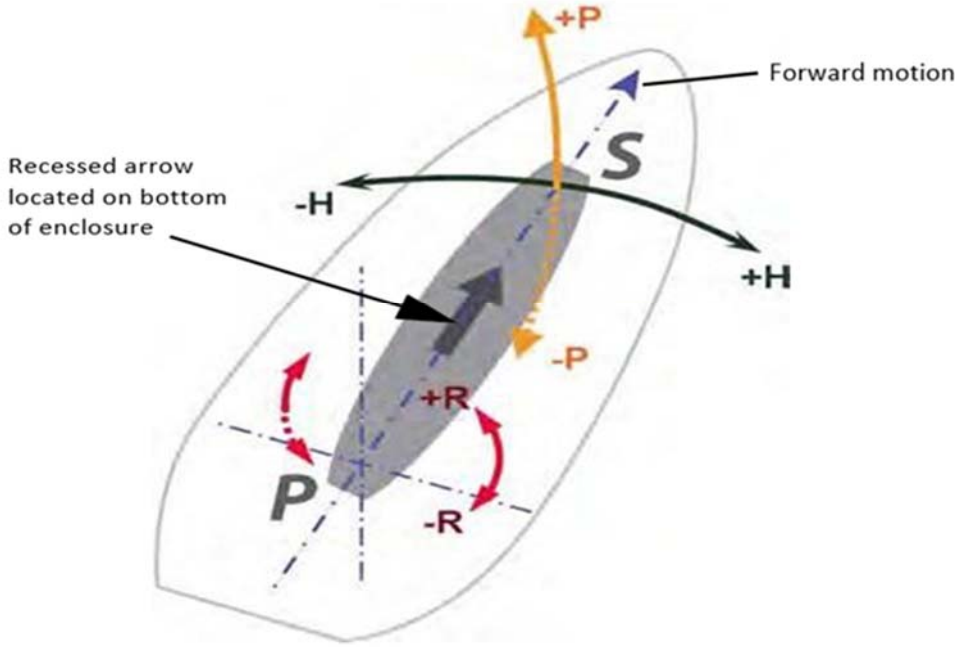


Figure 2-4: Recommended orientation and resulting signs of HPR values

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Overview, Continued

Mounting orientation example, continued**Mounting orientation example,**

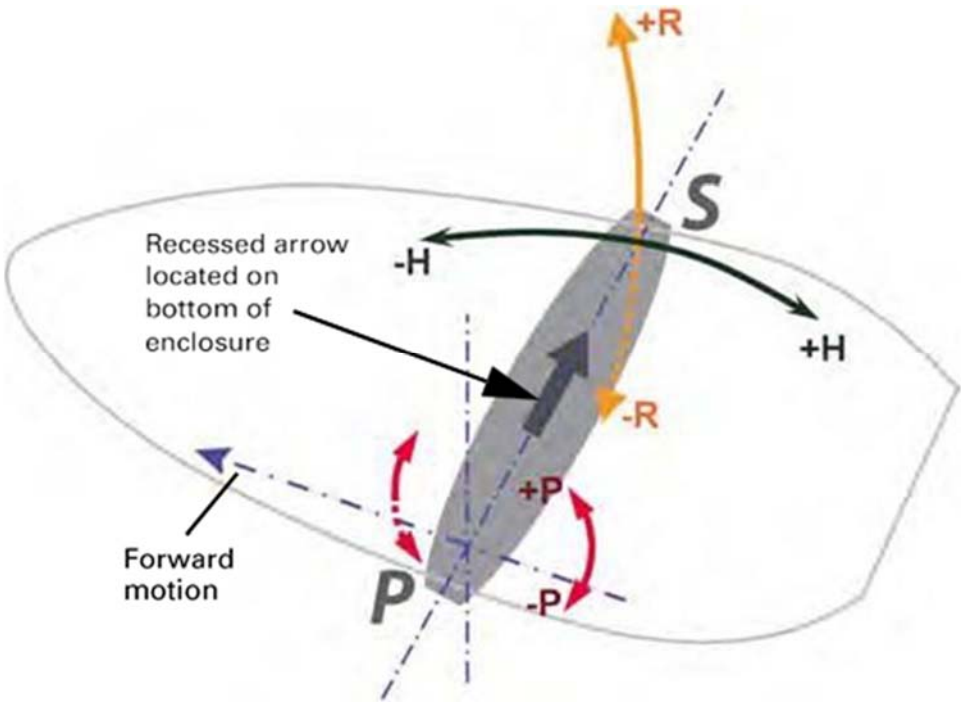

Figure 2-5: Alternate orientation and resulting signs of HPR values

Continued on next page

Overview, Continued

V200n dimensions

Figure 2-6 illustrates the physical dimensions of the V200n GNSS Compass.

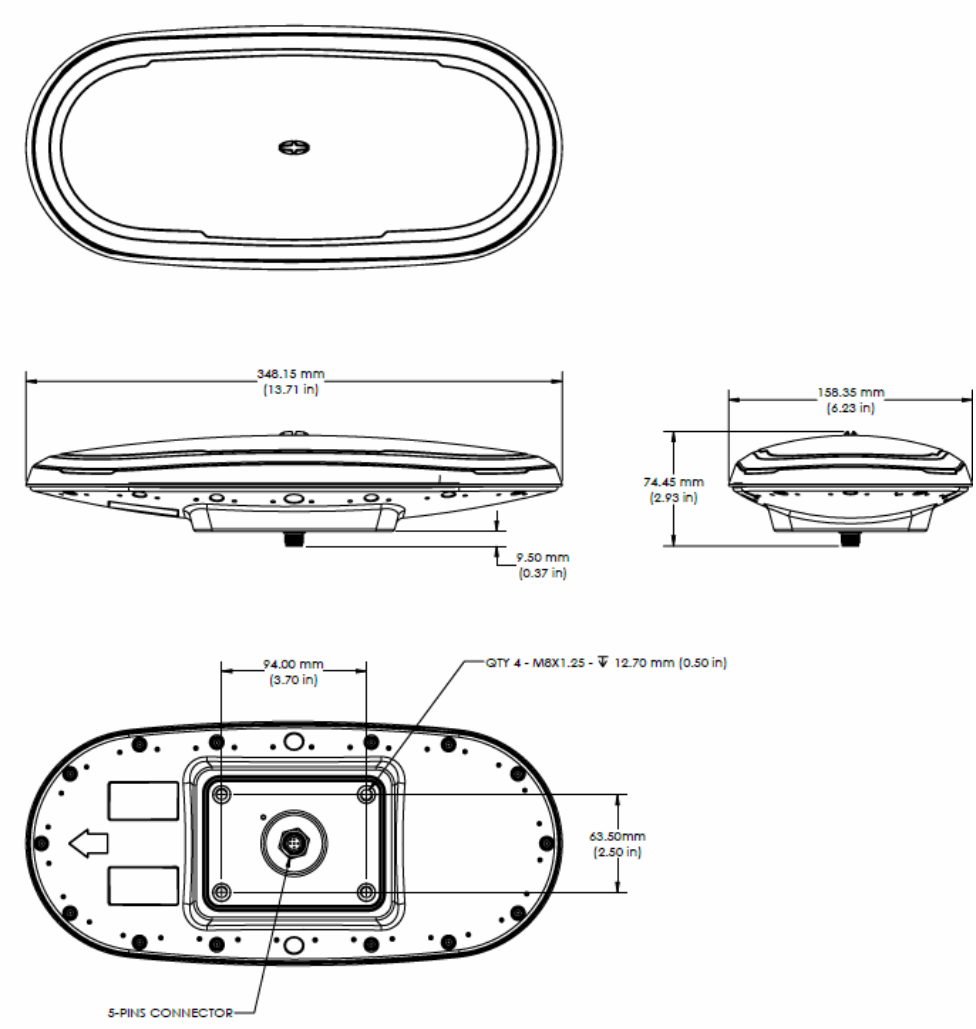

Figure 2-6: V200n dimensions

Continued on next page

Overview, Continued

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If you have another accurate source of heading data on your vessel, such as a gyrocompass, you may use its data to correct for a bias in V200n alignment within the V200n software configuration.

Alternatively, you can physically adjust the heading of the V200n so that it renders the correct heading measurement or add a software offset.

NMEA 2000 cable considerations

Before mounting the V200n, consider the following regarding NMEA 2000 cable routing:

Do	Do not
Ensure cable reaches appropriate power source	Run cables in areas of excessive heat
Keep cable away from corrosive chemicals	Run cables through a door or window jams
Connect to a data storage device, computer, or other device that accepts GNSS data	Crimp or excessively bend the cable
Keep cable away from rotating machinery	Place tension on the cable
Remove unwanted slack from the cable at the V200n end	
Secure along the cable route using plastic wrapping	

⚠WARNING:
Improperly installed cable near machinery can be dangerous.

Continued on next page

Overview, Continued

NMEA 2000 cable considerations, continued

Use the following steps to connect the NMEA 2000 cable.

Table 2-1: Connect NMEA 2000 cable

Step	Action
1	Align the cable connector key-way with the V200n connector key.
2	Rotate the cable ring clockwise, hand-tightening until it is firmly secured to the unit (see Figure 3-1).

WARNING: When installing the V200n, hand-tighten only. Damage resulting from over-tightening is not covered by the warranty.

Note: V200n performance is subject to the unit being installed in a location and environment as specified in this User Guide and using a NMEA 2000 certified cable.

Mounting options

The V200n offers four different mounting options:

- Bottom-up Surface Mounting for straight cable
- Top-down Surface Mounting for straight cable
- Top-down Surface Mounting for right-angle cable
- Pole Mounting

Note: Hemisphere GNSS does not supply mounting surface hardware or a mounting pole. You must supply the appropriate mounting hardware required to complete V200n installation.

Surface-mounting the V200n

Be mindful of the following when planning your installation:

- If you need the GNSS-assisted roll measurement, install the V200n perpendicular to the vessel's axis. If you do not need this measurement, install the V200n parallel with the vessel's axis.
- Hemisphere GNSS does not supply mounting surface hardware or a mounting pole. You must supply the appropriate hardware or mounting pole required to complete V200n installation.
- You can enter a software offset to accommodate for a heading measurement bias due to installation.
- The flat surface may be fabricated per your installation, an off-the-shelf item (such as a radar mounting plate), or an existing surface on your vessel.

Surface-mounting the V200n from the bottom up for straight cable

Complete the following steps to Surface-mount the V200n from the bottom up.

Table 2-2: Bottom-up, Surface-mounting the V200n

Step	Action
1	Determine the desired location and proper orientation for the V200n. See "Mounting Orientation" for information on determining the desired orientation.
2	Navigate to the HGNSS website Home / Products / Smart Antennas / Vector V200 GNSS Smart Antenna or to HGNSS website Home / Resources & Support / Technical Documentation / Drawings & Schematics
3	Use the supplied V200 Mounting Template drawing (from Step 2) or photocopy the bottom of the V200n to plan the mounting hole locations. If using a photocopy, make sure it is scaled one-to-one with the mounting holes on the bottom of the V200n.
4	If required, use a center punch to mark the hole centers on the mounting surface, then drill the mounting holes with a 9mm (.35 in) bit appropriate for the surface.

Continued on next page

Surface-mounting the V200n, Continued

Surface-mounting the V200n, continued

Table 2-2: Bottom-up, Surface-mounting the V200n (continued)

Step	Action
5	Place the V200n over the mounting holes and insert the mounting screws through the bottom of the mounting surface into the V200n.
6	Tighten to a torque of 10 - 13.6 nm. The maximum thread depth engagement must be no more than 1.27 cm
	⚠WARNING: **Damage resulting from over-tightening is not covered by the warranty.**

Surface-mounting the V200n from the top down for straight cable and for right-angle cable

Complete the following steps to surface-mount the V200n from the top down.

Table 2-3: Top down, Surface-mounting the V200n

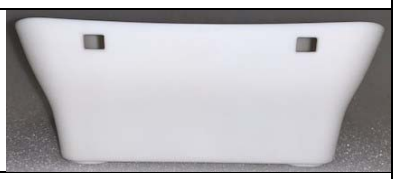
Step	Action
1	Secure the Surface Mount Adapter (676-0043-10) to the V200n using the supplied mounting hardware. Tighten to a torque of 10.8 nm - 13.6 nm. The maximum thread depth engagement must be no more than 1.27 cm!  **Figure 2-7: Surface Mount Adapter (676-0043-10)**  **Figure 2-8: Surface Mount Adapter secured to V200n**
2	Determine the desired location and proper orientation for the V200n. See "Mounting Orientation" for information on determining the desired orientation.

Continued on next page

Surface-mounting the V200n, Continued

Surface-mounting the V200n from the top down for straight cable and for right-angle cable, continued

Table 2-3: Top down, Surface-mounting the V200n (continued)

Step	Action
3	Select the applicable surface mount:
	Select this surface mount if you will thread the cable straight down.
	
	Figure 2-9: V200 Low-Profile Surface Mount (676-0041-10)
	Select this surface mount if you will thread the cable towards the back of the unit.
	
	Figure 2-10: V200 Right-Angle Surface Mount (676-0042-10)
4	Place the surface mount in the desired location on the installation surface.
5	If required, use a center punch to mark the hole centers, then drill the mounting holes with bit appropriate for the surface.
	Note: The diameter of the 676-0041-10 mounting holes is 6.4 mm (.25 in)
	
	Figure 2-11: 676-0041-10 Mounting Holes
	Note: The diameter of the 676-0042-10 mounting holes is 9 mm (.35 in)
	
	Figure 2-12: 676-0042-10 Mounting Holes
6	Secure the mount to the installation surface. Tighten to maximum torque of 13.6 nm

Continued on next page

Surface-mounting the V200n, Continued

Surface-mounting the V200n from the top down for straight cable and for right-angle cable, continued

Table 2-3: Top down, Surface-mounting the V200n (continued)

Step	Action
7	Thread the cable into through the surface mount, then connect the cable to the unit.
8	Carefully secure the mount to the V200n by placing it into the surface mount until the four latches snap into place, first on one side, and then the other.
	Low-Profile / **Right-Angle**  **Figure 2-13: Adapters with both sides secured**
	Note: To remove the V200n, simply reverse the process by pushing in the clips on one side, at which point the V200n can easily be removed.

Pole-mounting the V200n

Complete the following steps to pole-mount the V200n:

Table 2-4: Pole-mounting the V200n

Step	Action
1	Determine the desired location and proper orientation for the V200n. See "Mounting Orientation" for information on determining the desired orientation.
2	Thread the jam nut onto the 1-inch pole, then thread the pole mount.  **Figure 2-14: Pole mount with jam nut loosely threaded** **WARNING: Do not tighten the pole mount to more than 5.4 newton meter.**
3	Thread the cable either through the hollow pole or through the opening in the pole mount.
4	Connect the cable to the V200n, then secure the pole mount to the V200n using the supplied mounting hardware. Tighten to a torque of 10 - 13.6 nm. The maximum thread depth engagement must be no more than 1.27 cm!  **Figure 2-15: Pole mount secured to V200n**

Continued on next page

Pole-mounting the V200n, Continued

Pole-mounting the V200n, continued

Table 2-4: Pole-mounting the V200n (continued)

Step	Action
5	Verify the orientation of the unit, then tighten the jam nut to the bottom of the pole mount to a torque of 10 - 13.6 nm.  **Figure 2-16: Pole mount with jam nut tightly threaded to secure V200n orientation**

Chapter 3: Connecting the V200n

Overview

Introduction

This chapter provides instructions on how to connect your V200n receiver.

Contents

Ports

Overview	The V200n offers NMEA 2000 functionality.
NMEA 2000 port	Refer to Appendix C for details regarding supported NMEA 2000 messages.

Connecting the V200n to External Devices

NMEA 2000 cable pin-out specifications

The V200n uses a standard NMEA 2000 5-pin connector and does not include internal CAN termination.

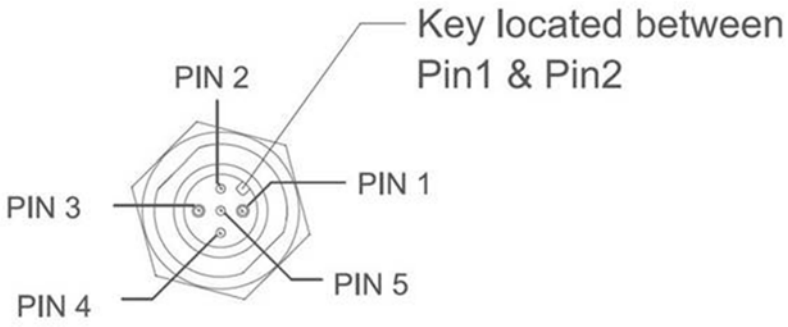


Figure 3-1: V200n pin-out assignments

Table 3-1 shows the cable pin-out specifications.

Table 3-1: V200n Pin-out (Device Out)

Pin	NMEA 2000 Mode (Device Out)
1	Shield
2	Power In
3	Power Ground
4	CAN Hi
5	CAN Lo

Pin	RS232 Mode * (Device Out)
1	Shield
2	- GND / RS232 GND
3	+ 12 Volt DC
4	RS232 TX --->
5	RS232 RX <----

Use RS232 mode only for config/fw-update

Electrical isolation

The V200n's power supply is isolated from the communication lines and the PC-ABS plastic enclosure isolates the electronics mechanically from the vessel (addressing the issue of vessel hull electrolysis).

Chapter 4: Understanding the V200n

Overview

Introduction

The GNSS receiver begins tracking satellites when it powers up and is placed outside in an open area. Position and heading accuracy vary depending upon location and environment. Position performance can be improved with RTK or DGNSS.

The following sections provide the steps to configure your V200n to use Atlas, SBAS, or RTK.

Note: Differential source and RTK status impact only positioning and heave. There is no impact to heading, pitch, or roll.

Contents

GNSS Overview

GNSS operation

The GNSS receiver is always operating, regardless of the DGNSS mode of operation. The following sections describe the general operation of the V200n's internal GNSS receiver.

Note: Differential source and status have no impact on heading, pitch, or roll. They only have an impact on positioning and heave.

The V200n provides accurate and reliable heading and position information at high update rates. To accomplish this task, the V200n uses a high performance GNSS receiver and two antennas for GNSS signal processing.

One antenna is designated as the primary GNSS antenna and the other is the secondary GNSS antenna. Positions computed by the V200n are referenced to the phase center of the primary GNSS antenna. Heading data references the Vector formed from the primary GNSS antenna phase center to the secondary GNSS antenna phase center.

The heading arrow located on the bottom of the V200n enclosure defines system orientation. The arrow points in the direction the heading measurement is computed (when the antenna is installed parallel to the fore-aft line of the vessel). The secondary antenna is directly above the arrow.

Differential Operation

Differential (DGNSS) operation	The V200n delivers positioning accuracies of 2.5 m 95% and provides positioning quality to better than 0.6 m 95% using differential corrections received through the internal SBAS demodulator or through Atlas L-band.

SBAS Tracking

SBAS tracking	The V200n features two-channel tracking that provides an enhanced ability to maintain a lock on an SBAS satellite when more than one satellite is in view. This redundant tracking approach results in more consistent tracking of an SBAS signal in areas where signal blockage of a satellite is possible.

Atlas L-band

Atlas L-band	Atlas L-band corrections are available worldwide. With Atlas, the positioning accuracy does not degrade as a function of distance to a base station, as the data content is not composed of a single base station's information, but an entire network's information. The V200n can calculate a position with 30 cm RMS (horizontal) accuracy. To configure the receiver to use Atlas L-band, a subscription must be purchased.

Supplemental Sensors

Overview

The V200n has a supplemental sensor integrated into the H220 GNSS board that is enabled by default. You can enable/disable the sensor.

The sensor acts to reduce the RTK search volume, which improves heading startup and reacquisition times. This improves the reliability and accuracy of selecting the correct heading solution by eliminating other possible, erroneous solutions.

The Hemisphere GNSS Technical Reference Manual describes the commands and methodology required to recalibrate, query, or change the sensor status.

Tilt aiding

The V200n' s internal sensor is factory calibrated and enabled by default and constrains the RTK heading solution beyond the volume associated with a fixed antenna separation.

The V200n knows the approximate inclination of the secondary antenna with respect to the primary antenna. The search space defined by the sensor is reduced to a horizontal ring on the sphere's surface by reducing the search volume and decreases startup and reacquisition times (see Figure 4-1).

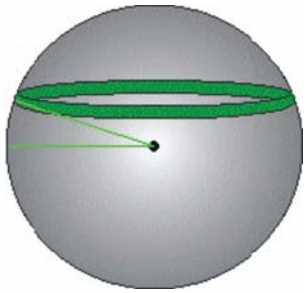


Figure 4-1: V200n tilt aiding

Continued on next page

Atlas L-band, Continued

Gyro aiding

The V200n's internal sensor reduces reacquisition times when a GNSS heading is lost due to blocked satellite signals.

The sensor provides a relative change in angle since the last computed heading and defines the search space as a wedge-shaped location (see Figure 4-2).

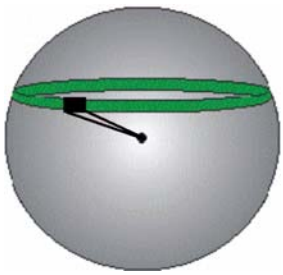


Figure 4-2: V200n gyro aiding

The gyro aiding accurately smooths the heading output and the ROT. The sensor also provides an alternate source of heading, accurate to within 1º per minute for up to three minutes in times of GNSS loss for either antenna. If the outage lasts longer than three minutes, the sensor will have drifted too far and the V200n begins outputting null fields in the heading output messages. There is no user control over the timeout period of the sensor.

The sensor initializes itself at power up and during initialization, or you can calibrate it as outlined in the Hemisphere GNSS Technical Reference Manual.

For optimal performance, when the sensor is first initializing, the dynamics the sensor experiences during this warm-up period are similar to the regular operating dynamics.

Continued on next page

Atlas L-band, Continued

Gyro aiding, continued

Gyro-aiding updates the post HTAU-smoothed heading. As a result, if the HTAU value is increased while gyro aiding is enabled, there will be little to no lag in heading output due to vessel maneuvers.

The Hemisphere GNSS Technical Reference Manual includes information on setting an appropriate HTAU value for the application.

Time Constants

Overview

The V200n incorporates user-configurable time constants that can provide a degree of smoothing to the heading, pitch, Rate-of-Turn (ROT), Course-over-Ground (COG), and speed measurements.

You can adjust these parameters depending on the expected dynamics of the vessel. For example, increasing the time is reasonable if the vessel is very large and is not able to turn quickly or would not pitch quickly. The resulting values would have reduced "noise," resulting in consistent values with time.

If the vessel is quick and nimble, increasing this value can create a lag in measurements.

If you are unsure on how to set this value, it is best to be conservative and leave it at the default setting.

Note: For heading and rate of turn there is no lag once the sensor is calibrated and enabled.

Formulas for determining the level of smoothing are located in the Hemisphere GNSS Technical Reference Manual. If you are unsure how to set this value, it is best to be conservative and leave the default setting.

Heading

Use either MSGID 0x0028 (NMEA 2000) or the $JATT,HTAU command (using the PocketMax Terminal window) to adjust the level of responsiveness of the true heading measurement. The default value of this constant is 0.1 seconds of smoothing when gyro-aid is enabled.

By disabling gyro-aid, the equivalent default value of the heading time constant should be 0.5 seconds of smoothing. This is not automatic, and therefore it must be manually entered.

Note: Increasing the time constant increases the level of heading smoothing and increases lag (with gyro-aid disabled).

Continued on next page

Time Constants, Continued

Pitch	Use either MSGID 0x003C (NMEA 2000) or the $JATT,PTAU command (using the PocketMax Terminal window) to adjust the level of responsiveness of the pitch measurement. The default value of this constant is 0.5 seconds of smoothing. **Note:** Increasing the time constant increases the level of pitch smoothing and increases lag.
Rate-of-Turn (ROT)	Use either MSGID 0x0029 (NMEA 2000) or the $JATT,HRTAU command (using the PocketMax Terminal window) to adjust the level of responsiveness of the ROT measurement. The default value of this constant is 2.0 seconds of smoothing. **Note:** Increasing the time constant increases the level of ROT smoothing.
Course-Over-Ground (COG)	Use either MSGID 0x002A (NMEA 2000) or the $JATT,COGTAU command (using the PocketMax Terminal window) to adjust the level of responsiveness of the COG measurement. The default value of this constant is 3.0 seconds of smoothing. **Note:** Increasing the time constant increases the level of COG smoothing. COG is computed using only the primary GNSS antenna and its accuracy depends upon the speed of the vessel (noise is proportional to 1/speed). This value is invalid when the vessel is stationary, as tiny movements due to calculation inaccuracies are not representative of a vessel's movement.
Speed	Use the $JATT,SPDTAU command (using the PocketMax Terminal window) to adjust the level of responsiveness of the speed measurement provided. The default value of this parameter is 3.0 seconds of smoothing. **Note:** Increasing the time constant increases the level of speed measurement smoothing.

Appendix A: Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for common problems.

Contents

Appendix A troubleshooting

Symptom	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connectors • Check power input voltage (9 to 36 VDC) • Check the voltage coming out of the connector at the end of the cable • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from V200n	• Check receiver power status to ensure the receiver is powered • Verify desired messages are activated using the $JSHOW command (in the PocketMax Terminal window) • Check integrity and connectivity of cable connections
No GNSS lock	• Verify the V200n has a clear view of the sky • Use PocketMax to check how many satellites are in view and the SNR values

Continued on next page

Troubleshooting, Continued

Appendix A troubleshooting, continued

Symptom	Possible Solution
No SBAS lock	• Verify the V200n has a clear view of the sky • Set SBAS mode to automatic with the $JWAASPRN,AUTO command **Note:** SBAS lock is only possible if you are in an appropriate SBAS region; currently, there is limited SBAS availability in the southern hemisphere.
No Atlas	• First, check to see for an Atlas Basic subscription by sending $JK,SHOW in the PocketMax Terminal window to see which commands are listed. Or, connect to PocketMax, go to the About tab, and check the listed activations • Ensure you are tracking the correct Atlas satellite, or set the receiver to 'Auto-Tune' by sending $JFREQ,AUTO in the PocketMax Terminal window.

Continued on next page

Troubleshooting, Continued

Appendix A troubleshooting, continued

Symptom	Possible Solution
No heading or incorrect heading value	• Check CSEP value is constant without varying more than 1 cm (0.39 in)—larger variations may indicate a high multipath environment and require moving the receiver location • Heading is from primary GNSS antenna to secondary GNSS antenna, so the arrow on the underside of the V200n is directed to the bow side • Sending the $JATT,SEARCH command (in the PocketMax Terminal window) forces the V200n to acquire a new heading solution (unless gyro is enabled) • Enable GYROAID to provide heading for up to three minutes during GNSS signal loss • Enable TILTAID to reduce heading search times • Monitor the number of satellites and SNR values for both antennas within PocketMax—at least four satellites should have strong SNR values • The volume of data requested for output by the V200n could be higher than the current baud rate supports.

Appendix B: Technical Specifications

Technical Specifications

Introduction

Appendix B provides the V200n technical specifications, and the V200n certification information.

Contents

V200n technical specifications

Table B-1: V200n sensor and positioning accuracy

Item	Specification
Receiver type	Vector sFreq GNSS Compass
Signals Received	GPS, GLONASS, BeiDou, Galileo, QZSS[1], and Atlas
Channels	422
GPS sensitivity	-142 dBm
SBAS tracking	2-channel, parallel tracking
Update rate (position and heading)	10 Hz standard, 20 Hz optional
Positioning accuracy (Standard)	1.2 m RMS (Autonomous, no SA) [1] 0.30 m RMS (SBAS) [2]
Positioning accuracy (Optional)	0.30 m RMS (Atlas) [3]
Heading accuracy (Standard)	1.5° RMS [1]
Heading accuracy (Optional)	0.75° RMS [1]
Heave accuracy (GNSS)	30 cm [4]
Pitch/Roll accuracy	1.5° RMS
Rate of turn	90°/s maximum
Cold start	60 s typical (no almanac or RTC)
Warm start	20 s typical (almanac and RTC)
Hot start	1 s typical (almanac, RTC, and position)
Heading fix	10 s typical (valid position)
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288m (60,000 ft)
Compass safe distance	50 cm [5]
Differential options	Atlas, SBAS

Continued on next page

V200n Technical Specifications, Continued

V200n technical specifications, continued

Table B-2: Communication

Item	Specification
Connector ports	5-pin
Ports	NMEA 2000
Data I/O Protocol	NMEA 2000

Table B-3: Power

Item	Specification
Input voltage	6 to 36 VDC
Power consumption	SBAS: 3.2 W (multi-GNSS, typical continuous draw @ 12V) Atlas: 3.6 W (multi-GNSS, typical continuous draw @ 12V
Power isolation	Isolated to enclosure
Reverse polarity protection	Yes

Continued on next page

V200n Technical Specifications, Continued

V200n technical specifications, continued

Table B-4: Mechanical

Item	Specification
Dimensions No Mount: Pole Mount:	 34.8 L x 15.8 W x 6.5 H (cm) 34.8 L x 15.8 W x 14.3 H (cm)
Weight (no mount)	0.75 kg
Power/data connector	5-pin
Aiding Devices Gyro: Tilt Sensor:	 Provides smooth heading, fast heading reacquisition and reliable 1˚ per minute heading for periods up to 3 minutes when loss of GPS has occurred [2] Provides pitch and roll data and assist in fast start-up and reacquisition of heading solution

Table B-5: Environmental

Item	Specification
Operating temperature	-40°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
Enclosure	ISO 60529:2013 for IPx6/IPx7/IPx9
Vibration	IEC 60945:2002 Section 8.7 Vibration
EMC	IEC60945:2002 EN 301 489-1 V2.1.1 EN 301 489-5 V2.1.1 EN 301 489-19 V2.1.0 EN 303 413 V1.1.1

Continued on next page

V200n Technical Specifications, Continued

V200n technical specifications, continued

Table B-6: Certifications

Certification
NMEA 2000
RCM (Australia)

1 Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity

2 Depends on multipath environment, number of satellites in view, SBAS coverage and satellite geometry

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

4 Based on a 40 second time constant

5 This is the minimum safe distance measured when the product is placed in the vicinity of the steering magnetic compass. The ISO 694 defines “vicinity” relative to the compass as within 5 m (16.4 ft) separation

Appendix C: Commands and Messages

Overview

Contents

NMEA 2000 Messages

V200n NMEA 2000 received messages

Table C-1: NMEA 2000 messages received based on a request

PGN	Description	Default Update Rate (msec)	Freq (Hz)
059392	ISO Acknowledgement Used to acknowledge the status of certain requests addressed to a specific ECU.	On Request	On Request
059904	ISO Request Request the transmission of a specific PGN, addressed or broadcast.	On Request	On Request
060928	ISO Address Claim Used to identify to other ECUs the address claimed by an ECU.	On Request	On Request
126996	Product Information NMEA 2000 database version supported, manufacturer's product code, NMEA 2000 certification level, Load Equivalency number, and other product- specific information.	On Request	On Request
126464	Receive/Transmit PGNs group function The Transmit / Receive PGN List Group type of function is defined by the first field.	On Request	On Request

Continued on next page

Overview, Continued

V200n NMEA 2000 received messages, continued

Table C-1: NMEA 2000 messages received based on a request (continued)

PGN	Description	Default Update Rate (msec)	Freq (Hz)
129545	GNSS RAIM Output Used to provide the output from a GNSS receiver's Receiver Autonomous Integrity Monitoring (RAIM) process. The Integrity field value is based on the parameters set in PGN 129546 GNSS RAIM Settings.	On Request	On Request
129546	GNSS RAIM Settings Used to report the control parameters for a GNSS Receiver Autonomous Integrity Monitoring (RAIM) process.	On Request	On Request

Continued on next page

Overview, Continued

V200n NMEA 2000 transmitted messages

Table C-2: NMEA 2000 transmitted messages

PGN	Description	Default Update Rate (msec)	Freq (Hz)
126992	System Time The purpose of this PGN is twofold: 1) To provide a regular transmission of UTC time and date, and 2) To provide synchronism for measurement data	1000	1
126993	Heartbeat Confirms a device is still present on the network.	60000	1/60
127250	Vessel Heading Heading sensor value with a flag for True or Magnetic. If the sensor value is Magnetic, the deviation field can be used to produce a Magnetic heading, and the variation field can be used to correct the Magnetic heading to produce a True heading.	100	10
127251	Rate of Turn Rate of change of heading.	100	10

Continued on next page

Overview, Continued

NMEA 2000 transmitted messages, continued

Table C-2: NMEA 2000 transmitted messages (continued)

PGN	Description	Default Update Rate (msec)	Freq (Hz)
127257	Altitude Provides a single transmission that describes the position of a vessel relative to both horizontal and vertical planes. Altitude can be used for vessel stabilization, vessel control and onboard platform stabilization.	1000	1
127258	Magnetic Variation Message for transmitting variation. The message contains a sequence number to synchronize other messages such as Heading or Course over Ground. The quality of service and age of service are provided to determine appropriate level of service if multiple transmissions exist.	1000	1

Continued on next page

Overview, Continued

NMEA 2000 transmitted messages, continued

Table C-2: NMEA 2000 transmitted messages (continued)

PGN	Description	Default Update Rate (msec)	Freq (Hz)
129025	Position, Rapid Update Provides latitude and longitude referenced to WGS84. A single frame message (opposed to other PGNs that include latitude and longitude and are defined as fast or multi- packet), this PGN lends itself to more frequent transmission without using excessive bandwidth.	100	10
129026	COG & SOG, Rapid Update Single frame PGN that provides Course Over Ground (COG) and Speed Over Ground (SOG).	250	4

Continued on next page

Overview, Continued

NMEA 2000 transmitted messages, continued

Table C-2: NMEA 2000 transmitted messages (continued)

PGN	Description	Default Update Rate (msec)	Freq (Hz)
129027	Position Delta, High Precision Rapid Update The 'Position Delta, High Precision Rapid Update' Parameter Group is for applications requiring high precision and very fast update rates for position data. This PGN provides delta position changes down to 1 mm with a delta time period accurate to 5 msec.	100	10
129028	Altitude Delta, High Precision Rapid Update The 'Altitude Delta, High Precision Rapid Update' Parameter Group is intended for applications requiring high precision and fast update rates are needed for altitude and course over ground data. This PGN can provide delta altitude changes down to 1 millimeter, a change in direction as small as 0.0057°, and with a delta time period accurate to 5 msec.	100	10

Continued on next page

Overview, Continued

NMEA 2000 transmitted messages, continued

Table C-2: NMEA 2000 transmitted messages (continued)

PGN	Description	Default Update Rate (msec)	Freq (Hz)
129029	GNSS Position Data Conveys a comprehensive set of Global Navigation Satellite System (GNSS) parameters, including position information.	1000	1
129033	Time & Date Single transmission that provides UTC time, UTC Date, and Local Offset.	1000	1
129539	GNSS DOPs Provides a single transmission containing GNSS status and dilution of precision components (DOP) that indicate the contribution of satellite geometry to the overall positioning error. Three DOP parameters are reported: horizontal (HDOP), Vertical (VDOP), and time (TDOP).	1000	1

Continued on next page

Overview, Continued

NMEA 2000 transmitted messages, continued

Table C-2: NMEA 2000 transmitted messages (continued)

PGN	Description	Default Update Rate (msec)	Freq (Hz)
129540	GNSS Sats in View GNSS information on current satellites in view tagged by sequence ID. Information includes PRN, elevation, azimuth, SNR, defines the number of satellites; defines the satellite number and the information.	1000	1
126993	Heartbeat Periodically announces presence on the CAN bus.	60000	0.016667

Continued on next page

Overview, Continued

NMEA 2000 transmitted messages, continued

Table C-2: NMEA 2000 transmitted messages (continued)

PGN	Description	Default Update Rate (msec)	Freq (Hz)
129033	Local Time Offset Indicates offset between a configured local time and UTC. As of currently we do not support a local time, so this always reports no offset.	On Request	On Request
126998	Configuration Information Used for returning fields describing an installation. Currently always returns blank.	On Request	On Request

NMEA 2000 Proprietary Messages

For NMEA 2000 proprietary messages via CAN for tasks such as receiver configuration, please refer to the Hemisphere GNSS website/Resources & Support/Technical Documentation/NMEA Proprietary Messages Reference Manual.

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NMEA 2000 proprietary messages

The following lists NMEA 2000 proprietary messages.

Table C-3: NMEA 2000 proprietary messages

NMEA 2000 proprietary messages
Single Frame packet definition - PGN: EFXX (Destination addressable)
MSGID 0x0001 - N2K,MCODE
MSGID 0x0002 - N2K,PCODE
MSGID 0x0003 - N2K,LOAD
MSGID 0x0004 - N2K,CERT
MSGID 0x0005 - JVERSION
MSGID 0x0006 - N2K,RESET
MSGID 0x0007 - N2K,ADDRESS
MSGID 0x0008 - JDIFF
MSGID 0x0009 - JDIFF,INCLUDE
MSGID 0x000A - JMODES
MSGID 0x000B - JSBASPRN
MSGID 0x000C - JBAUD,PORTx
MSGID 0x000D - JMASK
MSGID 0x000E - JATT,TILTAID
MSGID 0x000F - JATT,TILTCAL
MSGID 0x0010 - JATT,HBIAS
MSGID 0x0011 - JATT,PBIAS
MSGID 0x0012 - JATT,GYROAID
MSGID 0x0013 - JRESET
MSGID 0x0014 - JI, serial number
MSGID 0x0015 - JRAIM
MSGID 0x0016 - JATT,HIGHMP
MSGID 0x0017 - JAPP
MSGID 0x0018 - JAGE
MSGID 0x0019 - BIN1, stdev residuals
MSGID 0x001A - RD1
MSGID 0x001B - JK (read)
MSGID 0x001D - JWCONF,12

Continued on next page

, Continued

NMEA 2000 proprietary messages, continued

Table C-3: NMEA proprietary messages

NMEA 2000 proprietary message
Single Frame packet definition - PGN: EFXX (Destination addressable)
MSGID 0x001F - JI, application version
MSGID 0x0020 - JSYSVER
MSGID 0x0021 - JT
MSGID 0x0022 - JATT,MSEP
MSGID 0x0023 - JATT,CSEP
MSGID 0x0025 - NMEA2000 Message Control
MSGID 0x0026 - JNP
MSGID 0x0027 - JSMOOTH
MSGID 0x0028 - JATT,HTAU
MSGID 0x0029 - JATT,HRTAU
MSGID 0x002A - JATT,COGTAU
MSGID 0x002C - JATT,NEGTILT
MSGID 0x002E - JATT,LEVEL
MSGID 0x002F - JATT,MOVEBAS
MSGID 0x0031 - GPHEV Heave
MSGID 0x0032 - JSAVE
MSGID 0x0034 - INTLT Raw Tilt Values
MSGID 0x0037 - Distance to Base
MSGID 0x0038 - JFREQ
MSGID 0x0039 - JLIMIT
MSGID 0x003A - JAIR
MSGID 0x003B - JATT,EXACT
MSGID 0x003C - JATT,PTAU
MSGID 0x003D - JATT,ROLL
MSGID 0x003E - JPOS

MSGID 0x003F - Serial Messages
MSGID 0x0040 - HPR StdDev
MSGID 0x0045 - JGEO

Continued on next page

, Continued

NMEA 2000 proprietary messages, continued

Table C-3: NMEA proprietary messages (continued)

NMEA 2000 proprietary message
Multi-Frame Fast-Packet definition – PGN: 1EFXX (Destination addressable)
MSGID 0x8001 - N2K,VERSION
MSGID 0x8003 - JPOSOFFSET
MSGID 0x8004 - JVERSION
MSGID 0x8005 - JAUTH
MSGID 0x8008 - Generic GNSS Serial Command
MSGID 0x8009 - RAW data transfer for differential
MSGID 0x800A - JI, Extended info
MSGID 0x800B - N2K,MODEL
MSGID 0x800D - RTKSTAT
MSGID 0x800E - ATTSTAT

Main contact:

ProNav Norge AS / JRC Nord Europa
Hovlandsveien 52
4374 Egersund – Rogaland
Norway
e-mail: service@pronav.no Tlf: +47 51 46 43 00

Dokument revision:

Rev.3 20201214 – Added mounting recommendation.
Rev.2 20191025 – Added GPS smoothing
Rev.2 20191024 – Changed sea trail
Rev.1 – Internal revision version.