Hemisphere GPS

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Vector VS131 GPS Compass

User Guide

Part No. 875-0311-000 Rev. A1

Hemisphere GPS

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Chapter 1: Introduction

What's In This Guide?

Product Overview and Features

What's Included in Your Kit

Using VectorPC to Communicate with the VS131

What's In This Guide?

This User Guide provides the following information to get you up and running quickly with your Vector™ VS131™ GPS receiver compass.

- This chapter briefly describes the VS131 and the parts in your VS131 kit.
- Chapter 2, "Understanding the VS131" discussing GPS and differential operation as well as sensors and time constants related to the VS131.
- Chapter 3, "Installing the VS131" describes how to mount the antennas and receiver, connect the cables, and power the system.
- Chapter 4, "Operating the VS131" provides instructions on configuring the receiver, disabling aiding features, adjusting the time constants, and operating the receiver.
- Appendix A, "Troubleshooting" provides possible solutions for issues.
- Appendix B, "FAQ" includes answer to common questions.
- Appendix C, "Menu Map" provides a full map of all system menus.
- Appendix D, "Technical Specifications" lists the technical specifications of the VS131 and the included antennas.

Note: Throughout the rest of this user guide the Vector VS131 GPS Compass is referred to simply as the VS131.

Product Overview and Features

The VS131 (Figure 1-1) provides a highly-accurate GPS heading that takes into account the pitch, roll, and speed of various vehicles and vessels and is ideal for professional machine control and navigation applications in areas where either beacon or L-band positioning can be achieved. Featuring a Hemisphere GPS Crescent® Vector-based receiver and two separate antennas, VS131 achieves heading accuracy ranging from 0.1° to 0.3° rms (depending on the antenna separation) and offers robust positioning performance.

Figure 1-1: VS131 receiver and antennas

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Other key features of the VS131 include:

- Heave < 30 cm rms (DGPS)
- Pitch and roll < 1° rms
- Simple menu operations
- Accurate heading up to 3 minutes during GPS outages
- Integrated gyro and tilt sensors deliver fast start-up times and provide heading updates during temporary loss of GPS
- L-band, beacon, and SBAS capable

With more accurate code phase measurements, improved multipath mitigation and fewer components than competing products, VS131 offers superior accuracy and stability.

The VS131 receiver, with its display and user interface, can be conveniently installed near the operator, while the two antennas are mounted separately with a user-determined separation (up to 5 m) to meet the desired accuracy.

VS131 uses L-band, SBAS (WAAS, EGNOS, MSAS, etc.), or beacon for differential GPS positioning—offering differential positioning performance of less than 0.6 m 95% of the time.

VS131 also features Hemisphere GPS' exclusive COAST™ technology that enables Hemisphere GPS receivers to utilize aging differential GPS correction data for 40 minutes or more without significantly affecting positioning quality. VS131 is less likely to be affected by differential signal outages due to signal blockages, weak signals, or interference when using COAST.

What's Included in Your Kit

Your VS131 kit (Figure 1-2 on page 4) includes the following parts:

- VS131 receiver and related mounting hardware
- Antennas and related mounting hardware
- Power, data, and antenna cables

Table 1-1 on page 4 provides the description and part number of each part in your kit.

Review the parts shipped with your kit: if any parts are damaged, contact your freight carrier. If any parts are missing, contact your dealer.

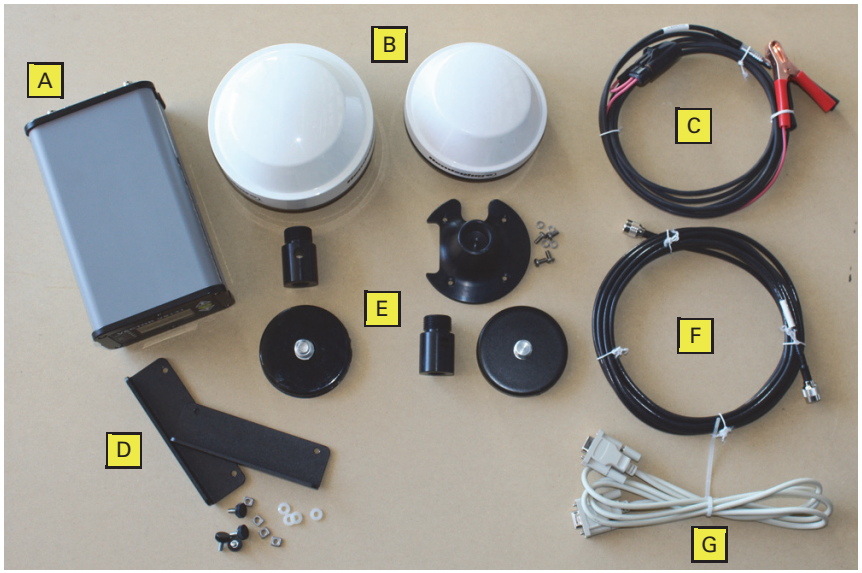

Figure 1-2: VS131 system parts diagram

Table 1-1: Parts list

Item	Part Name	Qty	Part Number
A	VS131 receiver	1	803-3022-000#
B	Antennas A21 antenna A31 antenna	 1 1	 804-3036-000# 804-3043-000#
C	Power cable, circular	1	054-0118-000#
D	Receiver mounting kit (two brackets and related hardware)	1	710-0056-000#
E	Antenna mounting kit A21 antenna mounting kit A31 antenna mounting kit ***Note:*** *Your kit may not include a mag mount.*	 1 1	 710-0110-000# 710-0111-000#
F	Antenna cable, TNC male to TNC male, 10 m	2	052-0004-000#
G	Data cable, DB-9 female to DB-9 male, 3 m	2	050-0011-022#

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Using VectorPC to Communicate with the VS131

Hemisphere GPS' VectorPC is a free utility program that runs on your Windows PC or Windows mobile device. Simply connect your Windows device to the VS131 via the COM port and open VectorPC. The screens within VectorPC allow you to easily interface with the VS131 to:

- Select the internal SBAS, beacon, or L-band correction source, if available, and monitor reception
- Configure GPS message output and port settings
- Review heading, pitch, and roll visually
- Help calculate heading offset or heading bias

VectorPC is available for download from the Software Downloads page of the Precision Product Support section on the Hemisphere GPS website (www.hemispheregps.com).

Table D-19: A31 environmental specifications

Specification	Description
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Operating temperature	-30°C to +70°C (-22°F to +158°F)
Enclosure rating	IP69K
Shock and vibration	EP 455
Humidity	95%, non-condensing

A31 Antenna Specifications

Table D-14 through Table D-19 list the technical specifications of the A31 antenna.

Table D-14: A31 GNSS sensor specifications

Specification	Description
GNSS reception	GPS, SBAS, L-band, and beacon
GNSS frequency	1.575 GHz (L1)
LNA gain	30 dB
LNA noise	< 2.0 dB

Table D-15: A31 L-Band sensor specifications

Specification	Description
L-Band frequency	1.525 - 1.585 GHz
L-Band LNA gain	30 dB

Table D-16: A31 Beacon sensor specifications

Specification	Description
Beacon frequency	283.5 - 325 kHz
Beacon LNA gain	30 dB

Table D-17: A31 power specifications

Specification	Description
Input voltage	5 to 12 VDC
Input current	50 to 60 mA

Table D-18: A31 mechanical specifications

Specification	Description
Enclosure	Lexan
Dimensions	10.4 H x 14.5 D (cm) 4.1 H x 5.7 D (in)
Weight	734 g (25.9 oz)
Mounting thread	1" coarse thread (5/8" adapter available)
Connector	TNC

Chapter 2: Understanding the VS131

GPS Overview

VS131 Overview

GPS Overview

For your convenience, both the GPS and SBAS operation of the VS131 features automatic operational algorithms. When powered for the first time, the VS131 performs a "cold start," which involves acquiring the available GPS satellites in view and the SBAS differential service.

If SBAS is not available in your area, an external source of RTCM SC-104 differential corrections may be used. If you use an external source of correction data, it must support an eight data bit, no parity, one stop bit configuration (8-N-1).

GPS Operation

The GPS receiver is always operating, regardless of the DGPS mode of operation. The following sections describe the general operation of the VS131's internal GPS receiver.

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

Automatic Tracking

The VS131's internal GPS receiver automatically searches for GPS satellites, acquires the signals, and manages the navigation information required for positioning and tracking.

Receiver Performance

The VS131 works by finding four or more GPS satellites in the visible sky. It uses information from the satellites to compute a position within 2.5 m. Since there is some error in the GPS data calculations, the VS131 also tracks a differential correction. The VS131 uses these corrections to improve its position accuracy to better than 0.6 m.

There are two main aspects of GPS receiver performance:

- Satellite acquisition
- Positioning and heading calculation

When the VS131 is properly positioned, the satellites transmit coded information to the antennas on a specific frequency. This allows the receiver to calculate a range to each satellite from both antennas. GPS is essentially a timing system. The ranges are calculated by timing how long it takes for the signal to reach the GPS antenna. The GPS receiver uses a complex algorithm incorporating satellite locations and ranges to each satellite to calculate the geographic location and heading. Reception of any four or more GPS signals allows the receiver to compute three-dimensional coordinates and a valid heading.

Differential Operation

The purpose of differential GPS (DGPS) is to remove the effects of selective availability (SA), atmospheric errors, timing errors and satellite orbit errors, while enhancing system integrity.

Autonomous positioning capabilities of the VS131 will result in positioning accuracies of 2.5 m 95% of the time. To improve positioning quality to sub-meter levels, the VS131 is able to use differential corrections received through the internal SBAS demodulator or externally-supplied RTCM corrections.

A21 Antenna Specifications

Table D-9 through Table D-13 list the technical specifications of the A21 antenna.

Table D-9: A21 GNSS sensor specifications

Specification	Description
GNSS reception	GPS, SBAS, and L-band
GNSS frequency	1.575 GHz (L1)
LNA gain	30 dB
LNA noise	< 2.0 dB

Table D-10: A21 L-Band sensor specifications

Specification	Description
L-Band frequency	1.525 - 1.585 GHz
L-Band LNA gain	30 dB

Table D-11: A21 power specifications

Specification	Description
Input voltage	3.3 to 12 VDC
Input current	24 mA, typical

Table D-12: A21 mechanical specifications

Specification	Description
Enclosure	Aluminum base with ASA plastic cap
Dimensions	7.0 H x 13.0 D (cm) 2.8 H x 5.1 D (in)
Weight	380 g (13.4 oz)
Mounting thread	5/8" female thread
RF connector	TNC

Table D-13: A21 environmental specifications

Specification	Description
Operating temperature	-30°C to +70°C (-22°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Enclosure rating	IP69K
Shock and vibration	EP455
Humidity	96% non condensing

Table D-6: VS131 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
Enclosure rating	IP66 (IEC 60529)
Shock and vibration	Mechanical Shock: EP455 Section 5.14.1 Vibration: EP455 Section 5.15.1 Random
EMC	CE (IEC 60945 Emissions and Immunity), FCC Part 15, Subpart B, CISPR 22
IMO wheelmarked certification	No

Table D-7: VS131 mechanical specifications

Item	Specification
Dimensions	20.2 L x 12.0 W x 7.5 H (cm) 8.0 L x 4.7 W x 3.0 H (in)
Weight	~1.1 kg (2.5 lb)
Status indications (LEDs)	Power, primary GPS lock, secondary GPS lock, differential lock, DGPS position, heading, RTK lock, L-band lock
Power switch	Front panel soft switch
Power connector	2-pin ODU metal circular
Data connectors	(2) DB9 sealed
Antenna connectors	(2) TNC female

Table D-8: Aiding devices

Item	Specification
Gyro	Provides smooth heading, fast heading reacquisition, and reliable < 1° per minute heading for periods up to 3 minutes when loss of GPS has occurred.[6]
Tilt Sensors	Provide pitch, roll data and assist in fast start-up and reacquisition of heading solution.

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

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

[3]Requires a subscription from L-band service provider

[4]Based on a 40 second time constant

[5]Hemisphere GPS proprietary

[6]Under static conditions

In addition to these differential services the VS131 can also receive radiobeacon corrections. You can also purchase the VS131 with an RTK rover option, which enables 0.02 m positioning performance when paired with a suitable Hemisphere GPS RTK base receiver product.

For more information on the differential services and the associated commands refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

Automatic SBAS Tracking

The VS131 automatically scans and tracks SBAS signals without the need to tune the receiver. The VS131 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.

Beacon Operation

Many marine authorities, such as coast guards, have installed networks of radiobeacons that broadcast DGPS corrections to users of this system. With the increasing utility of these networks for terrestrial applications, there is an increasing trend toward densification of these networks inland. The dual channel beacon receiver in the VS131 can operate in manual or automatic tuning mode, or, using database mode, will select the closest station in compliance with IEC 61108-4 standards.

RTK

Real time kinematic (RTK) technology is available on Crescent-based GPS receivers. RTK requires the use of two separate receivers: a stationary base station (primary receiver) that broadcasts corrections over a wireless link to the rover (secondary receiver). The localized corrections are processed on the rover to achieve superior accuracy and repeatability. Performance testing has shown positioning accuracy at the centimeter level.

L-Band

L-band corrections are available worldwide through third-party providers. With this service, 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.

VS131 Overview

The VS131 provides accurate and reliable heading and position information at high update rates. To accomplish this task, the VS131 uses a high performance GPS receiver and two antennas for GPS signal processing. One antenna is designated as the primary GPS antenna and the other is the secondary GPS antenna. Positions computed by the VS131 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.

Fixed Baseline Moving Base Station RTK

The VS131's internal GPS receiver uses both the L1 GPS C/A code and carrier phase data to compute the location of the secondary GPS antenna in relation to the primary GPS antenna with a very high sub-centimeter level of precision. The technique of computing the location of the secondary GPS antenna with respect to the primary antenna, when the primary antenna is moving, is often referred to as moving base station Real Time Kinematic (or moving base station RTK).

Generally, RTK technology is very sophisticated and requires a significant number of possible solutions to be analyzed where various combinations of integer numbers of L1 wavelengths to each satellite intersect within a certain search volume. The integer number of wavelengths is often referred to as the "ambiguity" as they are initially ambiguous at the start of the RTK solution.

The VS131 restricts the RTK solution by knowing that the secondary GPS antenna is a fixed distance from the primary GPS antenna. The default value is 1.0 m, but you may install the antennas with a different separation distance, then enter that value into the VS131. This is called a fixed baseline and it defines the search volume of the secondary antenna as the surface of a sphere with radius 1.0 m centered on the location of the primary antenna (see Figure 2-1).

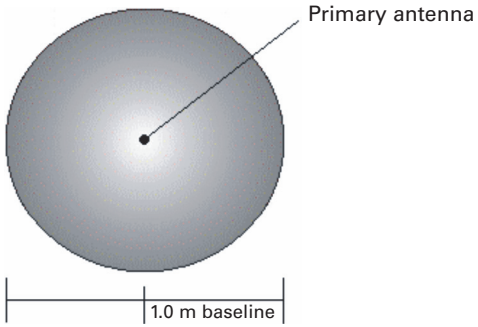


Figure 2-1: Secondary antenna's search volume

Note: The VS131 moving base station algorithm only uses GPS to calculate heading. Differential and RTK corrections are not used in this calculation and will not affect heading accuracy.

Table D-3: VS131 L-band sensor specifications

Item	Specification
Sensitivity	-130 dBm
Channel spacing	7.5 kHz
Satellite selection	Manual and automatic
Reacquisition time	15 seconds (typical)
Rejection	15 kHz spacing > 30 dB 300 kHz spacing > 60 dB
Processor	DSP for demodulation and protocol decoding module provides processing for differential algorithms
Command support	Reports L-band region and satellite information Allows input and status of L-band subscription, bit error rate (BER) output for reception quality indication, and manual frequency tuning

Table D-4: VS131 communication specifications

Item	Specification
Serial ports	2 full-duplex RS-232
USB ports	1 USB-B
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Crescent binary[5], L-Dif[5]
Correction I/O protocol	RTCM v2.3 (DGPS), RTCM SC-104, L-Dif[5]
Timing output	1 PPS CMOS, active high, rising edge sync, 10 kΩ, 10 pF load

Table D-5: VS131 power specifications

Item	Specification
Power input voltage	8 to 36 VDC
Power consumption	< 4.5 W nominal (L1 GPS and L-band) < 3.6 W nominal (L1 GPS)
Current consumption	< 0.38 A nominal (L1 GPS and L-band) < 0.30 A nominal (L1 GPS)
Power isolation	500 V
Reverse polarity protection	Yes
Antenna short circuit protection	Yes

VS131 Receiver Specifications

Table D-1 through Table D-7 list the technical specifications of the VS131.

Table D-1: VS131 GPS sensor specifications

Item	Specification		
Receiver type	L1, C/A code, with carrier phase smoothing		
Signals received	GPS		
Channels	Two 12-channel, parallel tracking (Two 10-channel when tracking SBAS)		
GPS sensitivity	-142 dBm		
SBAS tracking	2-channel, parallel tracking		
Update rate	10 Hz standard, 20 Hz available by subscription		
Horizontal accuracy		RMS (67%)	2DRMS (95%)
	RTK[1]	10 mm + 1 ppm	20 mm + 2 ppm
	L-band DGPS service[2,3]	0.3 m	0.6 m
	SBAS (WAAS)[2]	0.3 m	0.6 m
	Beacon[2]	0.3 m	0.6 m
	Autonomous, no SA[2]	1.2 m	2.5 m
Heading accuracy	< 0.33˚ rms @ 0.5 m antenna separation < 0.17˚ rms @ 1.0 m antenna separation < 0.08˚ rms @ 2.0 m antenna separation < 0.03˚ rms @ 5.0 m antenna separation		
Pitch/roll accuracy	< 1° rms		
Heave accuracy	30 cm rms[4]		
Timing (1PPS) accuracy	50 ns		
Rate of turn	90°/s maximum		
Cold start time	< 60 s typical (no almanac or RTC)		
Warm start time	< 20 s typical (almanac and RTC)		
Hot start time	< 1 s (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 D-2: VS131 beacon sensor specifications

Item	Specification
Channels	2-channel, parallel tracking
Frequency range	283.5 to 325 kHz
Operating modes	Manual, automatic, and database
Compliance	IEC 61108-4 beacon standard

Supplemental Sensors

The VS131 has an integrated gyro and two tilt sensors, which are enabled by default. Each supplemental sensor may be individually enabled or disabled. Both supplemental sensors are mounted on the printed circuit board inside the VS131.

The sensors act 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 GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon) describes the commands and methodology required to recalibrate, query, or change the sensors status.

Tilt Aiding

The VS131's accelerometers (internal tilt sensors) are factory calibrated and enabled by default. This constrains the RTK heading solution beyond the volume associated with just a fixed antenna separation. This is because the VS131 knows the approximate inclination of the secondary antenna with respect to the primary antenna. The search space defined by the tilt sensor will be reduced to a horizontal ring on the sphere's surface by reducing the search volume. This considerably decreases startup and reacquisition times (see Figure 2-2).

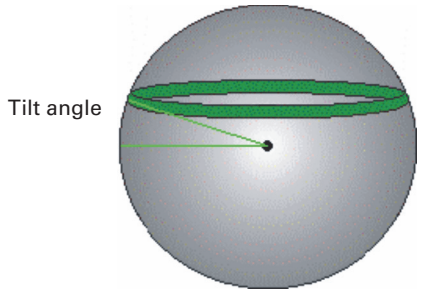


Figure 2-2: VS131's tilt aiding

Gyro Aiding

The VS131's internal gyro offers several benefits. It reduces the sensor volume for an RTK solution. This shortens reacquisition times when a GPS heading is lost because the satellite signals were blocked. The gyro provides a relative change in angle since the last computed heading, and, when used in conjunction with the tilt sensor, defines the search space as a wedge-shaped location (see Figure 2-3).

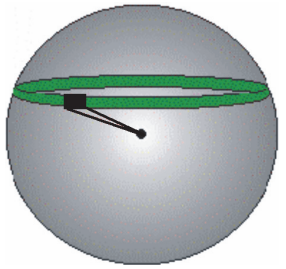


Figure 2-3: VS131's gyro aiding

The gyro aiding accurately smoothes the heading output and the rate of turn. It provides an accurate substitute heading for a short period depending on the roll and pitch of the vessel, ideally seeing the system through to reacquisition. The gyro provides an alternate source of heading, accurate to within 1° per minute for up to three minutes, in times of GPS loss for either antenna. If the outage lasts longer than three minutes, the gyro will have drifted too far and the VS131 begins outputting null fields in the heading output messages. There is no user control over the timeout period of the gyro.

The gyro initializes itself at powerup and during initialization, or you can calibrate it as outlined in the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon). When the gyro is first initializing, it is important that the dynamics that the gyro experiences during this warmup period are similar to the regular operating dynamics. For example, if you use the VS131 on a high speed, maneuverable craft, it is essential that when gyro aiding in the VS131 is first turned on, use it in an environment that has high dynamics for the first five to ten minutes instead of sitting stationary.

With the gyro enabled, the gyro is also used to update the post HTAU smoothed heading output from the moving base station RTK GPS heading computation. This means that if the HTAU value is increased while gyro aiding is enabled, there will be little to no lag in heading output due to vehicle maneuvers. The Hemisphere GPS Technical Reference includes information on setting an appropriate HTAU value for the application.

Time Constants

The VS131 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. However, if the vessel is quick and nimble, increasing this value can create a lag in measurements. Formulas for determining the level of smoothing are located in the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon). If you are unsure on how to set this value, it is best to be conservative and leave it at the default setting.

Heading Time Constant

Use the $JATT,HTAU command to adjust the level of responsiveness of the true heading measurement provided in the $GPHDT message. The default value of this constant is 2.0 seconds of smoothing when the gyro is enabled. The gyro is enabled by default, but can be turned off. By turning the gyro off, the equivalent default value of the heading time constant would be 0.5 seconds of smoothing. This is not automatically done and therefore you must manually enter it. Increasing the time constant increases the level of heading smoothing and increases lag.

Pitch Time Constant

Use the $JATT,PTAU command to adjust the level of responsiveness of the pitch measurement provided in the $PSAT,HPR message. The default value of this constant is 0.5 seconds of smoothing. Increasing the time constant increases the level of pitch smoothing and increases lag.

Appendix D: Technical Specifications

VS131 Receiver Specifications

A21 Antenna Specifications

A31 Antenna Specifications

System Setup Menu

The System Setup menu allows you quickly view and edit current system settings. General settings include such items as current applications, units, baud rates, logs, LED contrast, subscription code, display orientation (you can flip the display 180° by selecting *YES* under *Flip Display*), and language.

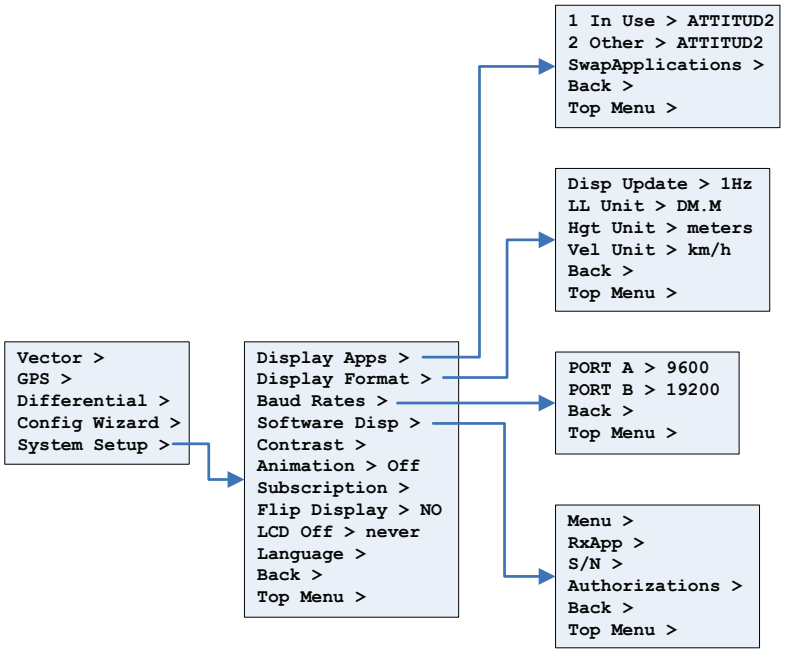


Figure C-7: System Setup menu

Rate of Turn (ROT) Time Constant

Use the $JATT,HRTAU command to adjust the level of responsiveness of the ROT measurement provided in the $GPROT message. The default value of this constant is 2.0 seconds of smoothing. Increasing the time constant increases the level of ROT smoothing.

Course Over Ground (COG) Time Constant

Use the $JATT,COGTAU command to adjust the level of responsiveness of the COG measurement provided in the $GPVTG message. The default value of this constant is 0.0 seconds of smoothing. Increasing the time constant increases the level of COG smoothing. COG is computed using only the primary GPS 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.

Speed Time Constant

Use the $JATT,SPDTAU command to adjust the level of responsiveness of the speed measurement provided in the $GPVTG message. The default value of this parameter is 0.0 seconds of smoothing. Increasing the time constant increases the level of speed measurement smoothing.

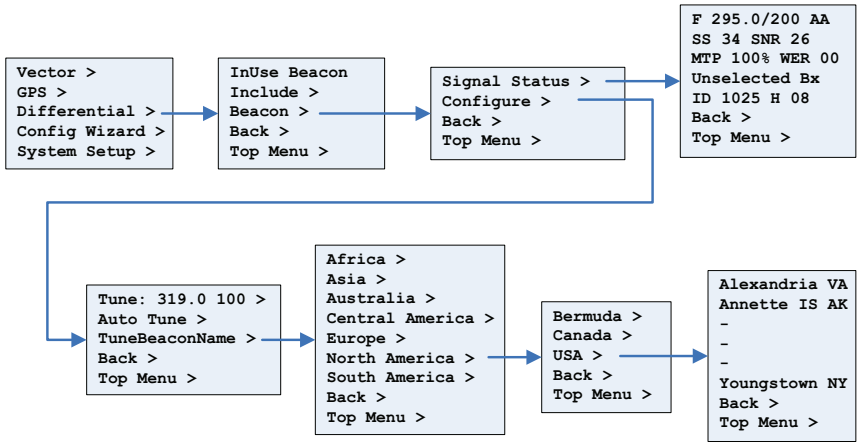


Figure C-5: Beacon menu

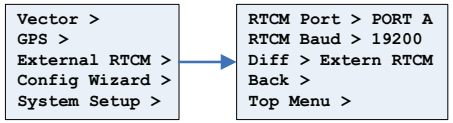


Figure C-6: External RTCM menu

Config Wizard Menu

The Config Wizard walks you through basic settings to get up and running. See “Configuration Wizard” on page 27 to view the Config Wizard menu map.

Differential Menu

Use the Differential menu to view your differential settings. From this menu, you can view your current status or adjust satellites tracked. The following available differential sources depend on the configuration you purchased.

- SBAS
- RTK (CMR, DFX, ROX, RTCM3)
- Beacon
- External RTCM
- Autonomous

Figure C-3 through Figure C-6 show the complete menu maps for the SBAS, RTK, Beacon, and External RTCM differential sources, respectively.

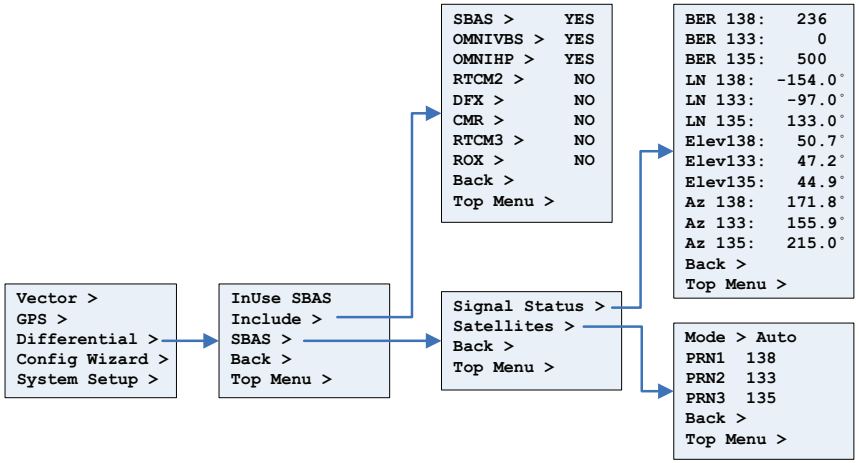


Figure C-3: SBAS menu

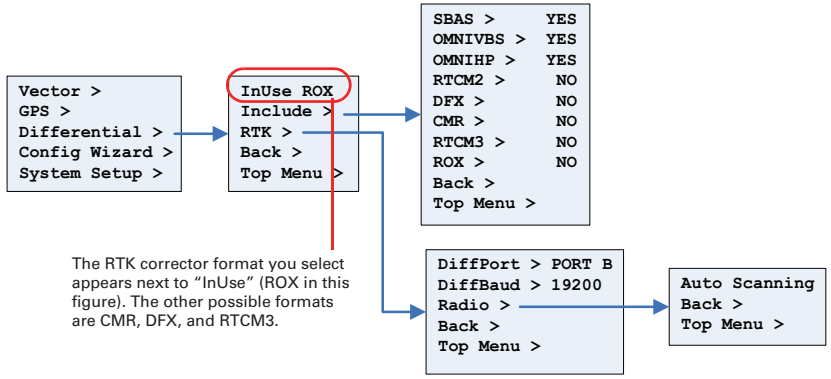


Figure C-4: RTK menu

Chapter 3: Installing the VS131

Mounting the Antennas
Mounting the Receiver
Connecting the Cables
Selecting a Port for GPS Data Message Output
Default Parameters

Mounting the Antennas

When mounting the antennas you need to consider the following:

- Mounting orientation (parallel or perpendicular)
- Proper antenna placement
- Magnetic, pole, or rail mounting

⚠WARNING: When installing the receiver and antennas the receiver display must face the primary antenna or you will have to disable tilt aiding.

Mounting Orientation

The VS131 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.

Regardless of which mounting orientation you use, the VS131 provides the ability to output the heave of the vessel. This output is available 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 VS131 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.

GPS Menu

Use the GPS menu to view and edit your GPS settings. Settings include the data port outputs, specific positioning parameters, UTC time offset, and satellite visibility and positioning information.

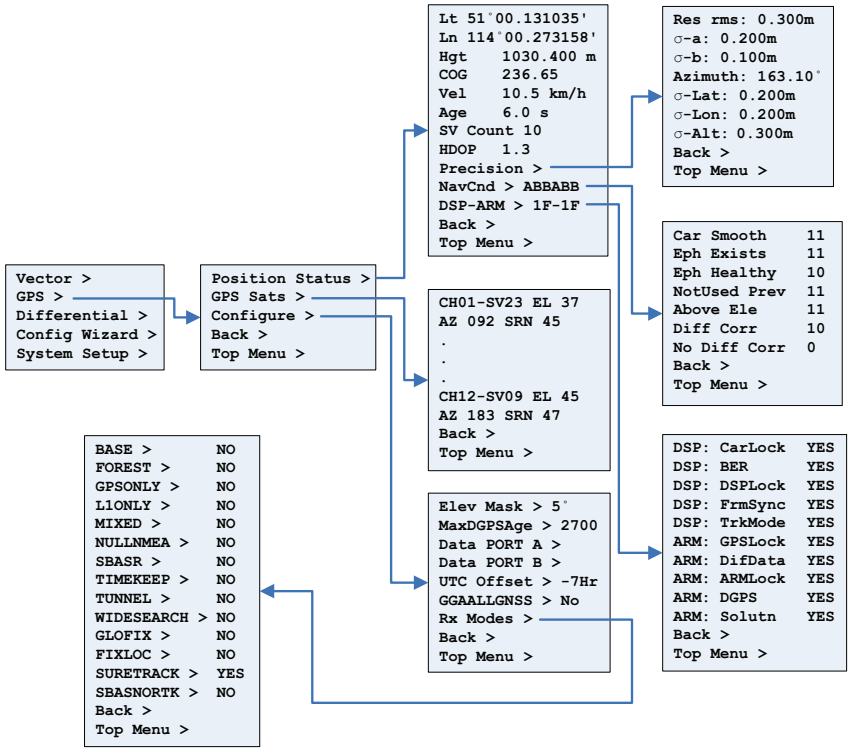


Figure C-2: GPS menu

This appendix shows the complete menu map for each menu (listed below) on the VS131 Top menu:

- Vector
- GPS
- Differential (menu item will be the selected differential source, such as SBAS or Autonomous)
- Config Wizard
- System Setup

Vector Menu

Use the Vector menu to view and adjust Vector settings. Options vary depending on whether you select Pitch or Roll and include such items as aiding features, time constants, heading bias, and antenna separation.

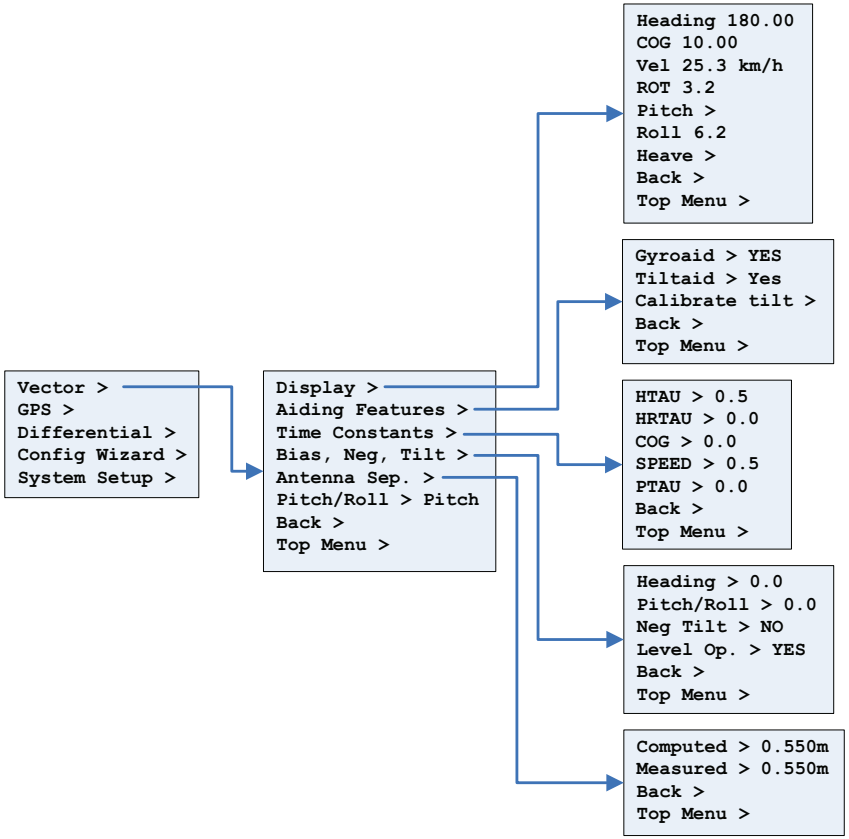


Figure C-1: Vector menu

Planning the Optimal Antenna Placement

Note: In the VS131 kit, install the A31 antenna as the primary antenna as it is used for positioning.

Note:

Proper antenna placement is important to obtain a high-precision GPS reading. For the best results, orient the antennas so the antennas' connectors face the same direction. Also, 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 is 1.0 m)
- Away from radio frequencies
- As high as possible

Set the MSEP value to be accurate to within 1 to 2 cm. For more information on MSEP refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

See Figure 3-1 below through Figure 3-3 on page 18 for mounting orientation examples.

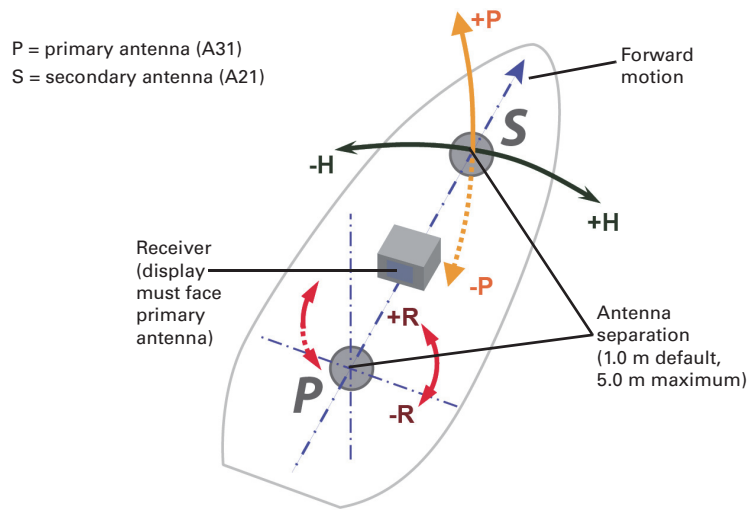


Figure 3-1: Recommended orientation and resulting signs of HPR values

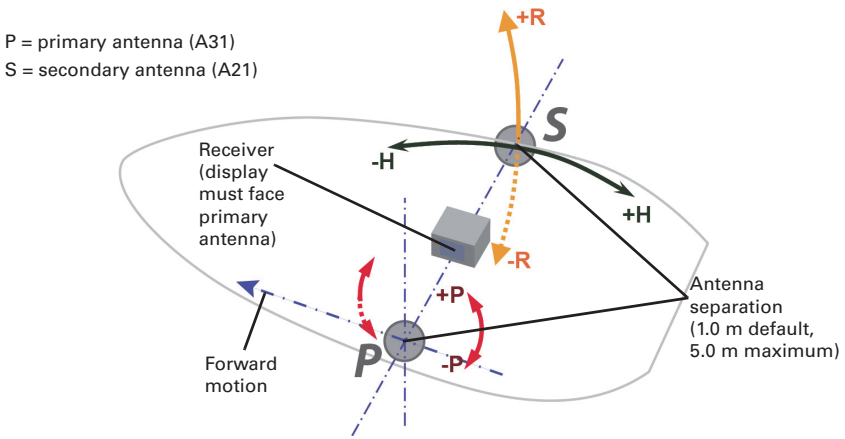


Figure 3-2: Alternate orientation and resulting signs of HPR values

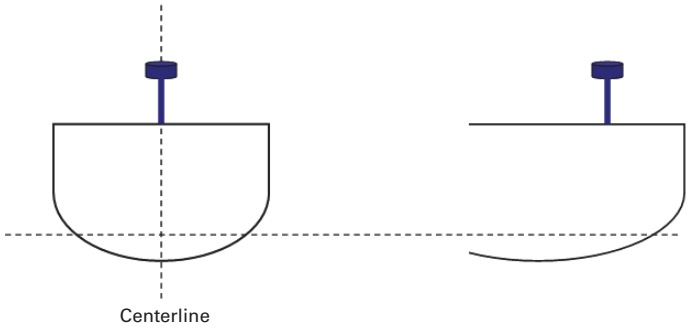


Figure 3-3: Antenna installation: Cross-section of boat

Mounting Options

You can mount the antennas with a magnetic mount, pole mount, or rail mount configuration. You can secure the antennas to a 5/8" threaded pole or a 1-14-UNS-2B threaded mount using the mounting adapters.

The VS131 kit contains one A21 antenna, one A31 antenna, and an A21 height adapter. The A31 antenna has a slightly higher profile than the A21, so the A21 height adapter is used to bring the two antennas level. If the adapter is not used, you will need to enter a non-level bias calculation into the system (see "Q: I could not install my antennas at the same height. How do I calibrate for the height offset?" on page 45 of Appendix B, "FAQ.")

⚠WARNING: The maximum allowable antenna separation is 5.0 m. Any greater distance may result in an incorrect heading.

Appendix C: Menu Map

Magnetic Mounting

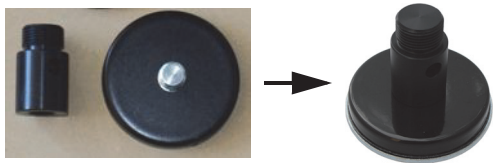
Note: Your kit may not include a magnetic mount.

You can screw the magnetic mount into the bottom of the antenna and mount it to any metal surface. If there are no metal surfaces, use the zinc disc and foam adhesive included in your kit to mount the antenna.

To mount the antennas using the magnetic mount:

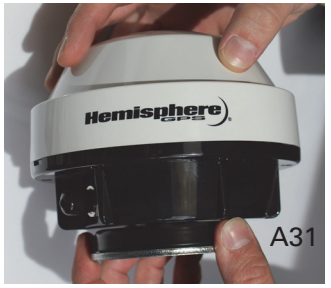
1. Select a location and orientation that meets the requirements outlined in “Mounting Orientation” on page 16 and “Planning the Optimal Antenna Placement” on page 17.
2. **A21 antenna only:** Unlike the A31, the A21 antenna does not include a threaded mounting hole. You must attach the mounting bracket (see at right) using the four screws in your kit.
3. Attach the magnetic mount extension to the magnetic base plate.

Note: Photos at right and in step 4 show the zinc disc attached to the magnetic base plate. You will only need the zinc disc if mounting the antenna to a non-metal surface (see steps 6 through 11 starting below).



4. Thread the magnetic mount into the mounting bracket on the bottom of the A21 antenna or into the bottom of the A31 antenna.

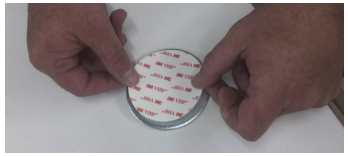
⚠WARNING: When threading the magnetic mounts, hand tighten only. Damage resulting from over-tightening may void your warranty.



If you are mounting the antenna on a metal surface, go to step 5.

If you are mounting the antenna on a non-metal surface and need to use the metal disc and foam adhesive, skip step 5 and complete steps 6 through 11.

5. Place the antenna in the desired location, ensuring the antenna is secure in its mounting position (end of metal surface mounting procedure).
6. Clean and dry the surface where you will attach the zinc disc.
7. Remove the backing from one side of the foam adhesive and press the adhesive onto the zinc plate (at right).



8. Remove the backing from the other side of the foam adhesive and press the zinc disc onto the mounting surface on the vessel, applying firm pressure to ensure good adhesion.
9. Place the antenna on top of the zinc disc, ensuring the antenna is secure in its mounting position.

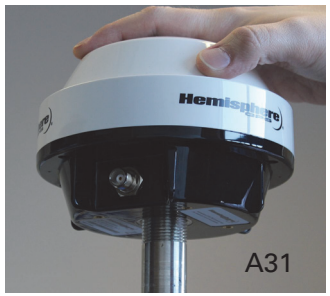
Pole Mounting

You can pole-mount the antennas using existing hardware on your vessel.

To mount the antennas using a pole mount:

1. Select a location and orientation that meets the requirements outlined in “Mounting Orientation” on page 16 and “Planning the Optimal Antenna Placement” on page 17.
2. **A21 antenna only:** Unlike the A31, the A21 antenna does not include a threaded mounting hole. You must attach the mounting base using the four screws included in your kit (see at right).

3. Thread the pole mount (not included) into the mounting bracket on the bottom of the A21 antenna or into the bottom of the A31 antenna.



⚠WARNING: When threading the pole mounts, hand tighten only. Damage resulting from over-tightening may void your warranty.

4. Mark and drill any mounting holes necessary for the pole mounts.

Rail Mounting

You can rail mount the antennas using existing hardware on your vessel.

- The external correction source should be using an 8 data bit, no parity, 1 stop bit (8-N-1) serial port configuration.
- Inspect the cable connection to ensure there are no signs of damage.
- Check the pinout information for the cables to ensure the transmit line of the external correction source is connected to the receive line of the VS131’s serial port and that the signal grounds are connected.

Save the configuration as the profile named “RTCM” in the Config Wizard, cycle the power and load the RTCM profile.

Q: Why am I not getting data from the VS131?

A: There are several possible reasons for this. Check the following items.

- Check receiver power status LED to ensure the receiver is powered.
- Verify the VS131 is locked to a valid DGPS signal (this can often be done on the receiving device or with PocketMax).
- Verify the VS131 is locked to GPS satellites (this can often be done on the receiving device or with PocketMax).
- Check the integrity and connectivity of power and data cable connections.

Q: Why am I getting random data from VS131?

A: There are three possible reasons for this. Check the following items.

- Verify the RTCM or the Bin95 and Bin96 messages are not being output accidentally (send a $JSHOW command).
- Verify the baud rate settings of VS131 and remote device match correctly.
- Potentially, the volume of data requested to be output by the VS131 could be higher than the current baud rate supports. Try increasing the baud rate to 38400 for all devices or reduce the amount of data being output.

Q: I could not install my antennas at the same height. How do I calibrate for the height offset?

A: You may enter an non-level bias calculation that adjusts the pitch/roll output to calibrate the measurement if the antenna array is not installed on a horizontal plane.

To calibrate the pitch/roll reading, send the following command:

$JATT,PBIAS,x<CR><LF>

where x is a bias (in degrees) that will be added to the pitch/roll measurement. The acceptable pitch bias range is -15.0° to 15.0° (default is 0.0°).

To determine the current pitch compensation angle, send the following command:

$JATT,PBIAS<CR><LF>

The pitch/roll bias is added after the negation of the pitch/roll measurement (if so invoked with the $JATT,NEGTILT command).

This appendix covers power, communication and external RTCM questions. For GPS and Heading troubleshooting, see Chapter 4, "Operating the VS131."

Q: Can COAST technology work with corrections from an external source?

A: Yes, the VS131 will operate in a similar fashion with COAST technology as when using SBAS or Beacon corrections. However, SBAS corrections have the advantage that they are separated into separate error components, allowing the VS131 to anticipate how errors will change over the coasting period with more consistent accuracy and for a longer period than regular RTCM range corrections.

Q: My VS131 does not appear to be communicating. What do I do?

A: This could be one of the following issues:

- Examine the power cable and its connector for signs of damage.
- Ensure you are properly powering the system with the correct voltage (8 to 36 VDC) by measuring the voltage at the receiver end of the power cable when the cable is connected to the power source.
- Check current restrictions imposed by power source (minimum available should be > 1.0 A).
- Verify the display has turned on and that time is incrementing in the upper right corner of the display, and configure the COM port baud rates appropriately through the menu system.
- Verify polarity of power leads.
- Check the 1.0 A inline power cable fuse.
- Since you are required to terminate the power input with your choice of connector, ensure you have made a good connection to the power supply.
- Consult the troubleshooting section of the other device's reference manual to determine if there is an issue with that device.

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

A: Yes, the ports are independent. For example, you may have one port set to 4800 and the other to 19200 or vice versa.

Q: Am I able to have the VS131 output different NMEA messages through the two ports?

A: Yes, you may have different NMEA messages turned on for the two serial ports. Further, these NMEA messages may also be at different update rates.

Q: How do I determine the current configuration of the VS131?

A: You can view the current configuration from various screens of the menu, which show all configurable items of the receiver. Alternately, you can select **Config Wizard > Use Previous** to return the receiver to a previously saved (known) configuration.

Q: My VS131 does not appear to be using corrections from an external correction source. What could be the problem?

A: This could be due to a number of issues. Check the following items.

- Make sure the corrections are of an RTCM SC-104 protocol.
- Verify the baud rates of the port used by the VS131 match that of the external correction source.

To rail mount the antennas:

1. Select a location and orientation that meets the requirements listed in "Mounting Orientation" on page 16 and "Planning the Optimal Antenna Placement" on page 17.
2. Use appropriate hardware to securely attach the antenna to the railing.

Routing and Securing the Antenna Cable

⚠WARNING: The VS131 receiver provides 5 VDC across the antenna ports. Connection to incompatible devices may damage equipment.

To route and secure the antenna cables, review the following guidelines. The two enclosed antennas each require a 50 Ω impedance antenna extension cable, such as RG-58U (up to a maximum of 15 m (49 ft.) in length), for proper operation.

- The GPS receiver inside the VS131 requires a minimum input gain of 10 dB (and maximum of 40 dB before saturation will occur). The antennas offer 28 dB of gain, so the loss budget to accommodate for cable losses is 18 dB.
- Regardless of the cable material and length you choose, ensure the cable losses are less than 18 dB of attenuation. Due to variances in the antenna gain and practical attenuation of cable materials and connectors, Hemisphere GPS recommends reducing this budget to 15 dB; this budget is present to overcome the resulting attenuation of a RF cable.
- When deciding on an antenna location, consider the amount of cable required: a longer cable of the same material will result in a higher loss than a shorter one. If the overall loss of the longer cable exceeds 15 dB, change the cable material (this normally means a more expensive material that has a larger diameter and less flexibility). The standard cables included with the VS131 are of the RG58 material family and their attenuation is ~0.8 dB/m. Including connector losses, the nominal loss of these RF cables is ~10 dB, which is within the tolerable loss budget. If a 15 m or 20 m cable run is required, a RG8 variety is available. If lengths longer than 20 m are required, more sophisticated materials are required.

For more information on cable length or low-loss cable, contact your dealer or Hemisphere GPS Technical Support. Table 3-1 provides a summary of other readily available cable materials with 50 Ω impedance.

Table 3-1: Cable losses (not including connector losses)

Material	Loss at GPS L1 (1.575 GHz)
RG58	0.78 dB/m
RG8	0.36 dB/m
Times Microwave LMR400	0.15 dB/m

For additional cable guidelines see "Connecting the Cables" on page 23.

Mounting the Receiver

Use the enclosed kit to mount the receiver. When mounting the VS131 receiver, adhere to the following guidelines:

- Install the receiver inside and away from the elements and in a location that minimizes vibration, shock, extreme temperatures, and moisture
- Position the receiver horizontally with its display facing the primary antenna
- Ensure the front panel (menu screen, LEDs, buttons) is visible and accessible
- Ensure the back panel is easily accessible to switch out cables

Figure 3-4 shows the dimensions (including attached mounting brackets) of the VS131. Use Figure 3-4 when using the receiver mounting procedure that follows.

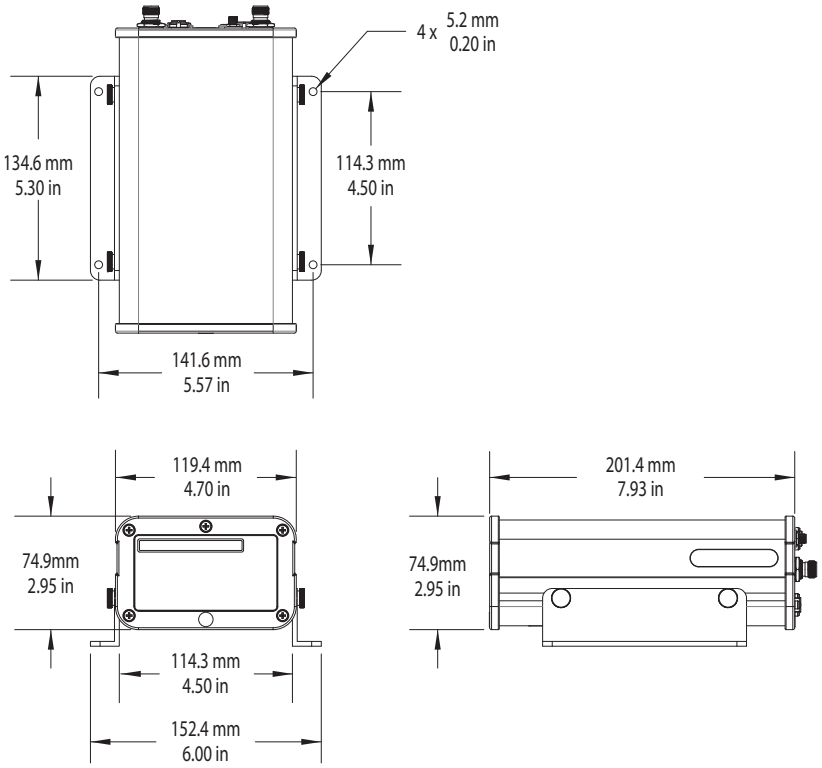


Figure 3-4: VS131 dimensions with mounting brackets

To mount the receiver:

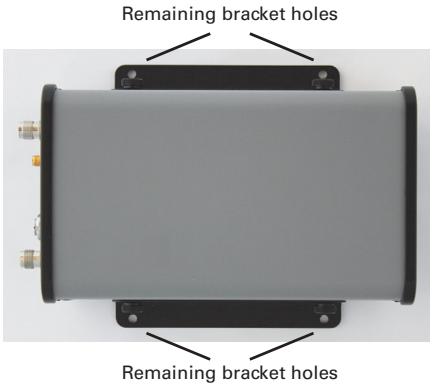
1. Locate the thumbscrews, nuts, and brackets included in your kit.
2. Slide the nuts through the opening (circled at right) along both sides of the receiver (see also Figure 3-4 on page 22).

Appendix B: FAQ

3. Place the bracket alongside the receiver and insert the thumbscrews (two thumbscrews per bracket) so they screw into the nuts.

4. Using the remaining holes in the brackets (two holes per bracket) screw down the brackets in the desired location.

Note: Hemisphere GPS does not provide the screws.



Connecting the Cables

This section contains instructions for connecting the cables for the power and serial ports.

Adhere to the following warnings when connecting the cables:

- Do not run cable in areas of excessive heat
- Do not expose cable to corrosive chemicals
- Do not crimp or excessively bend cable
- Do not place tension on cable
- Coil up excess cable near unit
- Secure along the cable route using plastic tie wraps as necessary
- Do not run cable near high Voltage or strong RF noise and transmitter sources

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

The power source for the VS131 must be between 8 V and 36 V. Attach the power cable to your power source.

Selecting a Port for GPS Data Message Output

The serial ports of the VS131 communicate at the RS-232 interface level with external data loggers, navigation systems and other devices. The two serial ports on the back panel of the receiver use a standard DB9 socket connection.

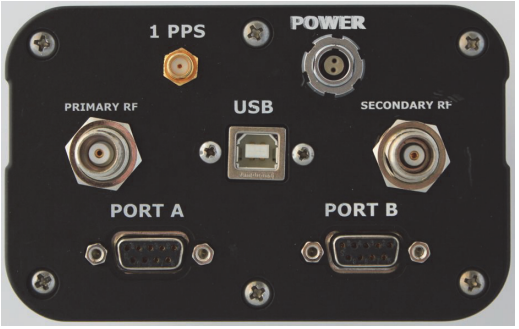


Figure 3-5: VS131 port connections

The default baud rates, NMEA message types, and update rates for serial ports A and B are listed in "Default Parameters" on the following page. If the NMEA data messages you desire are different from the default values, you will need to select those also. Use the Config Wizard to select your NMEA message types and update rates per port (see "Using the Config Wizard" on page 33).

Ports A and B have the connections detailed below in Figure 3-6 and Table 3-2.

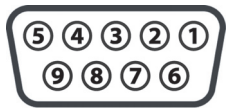


Figure 3-6: Serial port pinout assignment

Table 3-2: Port A / Port B serial port pinouts

Pin	Port A	Port B
1	Not connected	Not connected
2	Transmit data Port A (NMEA 0183, binary, and RTCM input)	Transmit data Port B (NMEA 0183, binary, and RTCM input)
3	Receive data Port A (NMEA 0183, binary, and RTCM output)	Receive data Port B (NMEA 0183, binary, and RTCM output)
4	Not connected	Not connected
5	Signal ground (signal return)	Signal ground (signal return)
6	Event marker input	Not connected
7	Not connected	Not connected
8	Not connected	Not connected
9	1 PPS timing output	5V output, 350 mA max

Table A-1: Troubleshooting (*continued*)

Symptom	Possible Solution
No heading or incorrect heading value	• Check CSEP value is fairly constant without varying more than 1 cm (0.39 in)—larger variations may indicate a high multipath environment and require moving the receiver location The standard antenna mounting configuration provides a 0.5° heading accuracy at 95% confidence. If you require more performance, you will need to increase the antenna separation (maximum recommended separation is 5.0 m). See Table D-1 on page 54 for antenna separation specifications. • Recalibrate the tilt sensor with $JATT,TILTCAL command if heading is calculated then lost at consistent time intervals • Heading is from primary GPS antenna to secondary GPS antenna • $JATT,SEARCH command forces the VS131 to acquire a new heading solution (unless gyro is enabled) • Enable GYROAID to provide heading for up to three minutes during GPS 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 • Potentially, the volume of data requested to be output by the VS131 could be higher than the current baud rate supports (try using 19200 as the baud rate for all devices or reduce the amount of data being output)
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) • Ensure corrections are being transmitted to the correct port—using the $JDIFF,PORTB command on Port A will cause the receiver to expect the corrections to be input through Port B

Table A-1 provides troubleshooting for common problems.

Table A-1: Troubleshooting

Symptom	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connectors • Check power input voltage (8 to 36 VDC) • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from VS131	• Check receiver power status to ensure the receiver is powered (an ammeter can be used for this) • Verify desired messages are activated (using PocketMax or $JSHOW in any terminal program) • Ensure the baud rate of the VS131 matches that of the receiving device • Check integrity and connectivity of power and data cable connections
Random data from VS131	• Verify the RTCM or binary messages are not being output accidentally (send a $JSHOW command) • Ensure the baud rate of the VS131 matches that of the remote device • Potentially, the volume of data requested to be output by the VS131 could be higher than the current baud rate supports (try using 19200 as the baud rate for all devices or reduce the amount of data being output)
No GPS lock	• Verify the VS131 has a clear view of the sky • Verify the lock status of GPS satellites (this can be done with PocketMax)
No beacon lock	• Verify the receiver is tuned to the correct frequency and bit rate • Ensure beacon signal coverage is expected in your area • Ensure environmental noise is not masking the signal, reducing the SNR reading
No SBAS lock	• Verify the VS131 has a clear view of the sky • Verify the lock status of SBAS satellites (this can be done with PocketMax - monitor BER value) • Set SBAS mode to automatic with the $JWAASPRN,AUTO command SBAS lock is only possible if you are in an appropriate SBAS region; currently, there is limited SBAS availability in the southern hemisphere.

Default Parameters

The following represents the standard configuration for the VS131. For more information on these commands refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

Note: Use the $JSAVE command to save changes you make to the VS131 configuration for the changes to be present in subsequent power cycles. Also, if you change any default values and then issue a $JRESET command make sure you verify your settings to make sure you consistently get correct headings. To reset the VS131 to its default parameters you can re-install the configuration file (shown below)—contact your dealer or Hemisphere GPS Technical Support for information on obtaining and re-installing the configuration file.

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

$JAGE,2700
$JLIMIT,10
$JMASK,5
$JNP,5
$JWAASPRN,AUTO
$JDIFF,LBAND
$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,1.0
$JATT,GYROAID,YES
$JATT,TILTAID,YES
$JATT,LEVEL,NO
$JATT,EXACT,NO
$JATT,HIGHMP,NO
$JATT,FLIPBRD,NO
$JATT,HBIAS,0.0
$JATT,NEGTILT,NO
$JATT,NMEAHE,1
$JATT,PBIAS,0.0
$JATT,PTAU,0.5
$JATT,ROLL,NO
$JATT,SPDTAU,0.0

$JASC,GPGGA,1.0,PORTA
$JASC,GPVTG,1.0,PORTA
$JASC,GPGSV,1.0,PORTA
$JASC,GPZDA,1.0,PORTA
$JASC,HEHDT,1.0,PORTA
$JASC,HEROT,1.0,PORTA
$JASC,GPGGA,1.0,PORTB
$JASC,GPVTG,1.0,PORTB
$JASC,GPGSV,1.0,PORTB
$JASC,GPZDA,1.0,PORTB
$JASC,HEHDT,1.0,PORTB
$JASC,HEROT,1.0,PORTB

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

$JSAVE
```

Appendix A: Troubleshooting

Chapter 4: Operating the VS131

Powering the Receiver On/Off
LED Indicators
Startup
Using the Menus
Configuring the VS131
Disabling the Aiding Features
Adjusting the Time Constants
Connecting to Existing Navigation Systems
Viewing GPS/DGPS Status

Powering the Receiver On/Off

The power button on the VS131 is located on the front panel (circled below). When you first apply power to the unit it turns on.

Figure 4-1: VS131 front panel with power button

The VS131 accepts an input voltage of 8 to 36 VDC via the power cable. The supplied power should be continuous and clean for best performance. Table D-5 on page 55 provides the power specifications of the VS131.

⚠WARNING: Do not apply a voltage higher than 36 VDC. This will damage the receiver and void the warranty. Also, do not attempt to operate the VS131 with the fuse bypassed as this will void the warranty.

The VS131 features reverse polarity protection to prevent damage if the power leads are accidentally reversed. Although the VS131 proceeds through an internal startup sequence when you apply power, it will be ready to communicate immediately.

Initial startup may take 5 to 15 minutes depending on the location. Subsequent startups will output a valid position within 1 to 5 minutes depending on the location and time since the last startup.

The VS131 may take up to 5 minutes to receive a full ionospheric map from SBAS. Optimum accuracy is obtained once the VS131 is processing corrected positions using complete ionospheric information.

To power on the VS131:

1. Connect the ends of the VS131 power cable to a clean power source providing 8 to 36 VDC.

   Note: Hemisphere GPS recommends you use a weather-tight connection and connector if the connection is located outside.

2. Press and hold the soft power switch on the front panel until the splash screen appears.

To power off the VS131:

- Press and hold the soft power switch on the front panel until the screen goes blank.

Connecting to Existing Navigation Systems

Most users connect the VS131 to their existing navigation system during installation. These users will receive the VS131's position and heading updates through the interface of their existing system.

Viewing GPS/DGPS Status

Most users will receive position and heading information through their on-board navigation system. If you have not connected the VS131 to an existing navigation system, or are troubleshooting your unit, you may need to view GPS, DGPS, or Beacon status on the VS131's display screen.

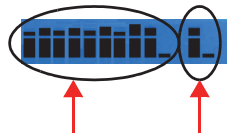
Do I Have a Signal?

Figure 4-2 on page 29 shows which LEDs on the VS131 will indicate GPS, DGPS or Beacon signal lock when illuminated. If you lose the differential signal lock, Hemisphere GPS COAST technology allows the VS131 to perform well for 40 minutes or more with aging differential GPS correction data. The amount of time you can "coast" depends on the degree of tolerable drift.

Note: To obtain a full set of SBAS corrections, the VS131 must receive the ionospheric map over a period of a few minutes. After this, the receiver can "coast" until the next set of corrections has been received.

How Good is the Quality of My Signal?

In addition to the LED indicators for signal lock, the VS131's display indicates signal quality. The bars along the top of the display represents the quality of the GPS and DGPS (or if applicable, beacon) signal. The first group of bars shows the GPS signal; the second group shows the DGPS or beacon signal. Each bar represents a distinct channel and its associated signal quality. The higher the bar, the better the signal.



Note: If using autonomous or external correction mode, the DGPS signal indicator will not appear in the display.

DGPS (SBAS)

The differential correction (or SBAS) signal indicator reflects the quality of each satellite signal, or the bit error rate (BER). A full bar height reflects a signal lock and a BER of 0. A bar height only 2 pixels tall reflects a signal loss, or BER, of 500 or greater. Bar heights in between reflect intermediate degrees of signal quality. For example, when using WAAS two satellites are available, so two BERs are provided.

Beacon

The beacon indicator reflects the quality of the beacon signal, or the signal strength (SS) and the signal-to-noise ratio (SNR). A full bar height reflects a signal lock, SS>=35, and SNR>=24. A bar height only 2 pixels tall reflects a signal loss, or SS and SNR values of 0. Bar heights in between reflect intermediate degrees of signal quality. If using beacon, the first bar indicates SS signal quality; the second bar indicates SNR signal quality.

Adjusting the Time Constants

The VS131's default settings are fine for most users; however, you can set the time constants to further smooth heading, course-over-ground (COG), and speed measurements. Table 4-3 provides an overview of the time constant values you can set in the Config Wizard, including the formulas for finding the optimal value of each time constant for your vessel.

Table 4-3: Time constants

Time Constant	Description
COGTAU (Course Over Ground)	Adjust the responsiveness to the course over ground measurement. If vessel is small and dynamic, leave this value at 0.0 s to be conservative. If the vessel is large and resistant to motion, you may want to increase this value. Default value: 0.0 s Range: 0.0 to 60 s Formula: cogtau (s) = 10 / max rate of change of course (^{O}/sec)
HRTAU (Rate of Turn)	Adjust the responsiveness to the rate of heading change. If vessel is large and unable to turn quickly, you may want to increase this value. Default value: 2.0 s with gyro enabled Range: 0.0 to 60 s Formula: hrtau (s) = 10 / max rate of the rate of turn (^{O}/s^2)
HTAU (Heading)	Adjust the responsiveness to true heading. If vessel is large and unable to turn quickly, you may want to increase this value. For longer baselines (5 m) HTAU should be between 0.5 and 1.0, since the gyro introduces noise. Default value: 2.0 s with gyro enabled Range: 0.0 to 60 s Formula: htau (s) = 40 / max rate of turn (^{O}/s) *with gyro ON* htau (s) = 10 / max rate of turn (^{O}/s) *with gyro OFF*
PTAU (Pitch)	Adjust the responsiveness to pitch. If vessel is large and unable to pitch quickly, may want to increase this value. Default value: 0.5 s Range: 0.0 to 60 s Formula: ptau (s) = 10 / max rate of pitch (^{O}/s)
SPDTAU (Speed)	Adjust the responsiveness to speed. If vessel is small and dynamic, leave this value at 0.0 s to be conservative. If the vessel is large and resistant to motion, you may want to increase this value. Default value: 0.0 s Range: 0.0 to 60 s Formula: spdtau (s) = 10 / max acceleration (m/s^2)

LED Indicators

The VS131 includes five LEDs located on to the left of the display on the front panel (shown at right).

Table 4-1 below describes each LED indicator.

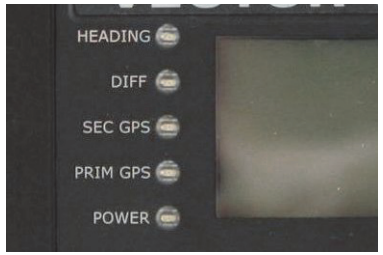


Figure 4-2: VS131 LEDs

Table 4-1: LED indicators

Indicator	Description/Function
HEADING	Valid GNSS heading available Illuminates solid green when the receive achieves a valid heading solution from the GNSS receiver. You must see PRIM GPS and SEC GPS illuminated before a heading solution is possible. If the GNSS solution is no longer available, the LED turns off.
DIFF	DGPS position indicator Illuminates solid green when the receiver achieves a differential position and a pseudorange residual of better than 10.0 m. If the residual value is worse than the current threshold, the LED blinks green indicating differential mode has been attained but the residual has not met the threshold.
SEC GPS	Secondary antenna is tracking 4 or more satellites Illuminates solid amber when the secondary antenna is tracking four or more satellites.
PRIM GPS	Primary antenna is tracking 4 or more satellites Illuminates solid amber when the Primary antenna is tracking four or more satellites.
POWER	Power indicator Illuminates solid red when the receiver is powered on.

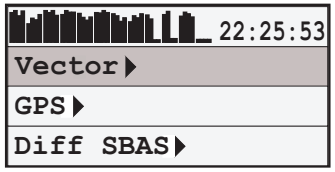
Startup

When you power on the VS131 the Hemisphere GPS splash screen appears followed by the main screen, or Top menu (see top right photo). Press the Down Arrow button to display the remaining items on the Top menu.

You use the menus to view and configure system data and settings for the following Top menu items:

- Vector
- GPS
- Differential (menu item will be the selected differential source, such as SBAS or Autonomous)
- Config Wizard
- System Setup

For a complete menu path of each Top menu item, see Appendix C, “Menu Map.”



Disabling the Aiding Features

While the default settings will work for most users, you can configure the tilt and gyro aiding features to further reduce heading startup and re-acquisition times.

Disabling Tilt Aiding

The VS131’s tiltaid (accelerometer) is enabled by default and constrains the RTK heading solution to reduce startup and re acquisition times. The tiltaid is precalibrated at the factory; however, if you experience any tilt measurement offset, you can recalibrate the tilt sensor via the Calibrate Tilt option in the Vector menu. See “Vector menu” on page 48 for a menu map on how to access this feature.

Note: Make sure the receiver is perfectly level before recalibrating the tiltaid.

The only times you may need to disable the tiltaid feature are:

- If you were unable to install the VS131 on a level plane with the antennas. The tilt sensor is located inside the VS131, so it is important that you install the VS131 on a level horizontal plane.

  ⚠WARNING: If you were unable to install the VS131 in a horizontal plane with the antennas, you must disable tiltaid. Failure to do so may cause erratic equipment behavior.

- If troubleshooting, to ensure the receiver is working properly.

You can turn tilt aiding off either through the Config Wizard or Vector menus.

Disabling Gyro Aiding

The VS131’s internal gyro-aid is enabled by default. The gyro:

- Shortens re-acquisition times when satellites are obstructed and heading is lost, by reducing the search volume required for the RTK solution, and
- Provides accurate substitute headings for a short period (depending on the roll and pitch of the vessel) ideally seeing you through to re-acquisition.

The only time you might need to disable the gyro-aid is during troubleshooting, to ensure the receiver is working properly.

⚠WARNING: Do not exceed turn rates of 90°/sec. The VS131 uses gyro measurements to obtain a heading rate measurement and the gyro cannot measure beyond this rate.

You can turn the gyroaid feature off either through the Config Wizard menu or the Vector menu.

For details on configuring the time constants, see “Adjusting the Time Constants” on page 36.

11. *Enter a heading bias:* If you did not install the antenna’s parallel to and along the vessel’s centerline, you will need to enter a heading bias in the Heading field of the Bias, Neg, Tilt menu. The heading bias (-180° to +180°) compensates for any offset from the centerline.

    Note: If you installed the antennas for roll (perpendicular to the boat’s axis), rather than pitch, you must enter the heading bias (+/-90°). You must also enter the bias for roll (see below).

12. *Enter a pitch/roll bias:* Enter the bias for pitch or roll (-15° - +15°) to compensate for any offset from the boat’s centerline. Enter this bias in the Pitch/Roll field of the Bias, Neg, Tilt menu.
13. *Enter the antenna separation:* If you did not install the antennas 1.0 m apart, enter the actual antenna separation In the Ant. Sep field. The available range is 0 - 5.0 m.
14. *Configure antenna for roll:* Most users install the antennas for pitch; however, if you install the antennas for roll, you will need to configure the VS131 for roll. In the Create New menu set the Pitch/Roll setting to Roll.
15. Save your configuration: To save your new configuration, select the Save to Location field. You will be prompted for a location to save your configuration.

    Select one of the empty slots, noted by the name Not Used or select a slot with an existing configuration to overwrite it.

    After your configuration is saved, you must select it from the Config Wizard in order to activate it. You may then continue to enter different receiver configurations without upsetting the current operation of the receiver. Re-enter the Config Wizard and select the configuration to use.

Using the Menus

The VS131 menu system is designed for easy setup and configuration of the unit in or out of the field and supports multiple languages. You can perform most configuration tasks entirely through the menu without having to connect to a computer.

The VS131 front panel contains the three soft buttons shown at right. The Enter button also functions as the power switch (see “Powering the Receiver On/Off” on page 28 for more information).

Table 4-2 describes the indicators to the right of specific menu items.

Up Arrow button - moves to the previous menu item or to the previous selection within a menu item

Enter button - displays a submenu or selects an option within a menu item

Down Arrow button - moves to the next menu item or to the next selection within a menu item

Table 4-2: Menu item indicators

Indicator	Purpose	Example
 Display indicator	Go to the indicated submenu This indicator also appears to the right of the “Back” and “Top Menu” menu items. • Press Enter when “Back” is selected to return to the previous menu. • Press Enter when “Top Menu” is selected to return to the Top menu.	1. On the Top menu press the **Down Arrow** button to highlight System Setup. The Display indicator appears to the right of System Setup. 2. Press **Enter** to display the System Setup menu. 3. Press the **Down Arrow** button again to highlight the Display Format option and then press **Enter**. The items on the Display Format menu appear and the Select indicator appears to the right of Disp Update (the first item on the Display Format menu). 4. Press **Enter** on the Disp Update item. The Display indicator changes to the Select indicator. 5. Press the **Up Arrow** or **Down Arrow** button to scroll through the available options (such as 1Hz and 5Hz). 6. Press **Enter** on the highlighted option to select it. That option is now the setting for the menu item and the Select indicator changes back to the Display indicator.
 Select indicator	Scrolls within a menu to highlight an option to select.	

To return the menu system to the factory default configuration:

- Press and hold the Enter and Up Arrow buttons until the splash screen disappears (Enter and Power share the same soft switch).

Configuring the VS131

The Config Wizard menu guides you through various configuration options, enabling you to save up to five different configurations that are useful when using the VS131 on different vessels or for different applications.

If you use a personal computer or Windows mobile device, you can use Hemisphere GPS' VectorPC software to configure the VS131. See "Using VectorPC to Communicate with the VS131" on page 5 for more information.

Config Wizard Menu

This section describes the basic Config Wizard options you need to set to get up and running. Figure 4-3 outlines the menu structure of the Config Wizard menu.

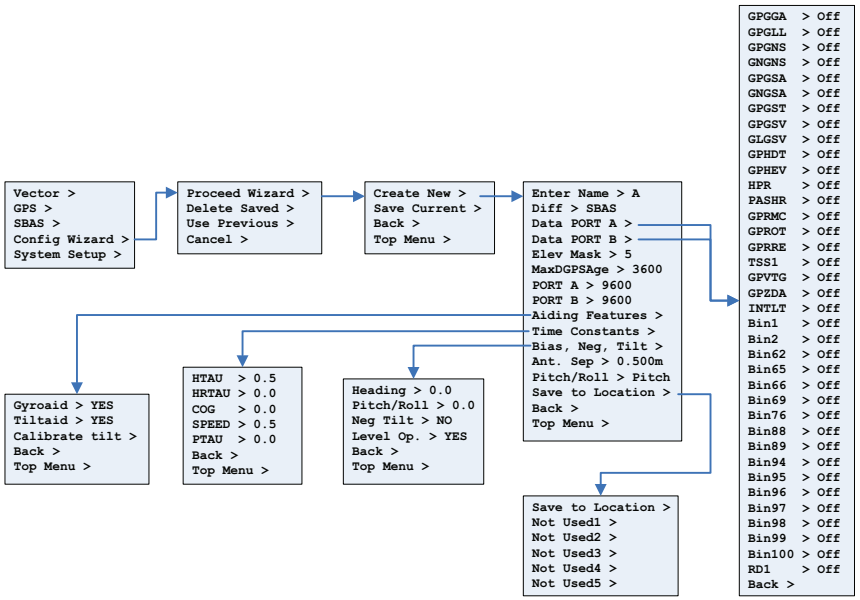


Figure 4-3: Config Wizard menu

Using the Config Wizard

The basic setup instructions outlined in this section assume the antennas are:

- Installed parallel to, and along the centerline of, the vessel's axis
- Separated by 1.0 m

If this is not the case, you will need to enter the actual antenna separation and bias in the Config Wizard.

1. Select **Config Wizard > Proceed Wizard**. The Proceed Wizard menu appears.
2. Select **Create New** to create a new configuration. You are prompted to enter a name for your configuration. In addition to the Name you can set the options shown at right (also shown in Figure 4-3 on the previous page).

   Note: For help on using the menus to view and set values see "Using the Menus" on page 31.

   ```
   Enter Name > A
   Diff > SBAS
   Data PORT A >
   Data PORT B >
   Elev Mask > 5
   MaxDGPSAge > 3600
   PORT A > 9600
   PORT B > 9600
   Aiding Features >
   Time Constants >
   Bias, Neg, Tilt >
   Ant. Sep > 1.000m
   Pitch/Roll > Pitch
   Save to Location >
   Back >
   Top Menu >
   ```

3. *Enter a name:* Use the arrow buttons to select a letter and then press the **Enter** button to save the letter. The cursor moves to the right.

   Enter a blank character at the end of your name until the ">" character appears at the end of the name. Press the **Enter** button again.

4. *Set a DGPS source:* From the same menu, select **DIFF**. The options are:

   SBAS (default)
   Autonomous
   RTK
   L-Band
   Extern RTCM (External RTCM)

5. *Change the type of GPS data message sent to the data ports:* Select either **Data Port A** or **Data Port B** from the menu list.
6. *Set the elevation cutoff angle:* Select **Elev Mask** and set the angle between 0° and 45°. The default value is 5°.
7. *Set the maximum DGPS age:* The maximum DGPS age is 2700 seconds (45 minutes) by default.
8. *Configure baud rates:* If the default baud rate on the selected port does not match that of the external device you are connecting to, you will need to configure the Baud Rate, using the Port A or Port B entries.

   4800, 9600, 19200, 38400, 57600, and 115200 are the available baud rates.

9. *Enable/disable aiding features:* The Aiding Features menu enables you to turn the gyroaid and tiltaid features on or off. For more information on disabling the aiding features, see "Disabling Tilt Aiding" on page 35 or "Disabling Gyro Aiding" on page 35.
10. *Adjust time constants:* While the default time constants settings will work for most users, if you have a large, slow turning vessel or a small, quick moving vessel you may want to adjust the time constants to reduce heading start up and re acquisition times.