

875-0428-10

**Vega™ 28/60
GNSS OEM Boards**

Integrator Guide
Revision: A4
January 21, 2022

Table of Contents

Device Compliance, License and Patents.....	4
Vega Terms & Definitions	6
Chapter 1: Introduction	9
Overview	9
Product Overview	10
Key Features.....	12
What’s Included in Your Kit.....	13
Firmware	14
Using PocketMax to Communicate with Vega Boards	15
Athena RTK and Atlas L-band.....	16
aRTK Position Aiding	17
Chapter 2: Integrating the Vega OEM Boards	18
Overview	18
Vega Board Integration.....	19
Mechanical Layout Vega Boards.....	20
Connectors	22
Mounting Options.....	24
Header Layouts and Pinouts	26
Signals	36
Vega 28 Ports	37
Vega 60 Ports	41
Chapter 3: Understanding the Vega Board Series	45
Overview	45
Timing Signal	46
Event Marker Input.....	47
Grounds.....	48
Shielding.....	49
Receiver Mounting.....	50
Antenna Mounting.....	51

Mounting Orientation	52
Vega Orientation and Sensor Calibration	53
Planning the Optimal Antenna Placement	57
Chapter 4: Operating the Vega OEM Boards	59
Overview	59
Powering the Vega OEM Board On/Off	60
Communicating with the Vega OEM Board Series	61
Configuring the Vega OEM Board Series	62
LED Indicators	63
Configuring the Data Message Output	64
‘THIS’ Port and the ‘OTHER’ Port	65
Using Port D for RTCM Input (Vega 60 Board Only)	67
Atlas L-band Message/Commands	68
Saving the Configuration.....	69
Configuration Defaults.....	70
Using the WebUI.....	72
Appendix A: Troubleshooting	88
Overview	88
Troubleshooting.....	89
Appendix B: Technical Specifications.....	93
Vega 28 Technical Specifications	94
Vega 60 Technical Specifications	99
Appendix C: Frequently Asked Questions.....	104
Overview	104
Frequently Asked Questions (FAQ).....	105
End User License Agreement	115
Warranty Notice.....	119

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](https://hemispheregnss.com/about-us/quality-commitment).

E-Mark Statement: This product is not to be used for driverless/autonomous driving.

Copyright Notice

Copyright Hemisphere GNSS, Inc. (2022). All rights reserved.

No part of this manual may be reproduced, transmitted, transcribed, stored in a retrieval system or translated into any language or computer language, in any form or by any means, electronic, mechanical, magnetic, optical, chemical, manual or otherwise, without the prior written permission of Hemisphere GNSS.

Trademarks

Hemisphere GNSS®, the Hemisphere GNSS logo, TRACER™, Crescent®, Eclipse™, e-Dif®, L-Dif™, PocketMax™, S320™, SBX-4™, Vector™, XF1™, XF2™ Phantom™, Vega™, Cygnus™ and Atlas®, Athena™ SureFix™ are proprietary trademarks of Hemisphere GNSS, Inc. Other trademarks are the properties of their respective owners.

Patents

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

Patents			
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	

Continued on next page

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
Phone: (480) 348-6380
Fax: (480) 270-5070
PRECISION@HGNSS.COM
WWW.HGNSS.COM

Technical Support If you need to contact Hemisphere GNSS Technical Support:

Hemisphere GNSS, Inc.
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
Phone: (480) 348-6380
Fax: (480) 270-5070
SUPPORT.HGNSS.COM

**Documentation
Feedback**

Hemisphere GNSS is committed to the quality and continuous improvement of our products and services. We urge you to provide Hemisphere GNSS with any feedback about this guide by opening a support case at the following website: SUPPORT.HGNSS.COM

Vega Terms & Definitions

Introduction

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

Vega terms & definitions, continued

Term	Definition
Activation	Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see Subscription .
ASCII	American Standard Code for Information Interchange
Atlas	Atlas is a subscription-based service provided by Hemisphere GNSS.
BeiDou	BeiDou is a global navigation satellite system deployed and maintained by China.
BIN message	Binary message
CAN	Controller Area Network
COG	Course Over Ground – The cardinal direction of travel of the primary antenna. This differs from heading, which is the direction of the vector created from the primary to secondary antenna.
CSEP	The distance in meters that the receiver has calculated between the primary and secondary antenna. This value should always be accurate to within 2 cm.
dB	Decibel. The unit of measurement used to express signal-to-noise ratio (SNR).
DGNSS	Differential GNSS refers to a receiver using differential corrections.
ESN	Electronic Serial Number
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 deployed and maintained 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.

Continued on next page

Vega Terms & Definitions, Continued

Vega terms & definitions, continued

Term	Definition
GNSS	Global Navigation Satellite System (GNSS) is a system that provides autonomous 3D position (latitude, longitude, and altitude) and accurate timing globally by using satellites. Current GNSS providers are GPS, GLONASS, Galileo, BeiDou, NavIC (IRNSS), and QZSS.
GPIO	General Purpose Input/Output
GPS	Global Positioning System (GPS) is a global navigation satellite system deployed and maintained by the United States.
I/O	Input/Output
LED	Light Emitting Diode
MSEP	This is the distance in meters between the primary and secondary antenna. This differs from CSEP in that the user measures this value and inputs it into the receiver.
Multipath	Multipath occurs when the GNSS signal reaches the antenna by two or more paths. This causes incorrect pseudo-range measurements and leads to less precise GNSS solutions.
NavIC (IRNSS)	Navigation with Indian Constellation and Indian Regional Navigational Satellite System (IRNSS) is a regional navigation satellite system deployed and maintained by India.
NMEA	National Marine Electronics Association (NMEA) is a marine electronics organization that sets standards for communication between marine electronics.
NTRIP	Networked Transport of RTCM via Internet Protocol – a protocol for transmitting differential GNSS or RTK over the internet.
PCB	Printed Circuit Board
PPS	Pulse-per-second is a pulse output by the receiver precisely aligned to the GNSS time. Default output is every one second.
QZSS	Quasi-Zenith Satellite System (QZSS) is a regional satellite navigation system deployed and maintained by Japan.

Continued on next page

Vega Terms & Definitions, Continued

Vega terms & definitions, continued

Term	Definition
RF	Radio Frequency
RMS	Root mean square
ROX	ROX is a Hemisphere GNSS propriety RTK message format that can be used as an alternative to RTCM3 when both the base and rover are Hemisphere branded.
RTCM	Radio Technical Commission for Maritime Services (RTCM) is a standard used to define RTK message formats so that receivers from any manufacturer can be used together.
RTK	Real-Time-Kinematic (RTK) is a real-time GNSS differential method that provides better accuracy compared to other differential corrections.
SBAS	Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.
SNR	Signal-to-Noise ratio
Subnet Mask	The technique used by the TCP/IP communications protocol that identifies which network segment a packet belongs to. The subnet mask is a binary pattern, and the default mask found in small local networks indicates that all the machines are in the same network.
Subscription	A subscription is a feature that is enabled for a limited time. Once the end-date of the subscription has been reached, the feature will turn off until the subscription is renewed.
TVS	Transient Voltage Suppressors
UART	Universal Asynchronous Receiver/Transmitter (UART) is the electronic circuit that makes up the serial port.
WAAS	Wide Area Augmentation System (WAAS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of North America.

Chapter 1: Introduction

Overview

Introduction

This Integrator Guide helps you integrate your Vega GNSS OEM boards with your heading and positioning products. You can download this manual from the Hemisphere GNSS website at <https://www.hemispheregnss.com>.

This manual does not cover receiver operation, the PocketMax™ utility, or commands and messages (NMEA 0183, NMEA 2000® or HGNS proprietary messages). For information on these subjects refer to the [Hemisphere GNSS \(HGNS\) Technical Reference Manual \(TRM\)](#).

Contents

	Topic	See Page
	Product Overview	10
	Key Features	12
	What's Included in Your Kit	13
	Firmware	14
	Using PocketMax to Communicate with Vega Boards	15
	Athena RTK and Atlas L-band	16
	aRTK Position Aiding	17

Product Overview

Vega product overview

The Vega GNSS OEM boards are some of Hemisphere’s most advanced GNSS heading and positioning boards. The Vega boards use dual antenna ports to create a series of functions, including fast, high-accuracy heading over short baselines, RTK positioning, onboard Atlas® L-band, RTK-enabled heave, low-power consumption, and precise timing.

With the Vega OEM boards, positioning is scalable and field upgradeable with all Hemisphere software and service options. Use centimeter-level accuracy in single frequency mode or employ the full performance and fast RTK initialization times over long distances with multi-frequency, multi-constellation GNSS signals. High-accuracy L-band positioning from meter to sub-decimeter levels are available via the Hemisphere Atlas correction service. Figure 1-1 shows the Vega 28 GNSS OEM board. The Vega 28 offers ethernet and has 3 serial ports and 2 CAN ports.

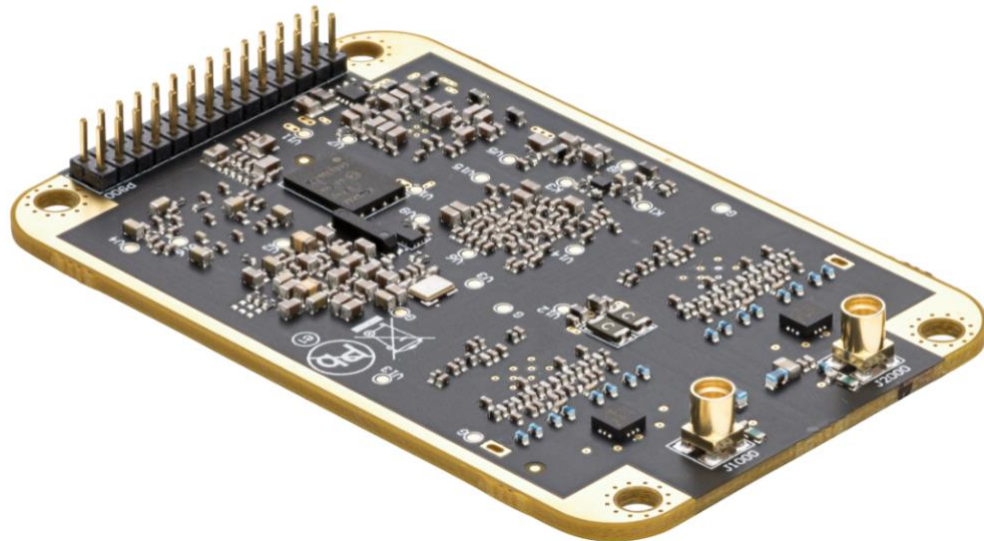


Figure 1-1: Vega 28 GNSS OEM Board

Continued on next page

Product Overview, Continued

Vega product overview
 Error! Not a valid bookmark self-reference., continued

Figure 1-2 shows the Vega 60 GNSS OEM board. The Vega 60 board offers ethernet and has 5 serial and 2 CAN ports.

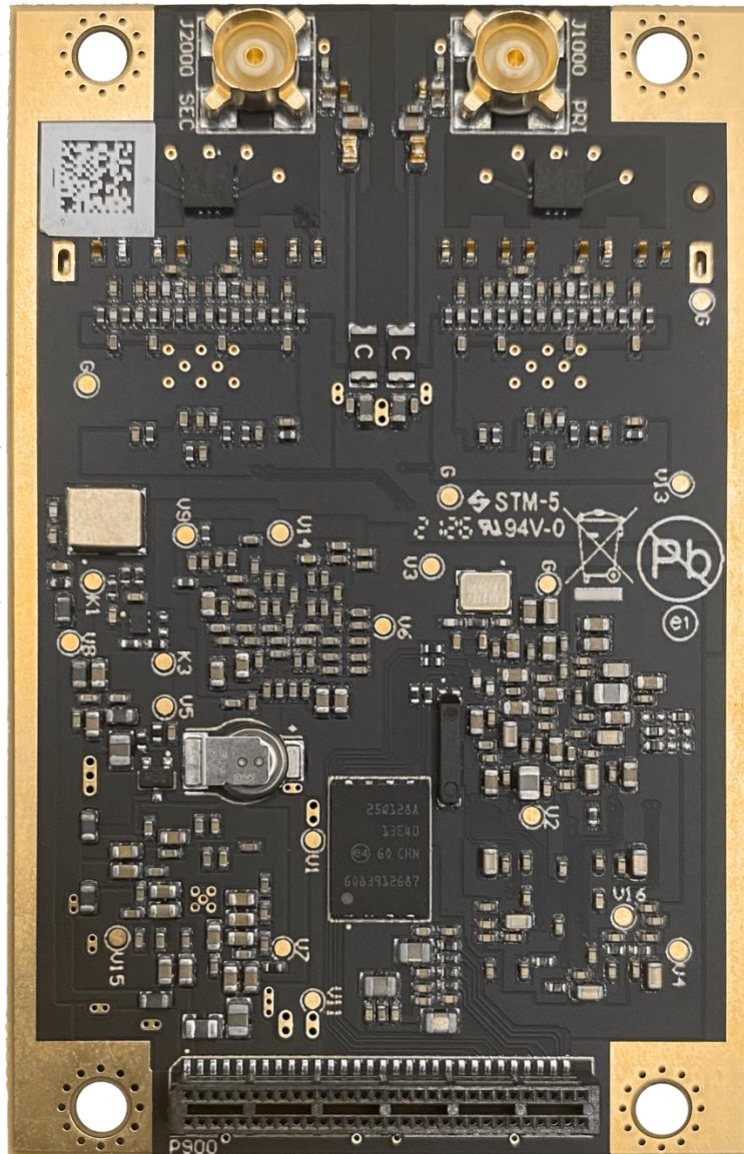


Figure 1-2: Vega 60 GNSS OEM Board

Key Features

Vega OEM board key features

The Vega OEM GNSS board series features low power consumption and simple on-board firmware with integrated L-band. Athena enhances the reliable positioning performance of the Vega series™ using RTK, Atlas corrections, aRTK™, SureFix, and TRACER™ technology.

The Vega 28 is offered in Hemisphere common form factor (71 L x 45 W x 10 H mm). The dual antenna Vega 28 provides accurate heading with an on-board gyro and a tilt sensor that provides heading during short GNSS outages.

The Vega 60 OEM GNSS board is offered in the industry common form factor (71 L x 46 W x 10 H mm).

Vega OEM GNSS boards are an ideal solution for integrators offering scalability and expandability from L1 GPS with SBAS to multi-frequency GPS, GLONASS, BeiDou, Galileo, NavIC (IRNSS), and QZSS (with RTK capability).

Key features of the Vega OEM GNSS boards include:

- Extremely accurate heading with long baselines
- Multi-frequency position, dual-frequency heading supporting GPS, GLONASS, BeiDou, Galileo, QZSS, NavIC (IRNSS), and L-band
- Atlas® L-band capable to 4 cm RMS
- Athena™ GNSS engine providing best-in-class RTK performance
- Excellent coasting performance
- 5 cm RMS RTK-enabled heave accuracy
- Strong multipath mitigation and Cygnus™ interference rejection
- New multi-axis gyro and tilt sensor for reliable coverage during short GNSS outages

For complete specifications of the Vega OEM boards, see [Appendix B Technical Specifications](#).

Continued on next page

What's Included in Your Kit

Vega kit contents

The Vega board series is available in two configurations:

1. Vega GNSS OEM board only -designed for integrators who are familiar with Hemisphere board integration
 - Vega 28 (P/N 725-1582-11)
 - Vega 60 (P/N 726-1168-10)
2. Vega series OEM board and the Universal Development Kit ST- designed to provide integrators with a platform to instantly begin working with their Vega OEM board, providing smooth access to all hardware features in a convenient easy-open enclosure.

For more information on requesting the Vega series with the Universal Development Kit ST, go to the [HGNS OEM Products](#) page, or contact your local dealer.

Firmware

Firmware

The software that runs the Vega boards is often referred to as firmware since it operates at a low level.

The Vega series currently ships with the Athena-based firmware. Refer to the [HGNS TRM](#) for information on querying and communicating with the Vega boards.

You can upgrade the firmware when in the field through any serial port as new versions become available.

Using PocketMax to Communicate with Vega Boards

PocketMax

Hemisphere's PocketMax is a free utility program that runs on your Windows PC or Windows mobile device. Simply connect your Windows device to a Vega board via the COM port and open PocketMax.

The screens within PocketMax allow you to easily interface with Vega boards to:

- Select the internal SBAS or RTCM correction source, and monitor reception (beacon optional)
- Configure GPS message output and port settings
- Record several types of data
- Monitor the Vega board status and function

PocketMax is available for download from the Hemisphere GNSS website ([HTTPS://WWW.HEMISPHEREGNSS.COM](https://www.hemispheregnss.com)).

Athena RTK and Atlas L-band

Athena RTK

Athena RTK is Hemisphere's next-generation RTK engine designed to support all available constellations and takes advantage of available new signals. Athena is designed to seamlessly integrate into existing product portfolios and supports all major industry correction formats and standards.

Athena RTK can be added to the Vega series as an activation. Athena RTK has the following benefits:

- **Improved Initialization time** - Performing initializations in less than 15 seconds at better than 99.9% of the time.
- **Robustness in difficult operating environments** - Extremely high productivity under the most aggressive of geographic and landscape-oriented environments.
- **Performance on long baselines** - Industry-leading position stability for long baseline applications.

For more information about Athena RTK, see:

[HTTPS://WWW.HEMISPHEREGNSS.COM/TECHNOLOGY/#ATHENA](https://www.hemispheregnss.com/technology/#athena)

Atlas L-band

Atlas L-band is Hemisphere's industry leading correction service, which can be added to the Vega series as a subscription. Atlas L-band has the following benefits:

- **Positioning accuracy**- Competitive positioning accuracies down to 4 cm RMS in certain applications.
 - **Positioning sustainability** - Cutting edge position quality maintenance in the absence of correction signals, using Hemisphere's patented technology.
 - **Scalable service levels** - Capable of providing virtually any accuracy, precision and repeatability level in the 4 cm to 50 cm range.
 - **Convergence time** - Convergence times of 10-40 minutes.
 - **Global Ionospheric Model** - Real-time ionospheric activity and data is sent to the receiver and allows Atlas-capable devices to adjust accordingly, providing excellent convergence performance. For more information about Atlas L-band, see: [HTTP://HGNS.COM/ATLAS](http://hgns.com/atlas)
-

aRTK Position Aiding

aRTK position aiding

aRTK is an innovative feature available in Hemisphere's Vega series that mitigates the impact of land-based communication instability.

Powered by Hemisphere's Atlas L-band system service, aRTK augments the ability to maintain an RTK solution when the original RTK data link is lost or interrupted. The aRTK provides an additional layer of communication redundancy to RTK users, assuring that productivity is not impacted by intermittent data connectivity.

Vega boards receive aRTK augmentation correction data over satellite, while also receiving the land-based RTK correction data. The receiver internally operates with two sources of RTK correction, creating one additional layer of correction redundancy as compared to typical RTK systems.

After a few seconds of RTK correction loss aRTK is established. The receiver uses Atlas corrections in the absence of RTK. This allows for a slower degradation of accuracy until RTK corrections resume.

Chapter 2: Integrating the Vega OEM Boards

Overview

Introduction This chapter provides instructions on how to integrate your Vega OEM boards with your positioning product.

Contents

	Topic	See Page
	Vega Board Integration	19
	Mechanical Layout Vega Boards	20
	Connectors	22
	Mounting Options	24
	Header Layouts and Pinouts	26
	Signals	36
	Vega 28 Ports	37
	Vega 60 Ports	41

Vega Board Integration

Introduction Successful integration of a Vega board within a system requires electronics expertise that includes:

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

Vega integration requirements The Vega board is a low-level module intended for custom integration with the following general requirements:

- Regulated power supply input: (3.3 VDC \pm 3%) and 850 mA continuous maximum.
- Radio frequency (RF) input to the engine from a GNSS antenna is required to be amplified (10 to 35 dB gain).
- Antenna input impedance is 50 Ω capable of supplying 5VDC @ 100 mA total for amplified antennas.

Message interface You can output standard NMEA 0183 messages and proprietary Hemisphere ASCII and binary messages over serial, USB, and Ethernet. For more information on NMEA 0183 commands and messages and binary messages, refer to the [HGNSS TRM](#).

You can output NMEA 2000 and some Hemisphere proprietary messages over CAN. Refer to the [Hemisphere GNSS NMEA 2000 manual](#).

Mechanical Layout Vega Boards

Overview

This section contains the mechanical layout drawings for the Vega 28 and the Vega 60 GNSS OEM boards.

Vega 28 mechanical layout

Figure 2-1 shows the mechanical layout for the Vega 28 OEM board. Dimensions are in millimeters for all layouts.

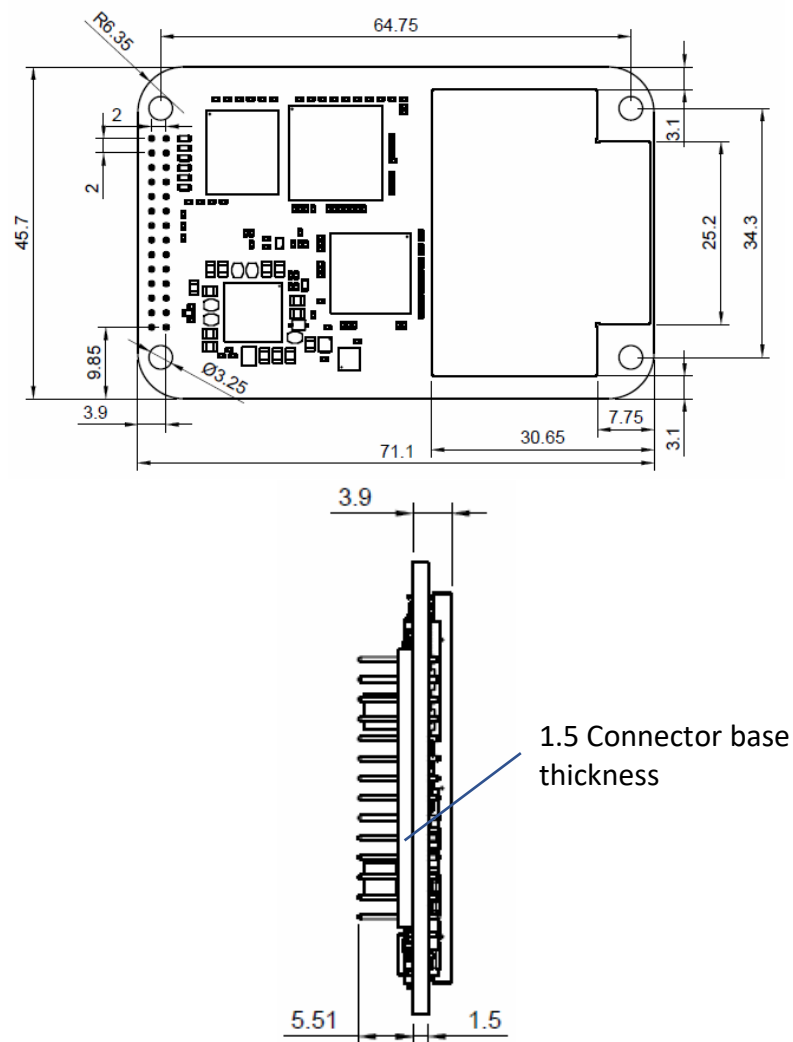


Figure 2-1: Vega 28 mechanical layout

Continued on next page

Mechanical Layout Vega Boards, Continued

Vega 60 mechanical layout

Figure 2-2 shows the mechanical layout for the Vega 60 OEM board. Dimensions are in millimeters for all layouts.

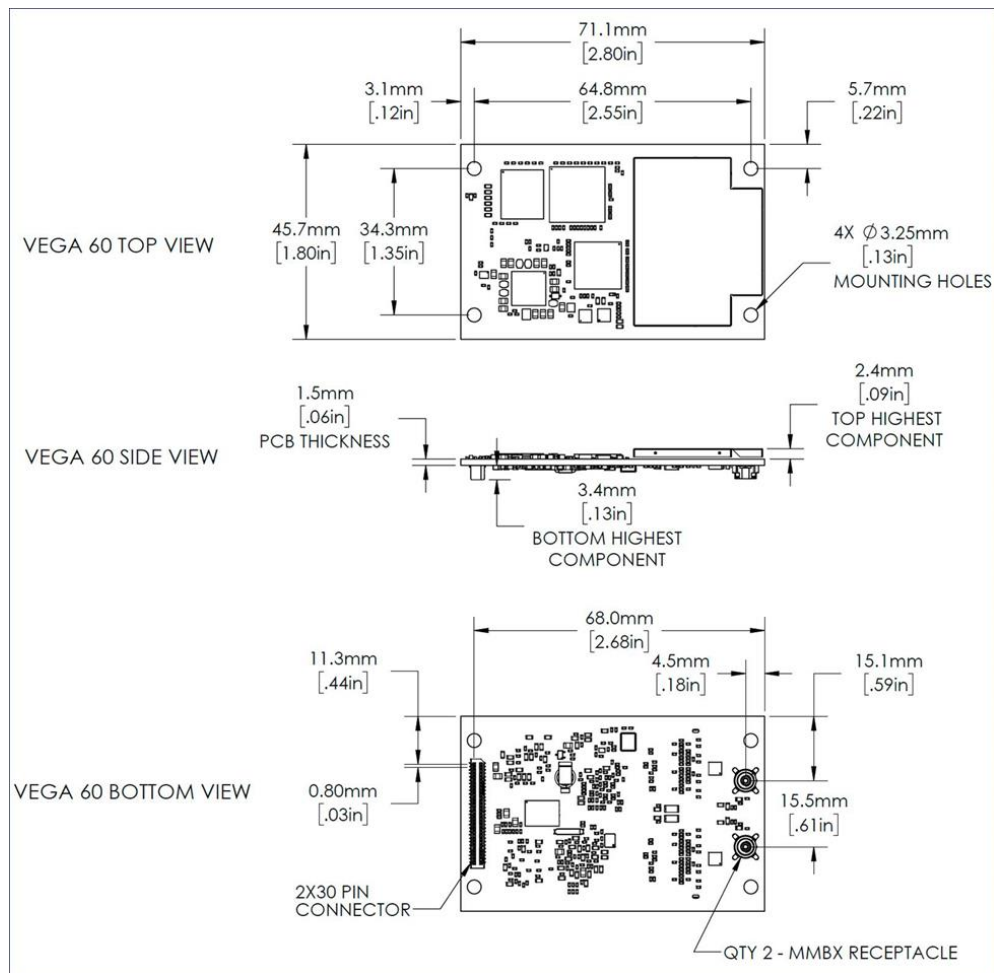


Figure 2-2: Vega 60 mechanical layout

Connectors

Overview This section contains the connectors needed for the Vega board series.

Vega 28 connectors Table 2-1 lists the Vega 28 connectors and mating connectors. You can use different compatible connectors; however, the requirements may be different. The antenna input impedance is 50 Ω .

Table 2-1: Vega 28 connectors

GNSS Board and Connector Type		Through-Hole Connector	Mating Connector
Vega 28	RF	MMCX, female straight jack Molex 734152063	MMCX, male straight plug
	Power / data	28-pin (14x2) male header, 0.0787 in (2 mm) pitch Samtec TMM-114-03-G-D	Samtec SQW-114-01-F-D 2mm Pitch 2 x 14 Socket

To reduce fatigue of the MMCX connectors on the Vega 28, please use the following recommendations:

- When connecting the Vega 28 to another board, a cable should be used. The recommended cable is either the RG-316 or the RG-174, which provide a more flexible sheathing, and result in reduced strain on the MMCX connectors.
- Use caution when connecting and/or disconnecting the Vega 28 board within an assembly. Vega 28 MMCX connectors are intended for a one-time insertion. Multiple connections to the MMCX connectors can result in fatigue at the solder joints and could cause detachment from the Vega 28 board.
- When disconnecting an RF cable from the Vega 28, hold the board and pull the mating MMCX cable straight up to protect the integrity of the MMCX connectors.
- Significant force is required to disconnect the MMCX cable.

Continued on next page

Connectors, Continued

Vega 60 connectors

Table 2-2 lists the Vega 60 connectors and mating connectors. You can use different compatible connectors; however, the requirements may be different. The antenna input impedance is 50 Ω .

Table 2-2: Vega 60 connectors

GNSS Board and Connector Type		GNSS Connector	Mating Connector
Vega 60	RF	MMBX, Jack Receptacle Radiall R223424000	MMBX Plug Receptacle (SMT) Radiall R223434000
	Power/ data	2 x 30 Header, 0.8mm pitch Samtec, Inc SEMS-130-02- 03.0-H-D-K-TR	2 x 30 Socket, 0.8mm pitch Samtec, Inc TEMS-130-02-03.0-H-D-K-TR (Requires 6mm board gap, 1/4-inch board gap is also acceptable.)

Mounting Options

Overview

When mounting the Vega series, use metal standoffs, bolts, nuts, or screws. Plastic or nylon standoffs are not appropriate for vibration concerns. PCB snap-in place standoffs should be avoided. The pressure and snapping action put undue stress on the board and compromises solder integrity. In addition, metal standoffs help heat dissipate off the GNSS board.

There are two options for mounting the Vega OEM boards:

1. Direct Electrical Connection method (Vega 28/60)
2. Indirect Electrical Connection (cable) method (Vega 28)

Direct electrical connection

Place the RF connectors, the header connector, and the mounting holes on the carrier board, and then mount the Vega 60 OEM board on the standoffs and RF and header connectors. Vega 28 uses MMCX connectors which are not recommended for board-to-board connections, and therefore RF cables are recommended for installation.

Note: Use care when routing RF traces. Trace impedance shall be 50 ohms. Ensure the trace has no breaks in the ground plane beneath it and that the RF trace does not cross or run adjacent to power or data traces.

Be aware of the relationship between the gap between boards. The power-data connector, the RF connector and the standoffs all need to function properly at the selected board gap spacing.

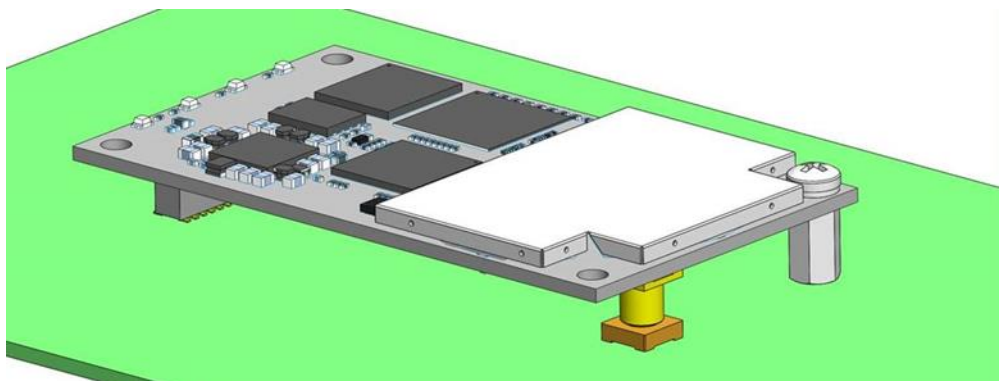


Figure 2-3: Connector selections

Continued on next page

Mounting Options, Continued

Direct electrical connection,
continued

Use metal standoffs, bolts, nuts, or screws. Plastic or nylon standoffs are not appropriate for vibration concerns. Avoid PCB snap-in place standoffs. The pressure and snapping action add undue stress on the board and compromises solder integrity. Metal standoffs help heat dissipate from the GNSS board. The Vega OEM boards use multiple standoff heights. Refer to the table below for a listing of the Vega board standoff heights.

Vega Board	Standoff Height
Vega 28	5/16" or 13/32"
Vega 60	¼" or 6 mm

There are two common methods to create a hybrid direct electrical connection on Vega 28 using a combination of headers and RF cables:

1. Use right-angle RF cable connectors. You may require a taller header than the part numbers suggested in this guide. This will provide clearance to for a right-angle cable-mount connectors and eliminate the need for the carrier board to handle the RF signals.
2. Use the standard headers and create a PCB cutout for the antenna connectors.

Note: This method is not recommended for Vega 60, as the MMBX RF connectors are intended for board-to-board connections. Vega 60 integrators using RF cables may need to take additional precautions to ensure a robust RF connection.

Note: See Table 2-1 through Table 2-2 for Vega connector information.

Indirect electrical connection (cable) method

The second method is to mount the Vega 28 board mechanically, so you can connect a ribbon power/data cable to the Vega board. This requires cable assemblies and there is a reliability factor present with cable assemblies in addition to increased expense. Vega 60 is not intended to be mounted with RF cables due to the MMBX connector design.

Header Layouts and Pinouts

Overview This section contains the header layouts and pinouts for the Vega 28 and Vega 60 GNSS OEM boards.

Vega 28 Header layouts and pinouts The Vega 28 uses a dual-row header connector to interface with power, communications, and other signals. The mounting holes of the Vega 28 have a standard inner diameter of 3.50 mm (0.138 in).

To identify the first header pin, orient the board so the bar is to the upper left of the pins; the first pin is on the left directly below the bar (see Figure 2-5). The pins are then sequentially numbered per row from top to bottom.

Figure 2-4 shows the Vega 28 pin header layout.

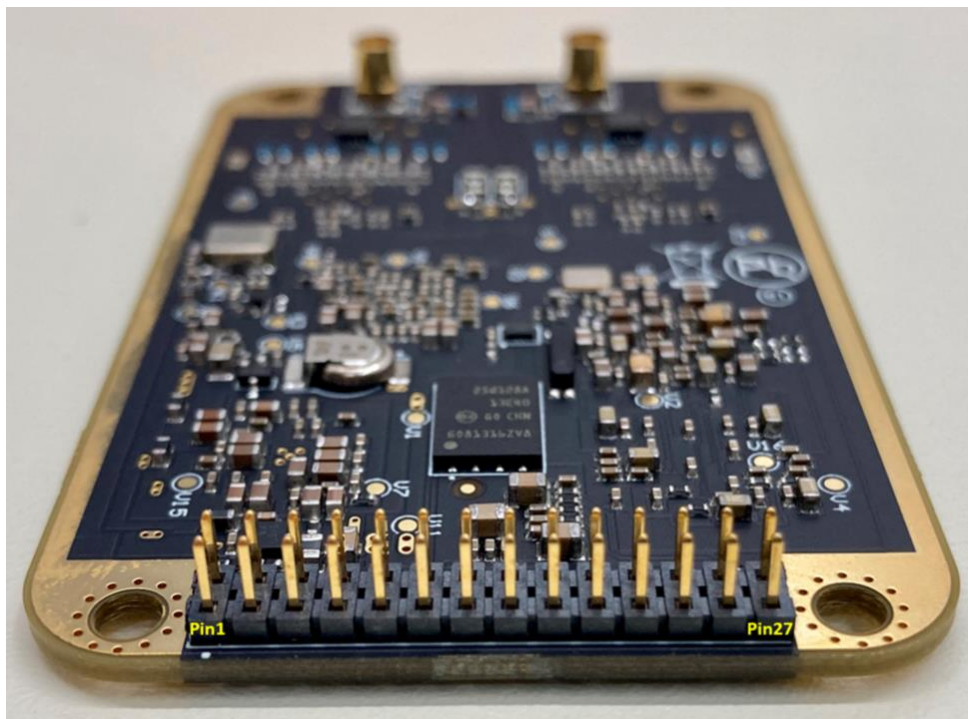


Figure 2-4: Vega 28 pin layout

Continued on next page

Header Layouts and Pinouts, Continued

Vega 28 Header layouts and pinouts, continued

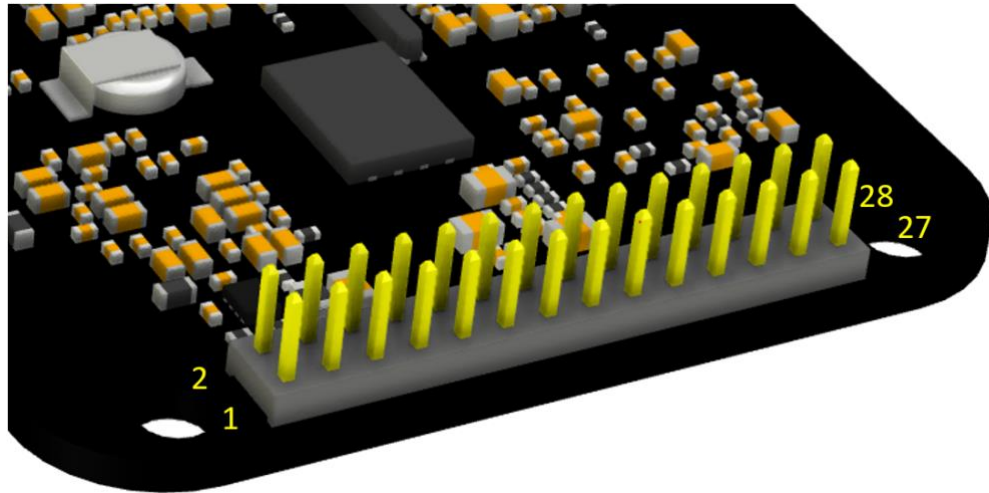


Figure 2-5: Vega 28 28-pin layout

Continued on next page

Header Layouts and Pinouts, Continued

Vega 28 Header layouts and pinouts, continued

The Vega 28 board has a 28-pin header. Table 2-3 provides the 28-pin header pin-out signals and descriptions.

Note: Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted. Leave any data or I/O pins that will not be used unconnected.

Table 2-3: Vega 28 28-Pin header pin-out

Pin	Signal Name	Signal Type	Signal Direction	Description
1	USB ID	3.3 V CMOS	Input	USB ID (N/C for device mode, pull low for host mode)
2	USB VBUS	Power	-	USB bus voltage
3	ETH LINK LED	3.3 V CMOS	Output	Ethernet LED
4	ETH BIAS	Ethernet	-	Ethernet Bias
5	N/C			
6	3.3V	Power	-	Receiver power supply, 3.3 V
7	USB D- -	I/O	Input / Output	USB device or host data -
8	USB D+ (default) / PCRX Port C	I/O	Input / Output	Dual use pin: Default: USB device or host data + PCRX Port C: Port C Receive

Continued on next page

Header Layouts and Pinouts, Continued

Vega 28 Header layouts and pinouts, continued

Table 2-3: Vega 28 28-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
9	Reset	3.3 V CMOS	Input	Active Low. Resets the receiver card. This pin must be held low for a minimum of 100 microseconds to guarantee operation. Internal 10 kΩ pullup.
10	VARF (default)/ CAN RX Port A	3.3 V CMOS	Output / Input*	Dual use pin: Default: VARF: Variable Frequency Output (Rising or falling edge active) CAN Tx Port A: CAN Port A Receive
11	Event2 (default)/ CAN TX Port A	3.3 V CMOS	Input / Output*	Dual use pin: Default: Event 2 (Rising edge triggered) CAN TX Port A CAN Port A Transmit
12	CAN RX Port B	3.3V CMOS	Input	CAN Port B Receive
13	Event1 (default) /PCTX Port C	3.3V CMOS	Input / Output*	Dual use pin: Default: Event 1 (Falling edge triggered) PCTX Port C Transmit

Continued on next page

Header Layouts and Pinouts, Continued

Vega 28 Header layouts and pinouts, continued

Table 2-3: Vega 28 28-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
14	Ground	Power	-	Receiver ground
15	PATX Port A	3.3V CMOS	Output	Port A Transmit
16	PARX Port A	3.3V CMOS	Input	Port A Receive
17	Ground	Power	-	Receiver ground
18	PBTX Port B	3.3V CMOS	Output	Port B Transmit
19	PBRX Port B	3.3V CMOS	Input	Port B Receive
20	Ground	Power	-	Receiver ground
21	PValid	3.3 CMOS	Output	Active High. Position Valid Indicator. Indicates the receiver has computed a position. Active High output.
22	Ground	Power	-	Receiver ground
23	PPS	3.3V CMOS	Output	Active high, rising edge, 3.3 V CMOS
24	CAN TX Port B	3.3V CMOS	Output	CAN Port B Transmit
25	ENET TX+	Ethernet	Output	Ethernet Transmit +
26	ENET RX+	Ethernet	Input	Ethernet Receive +
27	ENET TX-	Ethernet	Output	Ethernet Transmit -
28	ENET RX-	Ethernet	Input	Ethernet Transmit +

**Selectable pin with input/output option*

Continued on next page

Header Layouts and Pinouts, Continued

Vega 60 Header layouts and pinouts

The Vega 60 boards have a 60-pin dual row header. Figure 2-6 shows the Vega 60 pin header layout. Table 2-4 lists the Vega 60 pin-out.

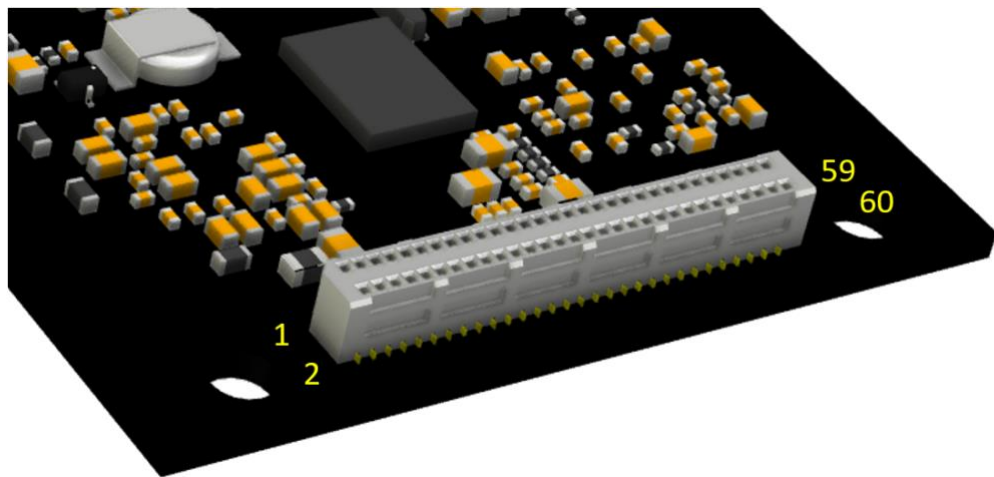


Figure 2-6: Vega 60 60-pin layout

Continued on next page

Header Layouts and Pinouts, Continued

Vega 60 Header layouts and pinouts, continued

Table 2-4: Vega 60 60-pin header pin out

Pin	Signal Name	Signal type	Signal Direction	Description
1	3.3V CMOS	Power	Input Power	3.3V +-5% Input power
2	3.3V CMOS	Power	Input Power	3.3V +-5% Input power
3	TXPB	3.3V CMOS	Output	Transmit, Port B, Serial Communications Port
4	TXPA	3.3V CMOS	Output	Transmit, Port A, Serial Communications Port
5	TXPE / RTSPB	3.3V CMOS	Output	Multiplexed through Software, Transmit Port E / RTS Port B
6	RTSPA	3.3V CMOS	Output	Request To Send (RTS) Port A, Serial Communications Control
7	GROUND	Power	Ground	Ground
8	GROUND	Power	Ground	Ground
9	RXPB	3.3V CMOS	Input	Receive, Port B, Serial Communications Port
10	RXPA	3.3V CMOS	Input	Receive, Port A, Serial Communications Port
11	RXPE / CTSPB	3.3V CMOS	Input	Multiplexed through Software, Receive Port E / CTS Port B
12	CTSPA	3.3V CMOS	Input	Clear To Send (CTS) Port A, Serial Communications Control
13	RXPD	3.3V CMOS	Input	Receive Port D, Serial Communications Port

Continued on next page

Header Layouts and Pinouts, Continued

Vega 60 Header layouts and pinouts, continued

Table 2-4: Vega 60 60-pin header pin out (continued)

Pin	Signal Name	Signal type	Signal Direction	Description
14	RXPC	3.3V CMOS	Input	Receive Port C, Serial Communications Port
15	STAT GREEN	3.3V CMOS	Output	Logic Indicator, Green LED, Active High
16	STAT RED	3.3V CMOS	Output	Logic Indicator, Red LED, Active High
17	EVENT OUT 1	3.3V CMOS	Output	Event Out 1, Timer
18	ME RDY	3.3V CMOS	Output	Logic Indicator, Receiver Ready Indicator, Active High
19	TXPD	3.3V CMOS	Output	Transmit, Port D, Serial Communications Port
20	TXPC	3.3V CMOS	Output	Transmit, Port C, Serial Communications Port
21	ERROR	3.3V CMOS	Output	Logic Indicator, Receiver Error Indicator, Active High
22	PVALID	3.3V CMOS	Output	Logic Indicator, Position Valid, Active High
23	EVENT OUT 3	3.3V CMOS	Output	Event Out 3, Timer
24	PPS	3.3V CMOS	Output	Pulse Per Second, Active High (default)
25	EVENT OUT 4	3.3V CMOS	Output	Event Out 4, Timer
26	EVENT OUT 2	3.3V CMOS	Output	Event Out 2, Timer
27	GROUND	Power	Ground	Ground
28	GROUND	Power	Ground	Ground

Continued on next page

Header Layouts and Pinouts, Continued

Vega 60 Header layouts and pinouts, continued

Table 2-4: Vega 60 60-pin header pin out (continued)

Pin	Signal Name	Signal type	Signal Direction	Description
29	EVENT IN 2	3.3V CMOS	Input	Event In 2, Trigger
30	EVENT IN 1	3.3V CMOS	Input	Event In 1, Trigger
31	EVENT IN 4	3.3V CMOS	Input	Event In 4, Trigger
32	EVENT IN 3	3.3V CMOS	Input	Event In 3, Trigger
33	GROUND	Power	Ground	Ground
34	GROUND	Power	Ground	
35	RX CAN B	3.3V CMOS	Input	Receive CAN Port B, Serial CAN Communications
36	TX CAN A	3.3V CMOS	Output	Transmit CAN Port A, Serial CAN Communications
37	TX CAN B	3.3V CMOS	Output	Transmit CAN Port B, Serial CAN Communications
38	RX CAN A	3.3V CMOS	Input	Receive CAN Port A, Serial CAN Communications
39				Reserved, No Connect
40				Reserved, No Connect
41				Reserved, No Connect
42				Reserved, No Connect
43				Reserved, No Connect
44				Reserved, No Connect
45	GROUND	Power	Ground	Ground
46	GROUND	Power	Ground	Ground
47	USB1 DR-	I/O	Diff. IO	USB1 Dual Role 1 D-, Pair with USB1 DR+
48	USB0 DR+	I/O	Diff. IO	USB0 Dual Role 0 D+, Pair with USB0 DR-

Continued on next page

Header Layouts and Pinouts, Continued

Vega 60 Header layouts and pinouts, continued

Table 2-4: Vega 60 60-pin header pin out (continued)

Pin	Signal Name	Signal type	Signal Direction	Description
49	USB1 DR+	I/O	Diff. IO	USB1 Dual Role 1 D+, Pair with USB1 DR-
50	USB0 DR-	I/O	Diff. IO	USB0 Dual Role 0 D-, Pair with USB0 DR+
51	USB ID0	3.3V CMOS	Input	Floating USB0 Device USB1 Host, Grounded USB0 Host USB1 Device
52	USB0 VBUS	Power	Power	5V output when USB0 Host Mode, 5V input when USB0 Device Mode
53	nRESET	3.3V CMOS	I/O	RESET, Active Low, Input / Output
54	GROUND	Power	Ground	Ground
55	ENET LED	3.3V CMOS	Output	Ethernet Activity Logic Indicator
56	ENET BIAS	ETHER NET	Analog	Ethernet DC Magnetic Bias
57	ENET RX+	ETHER NET	Diff. IO	Ethernet Receive+, Pair with Receive-
58	ENET TX+	ETHER NET	Diff. IO	Ethernet Transmit+, Pair with Transmit-
59	ENET RX-	ETHER NET	Diff. IO	Ethernet Receive-, Pair with Receive+
60	ENET TX-	ETHER NET	Diff. IO	Ethernet Transmit-, Pair with Transmit+

Signals

Overview This section provides information on the signals available on the Vega board series via connectors.

RF Input The Vega series is designed to work with active GNSS antennas with an LNA gain range of 10 to 35 dB. While the on-board Automatic Gain Control (AGC) circuitry will compensate for variations in signal level, system designers should try to have the antenna's gain offset the cable's loss with a 10-15dB margin. For example, a cable with a signal loss of 10 dB @ 1575 MHz should be used with a 25 dB gain antenna. Cable losses of more than 20 dB should be avoided and may require special system design.

Hemisphere's antennas typically have a 25 to 30 dB gain. They are designed to be paired with our 1 m to 30 m antenna cables which have between 2 dB and 12 dB loss. This still allows a few dB margin for additional interconnection items and short interface cables in integrated products.

Hemisphere recommends using the same type of antenna on both antenna ports. Orient the antennas the same way for the best heading performance.

Vega 28 Ports

Vega 28 Serial ports

The Vega 28 has three serial communication ports:

Port A- 3.3V CMOS UART

Pin 15 (TX), Pin 16 (RX)

Port B- 3.3V CMOS UART

Pin 18 (TX), Pin 19 (RX)

Port C- 3.3V CMOS UART (multiplexed with USB+, and Event 1)

Pin 8 (RX), Pin 13 (TX)

A transceiver is required if serial ports A, B, or C (UART 3.3V CMOS) are used for external devices that use RS-232.

Vega 28 USB ports

The Vega 28 USB device port serves as a high-speed data communications port. The Vega 28 USB data lines are bi-directional. The USB data lines should be laid out on printed circuit board (PCB) as a differential pair with $90 \Omega \pm 15\%$ differential impedance.

The traces should be over a solid continuous ground plane to maintain parallel traces and symmetry. There shall be no traces or breaks in the ground plane underneath the D+ and D- traces.

It is recommended to leave a minimum 20 mil spacing between USB signals and other signals. Treat the data lines as if they are RF signals. USB Transient Voltage Suppressors (TVS's) should be considered on D+ and D- for transient and electrostatic discharge protection.

Continued on next page

Vega 28 Ports, Continued

Vega 28 CAN port

A CAN transceiver is required. The Vega 28 CAN RX and CAN TX are 3.3V CMOS signals. The Vega 28 connects to the transceiver on the single-ended CMOS port. CANH and CANL are CAN standard pins on the physical bus side of the transceiver. The Vega 28 does not connect to this portion of the transceiver.

Note: Resistor values can vary based on application.

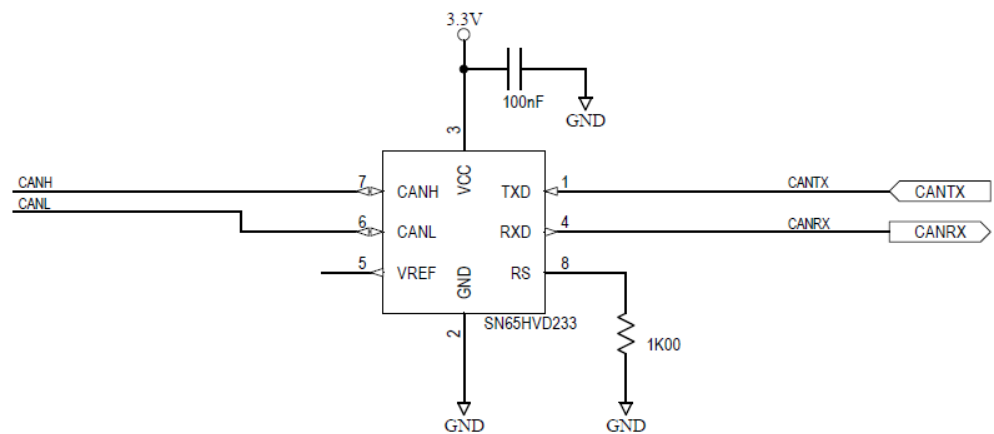


Figure 2-7: Vega 28 CAN design example

Vega 28 Ethernet port overview

The Hemisphere Vega 28 receiver board has ethernet support. It is disabled by default but may be enabled.

The Vega 28 is connected to a carrier board or enclosure which connects the Vega 28's ethernet pins to a standard RJ-45 jack (with integrated magnetics as appropriate).

Continued on next page

Vega 28 Ports, Continued

Vega 28 Enabling / disabling ethernet

The full current state of Ethernet configuration may be checked with the command “**\$JETHERNET.**” When Ethernet is disabled, the following response displays:

```
$JETHERNET  
$>JETHERNET,MAC,8C-B7-F7-F0-00-01  
$>JETHERNET,MODE,OFF  
$>JETHERNET,PORTI,OFF  
$>JETHERNET,PORTUDP,OFF  
$>JETHERNET,NTRIPCLIENT,OFF  
$>JETHERNET,NTRIPSERVER,OFF  
$>JETHERNET,WEBUI,OFF  
$>JETHERNET,IPADDRESS,NONE  
$>JETHERNET,LINK,Offline
```

To enable Ethernet, determine if the receiver is allowed to be assigned an IP address automatically via DHCP, or statically assigned. If you are unsure, please contact the network administrator.

To enable Ethernet support with a DHCP-assigned IP address, simply use the command:

```
$JETHERNET,MODE,DHCP
```

The receiver will attempt to get an address from the DHCP server on the network. You should be able to see the current IP address reported by a “**\$JETHERNET**” query change.

Continued on next page

Vega 28 Ports, Continued

Vega 28 Enabling / disabling ethernet, continued

To enable Ethernet support with a statically assigned IP address, use the command:

\$JETHERNET,MODE,STATIC,ip,subnet,gateway,dns

In the previous command, ip/subnet/gateway/dns are each replaced with the relevant IP address. The gateway and dns parameters are optional, and only useful for allowing outgoing connections from the Vega 28 (not currently supported). The following is an example command:

\$JETHERNET,MODE,STATIC,192.168.0.42,255.255.255.0.

To disable Ethernet, use the command:

\$JETHERNET,MODE,OFF

With Ethernet enabled, you can test sending an Internet Control Message Protocol (ICMP) ping to the Vega 28 receiver from a PC on the same network. No actual services are enabled on Ethernet by default, so to make practical use of Ethernet support, enable a service.

The only Ethernet service implemented is the PORTI virtual serial port. Additional types of Ethernet services may be implemented in future firmware versions. The PORTI virtual serial port allows a listening TCP port to be opened, acting like a local serial port of the receiver. Only one TCP client may be connected at a time.

Note: Enabling “PORTI” on Ethernet should only be done with the Vega 28 connected to a trusted network, since it gives full access to the receiver as a local serial port and has no authentication or security mechanisms.

To enable the PORTI service, use the command **\$JETHERNET,PORTI, port** where port is replaced with the desired TCP port number. Any port in the range 1 to 65535 is allowable, but it is recommended to consider which TCP port numbers are typically reserved for various common protocols and avoid those port numbers.

To disable the PORTI service, use the command **\$JETHERNET,PORTI,OFF**

Vega 60 Ports

Vega 60 CAN ports

A CAN transceiver is required. The Vega 60 CAN RX and CAN TX are 3.3V CMOS signals. The Vega 60 connects to the transceiver on the single-ended CMOS port. CANH and CANL are CAN standard pins on the physical bus side of the transceiver. The Vega 60 does not connect to this portion of the transceiver.

Note: Resistor values can vary based on application.

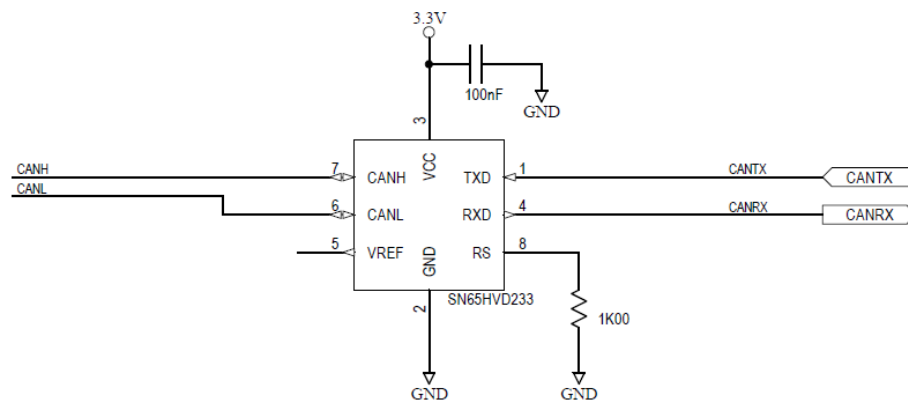


Figure 2-8: Vega 60 CAN design example

Vega 60 Ethernet port overview

The Hemisphere Vega 60 receiver board has ethernet support. It is disabled by default but may be enabled.

The Vega 60 is connected to a carrier board or enclosure which connects the Vega 60's ethernet pins to a standard RJ-45 jack (with integrated magnetics as appropriate).

Continued on next page

Vega 60 Ports, Continued

Vega 60 Enabling / disabling ethernet

The full current state of Ethernet configuration may be checked with the command “**\$JETHERNET.**” When Ethernet is disabled, the following response displays:

```
$JETHERNET  
$>JETHERNET,MAC,8C-B7-F7-F0-00-01  
$>JETHERNET,MODE,OFF  
$>JETHERNET,PORTI,OFF  
$>JETHERNET,PORTUDP,OFF  
$>JETHERNET,NTRIPCLIENT,OFF  
$>JETHERNET,NTRIPSERVER,OFF  
$>JETHERNET,WEBUI,OFF  
$>JETHERNET,IPADDRESS,NONE  
$>JETHERNET,LINK,Offline
```

To enable Ethernet, determine if the receiver is allowed to be assigned an IP address automatically via DHCP, or statically assigned. If you are unsure, please contact the network administrator.

To enable Ethernet support with a DHCP-assigned IP address, simply use the command:

```
$JETHERNET,MODE,DHCP
```

The receiver will attempt to get an address from the DHCP server on the network. You should be able to see the current IP address reported by a “**\$JETHERNET**” query change.

Continued on next page

Vega 60 Ports, Continued

Vega 60 Enabling / disabling ethernet, continued

To enable Ethernet support with a statically assigned IP address, use the command:

\$JETHERNET,MODE,STATIC,ip,subnet,gateway,dns

In the previous command, ip/subnet/gateway/dns are each replaced with the relevant IP address. The gateway and dns parameters are optional, and only useful for allowing outgoing connections from the Vega 60 (not currently supported). The following is an example command:

\$JETHERNET,MODE,STATIC,192.168.0.42,255.255.255.0.

To disable Ethernet, use the command:

\$JETHERNET,MODE,OFF

With Ethernet enabled, you can test sending an Internet Control Message Protocol (ICMP) ping to the Vega 60 receiver from a PC on the same network. No actual services are enabled on Ethernet by default, so to make practical use of Ethernet support, enable a service.

The only Ethernet service implemented is the PORTI virtual serial port. Additional types of Ethernet services may be implemented in future firmware versions. The PORTI virtual serial port allows a listening TCP port to be opened, acting like a local serial port of the receiver. Only one TCP client may be connected at a time.

Note: Enabling “PORTI” on Ethernet should only be done with the Vega 60 connected to a trusted network, since it gives full access to the receiver as a local serial port and has no authentication or security mechanisms.

To enable the PORTI service, use the command **\$JETHERNET,PORTI, port** where port is replaced with the desired TCP port number. Any port in the range 1 to 65535 is allowable, but it is recommended to consider which TCP port numbers are typically reserved for various common protocols and avoid those port numbers.

To disable the PORTI service, use the command **\$JETHERNET,PORTI,OFF**

Continued on next page

Vega 60 Ports, Continued

Vega 60 serial ports

The Vega 60 boards have five serial communication ports:

- Port A, Port B, Port C, Port E - main ports
- Port D - Functions as the other ports but also is the recommended port to interface with a beacon board. See “Communication Port D” below for more information on Port D.

The Vega 60 serial ports’ 3.3 V CMOS signal level can be translated to interface to other devices.

Vega 60 Communication Port D

Communication Port D will automatically detect if Hemisphere GNSS’ SBX beacon board is connected. Ensure the port is set to 9600 baud. When communicating into either Port A, B, or C, a virtual connection may be established to the SBX board on Port D using the **\$JCONN** command.

Vega 60 USB ports

The Vega 60 has both a USB host port and a USB device port.

The USB data lines are bi-directional and are differential pairs. The USB data lines should be laid out on printed wire board (PWB) with $90 \Omega \pm 15\%$ differential impedance.

The traces should be over a solid continuous ground plane. Maintain parallel traces and symmetry. There shall be no traces or breaks in the ground plane underneath the D+ and D- traces.

It is also recommended to leave a minimum 20 mil spacing between USB signals and other signals. Treat the data lines as if they are RF signals. A device can use USB Type-B or Mini-B connectors. If Mini-B is used, “ID” pin 4 is NOT CONNECTED.

Chapter 3: Understanding the Vega Board Series

Overview

Introduction This chapter provides information you need to understand the Vega series OEM boards and functions.

Contents

	Topic	See Page
	Timing Signal	46
	Event Marker Input	47
	Grounds	48
	Shielding	49
	Receiver Mounting	50
	Antenna Mounting	51
	Mounting Orientation	52
	Vega Orientation and Sensor Calibration	53
	Planning the Optimal Antenna Placement	57

Timing Signal

PPS timing signal

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

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

The PPS is a 3.3 V CMOS signal. By default, the PPS is a rising edge synchronized pulse occurring once per second with a width of approximately 1ms.

The Vega series support a programmable PPS. Users can select the frequency to 1, 2, 5 or 10Hz. The pulse can be programmed as either active high (rising edge synchronized) or active low (falling edge synchronized). The Vega series can support pulse widths as wide as 900 ms.

\$JPPS,RATE,<Rate_In_Hz (limited to 1.0 ,2.0 ,5.0 ,10.0 >],[SAVE]

or if you prefer to work with the period (inverse of RATE)

\$JPPS,PERIOD,<Period in seconds (limited to 1.0, 0.5, 0.2, 0.1) >],[SAVE]

PPS Width can be controlled using

\$JPPS,WIDTH,<width in μ s (microseconds)>],[SAVE]

The width command parameter is in μ s (microseconds).

Note: **\$JSAVE** does NOT save the JPPS configuration. The optional **SAVE** argument in the commands above may be included to save the settings to non-volatile memory, or the desired PPS configuration settings must be applied every time the receiver is powered on. Each parameter must be individually saved as it is entered (by adding the optional **SAVE** at the end of the command).

Event Marker Input

Event marker input

Depending on the application, a GNSS solution may need to be forced and not synchronized with GPS time.

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

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

Grounds

Grounds

You must connect all grounds together when connecting the ground pins of the Vega series. These are not separate analog and digital grounds which require separate attention. Refer to Tables 2-1 through 2-2 for Vega pin-out ground information.

Shielding

Shielding

The Vega board series are sensitive instruments. When integrated into an enclosure, the Vega board requires shielding from other electronics to ensure optimal operation.

The Vega board shield design consists of a thin piece of metal which prevents interference.

Receiver Mounting

Receiver mounting

The Vega boards are precision instruments. To ensure optimal operation, mount the receiver to minimize vibration and shock.

When mounting the Vega board immediately adjacent to the GPS antenna, Hemisphere GNSS highly recommends shielding the board from the LNA of the antenna.

Note: This step can be more complex than some integrators initially estimate. Confirm the operation in your application as early in the project as possible. Use the RTKSTAT and ATTSTAT messages to ensure the signal grades includes as many A's as possible.

Antenna Mounting

Antenna mounting

The Vega board series is compatible with the following Hemisphere GNSS single and dual frequency antennas:

- Single frequency: A21, A25, and A31 (beacon)
- Dual frequency: A42, A43 (beacon), and A45

When mounting the antennas, consider mounting orientation (pitch or roll) and proper antenna placement.

Mounting Orientation

Mounting The Vega series outputs heading, pitch, and roll readings regardless of the orientation of the antennas.

Heading is calculated from the vector created between the primary and secondary antenna.

A heading, pitch, or roll bias may need to be set after installing the antennas to correctly calibrate the heading, pitch, and roll. The primary antenna is used for positioning and works in conjunction with output heading, pitch, and roll values.

Pitch orientation If the vertical angle calculated between the primary and secondary antenna is the pitch, send **\$JATT,ROLL,NO** and **\$JATT,HBIAS,0** to the receiver to tell the receiver the antennas are calculating pitch instead of roll (**\$JATT,ROLL,NO**) and that a heading bias is not necessary.

Roll orientation If the vertical angle calculated between the primary and secondary antenna is the roll, send **\$JATT,ROLL,YES** and **\$JATT,HBIAS,-90** to the receiver. This tells the receiver the antennas are calculating roll instead of pitch (**\$JATT,ROLL,NO**). This assumes the primary antenna is on the left. If it is on the right, use **\$JATT,HBIAS,90**.

When heading should be 0 degrees and the primary antenna is on the left, the heading output will be 90 (since the antennas are calculating roll). Therefore, set the heading bias to -90 with **\$JATT,HBIAS,-90**. Similarly, if the primary antenna is on the right, set the heading bias to +90 with **\$JATT,HBIAS,90**.

Note: Regardless of which mounting orientation you use, the Vega series provide the ability to output the heave measurement via the **\$GPHEV** message. For more information on this message refer to the [HGNSS TRM](#).

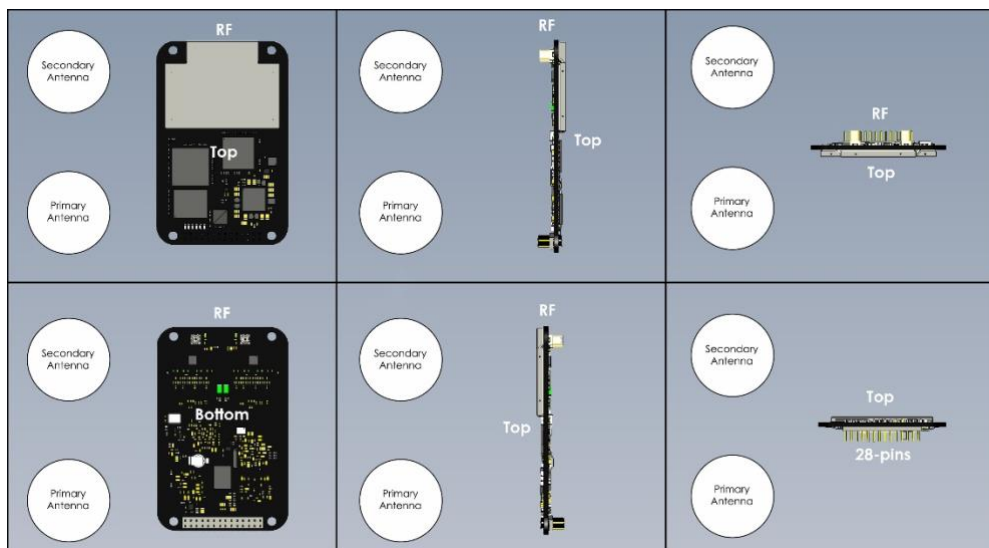
Vega Orientation and Sensor Calibration

Vega orientation and sensor calibration

The Vega OEM boards can determine mounting orientation in 90-degree steps using integrated inertial sensors. This allows the receiver to be installed in various orientations without affecting performance. A simple one-time calibration procedure is required to complete the orientation and sensor calibration.

1. Determine which of Group A, B, C, or D the installation matches.
2. Send the appropriate **\$JATT,ACC180,YES/NO** and **\$JATT,ACC90,YES/NO** commands which match the installation.
3. Send the command **\$JATT,TILTCAL** to finalize the calibration.

Note: Figure Groups A, B, C, and D are shown using the Vega 28 board.



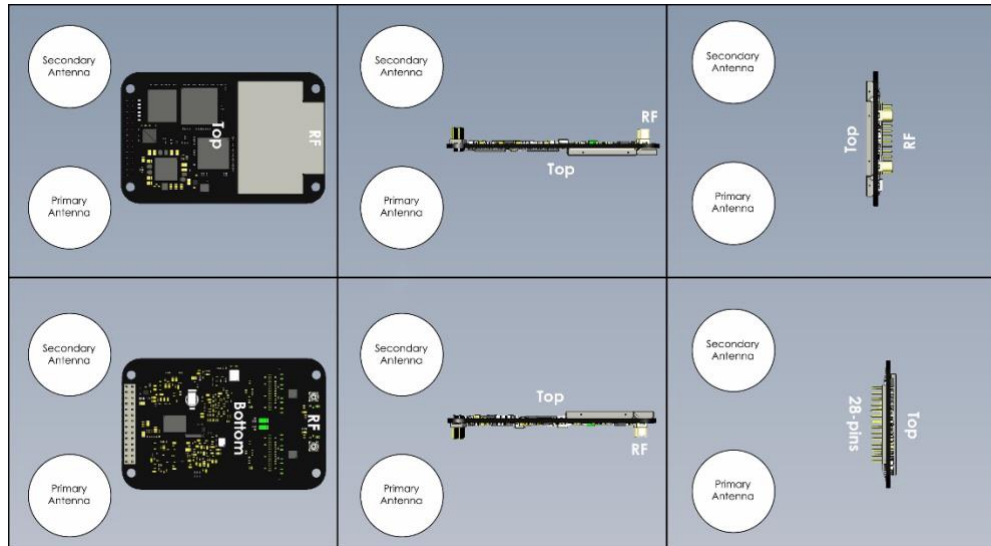
\$JATT,ACC90,NO
\$JATT,ACC180,NO

Figure 3-1: Group A

Continued on next page

Vega Orientation and Sensor Calibration, Continued

Vega orientation and sensor calibration, continued



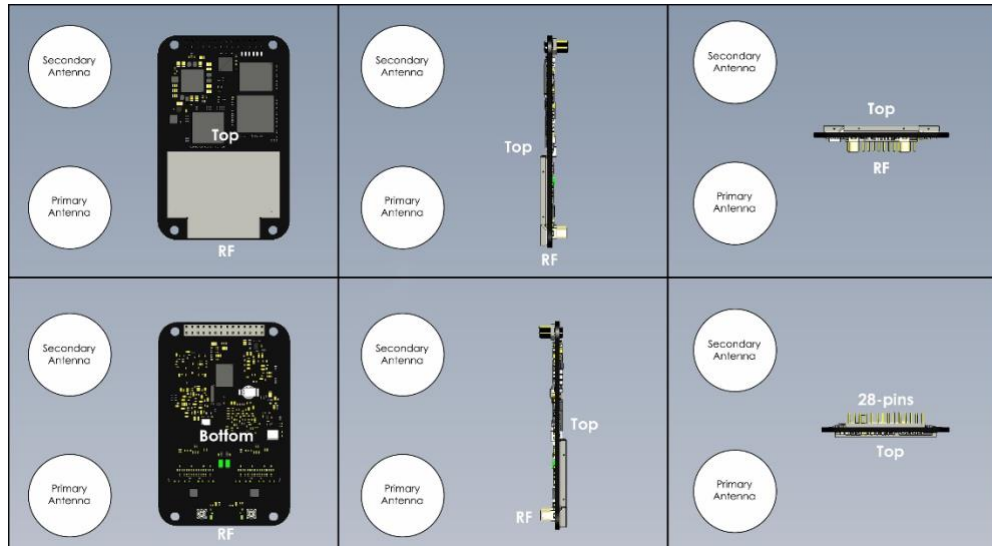
\$JATT,ACC90,YES
\$JATT,ACC180,NO

Figure 3-2: Group B

Continued on next page

Vega Orientation and Sensor Calibration, Continued

Vega orientation and sensor calibration, continued



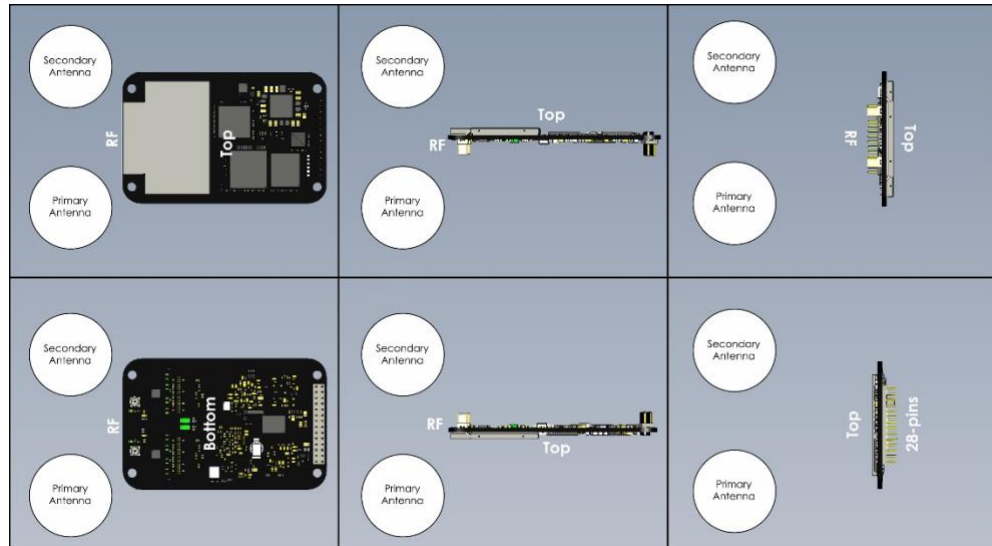
\$JATT,ACC90,NO
\$JATT,ACC180,YES

Figure 3-3: Group C

Continued on next page

Vega Orientation and Sensor Calibration, Continued

Vega orientation and sensor calibration, continued



\$JATT,ACC90,YES
\$JATT,ACC180,YES

Figure 3-4: Group D

Planning the Optimal Antenna Placement

Planning the optimal antenna placement

Proper antenna placement is important to obtain a high-precision GNSS reading.

Place the antennas with a clear view of the horizon, away from other electronics and antennas, and along the machine or 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.

Install on a level plane with a 20.0 m* maximum separation (default of 1.0 m) away from other radio antennas, as high as possible. For optimal performance, orient GNSS antennas so the antennas' connectors face the same direction.

*A multi-frequency activation is necessary if using a baseline greater than 5 m.

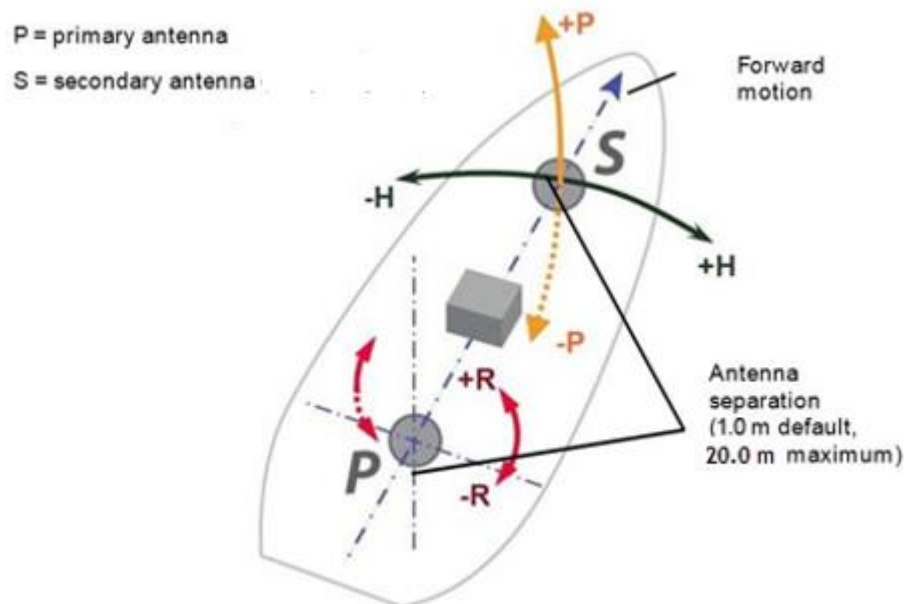


Figure 3-5: Recommended orientation and resulting signs of HPR values

Continued on next page

Planning the Optimal Antenna Placement, Continued

Planning the optimal antenna placement, continued

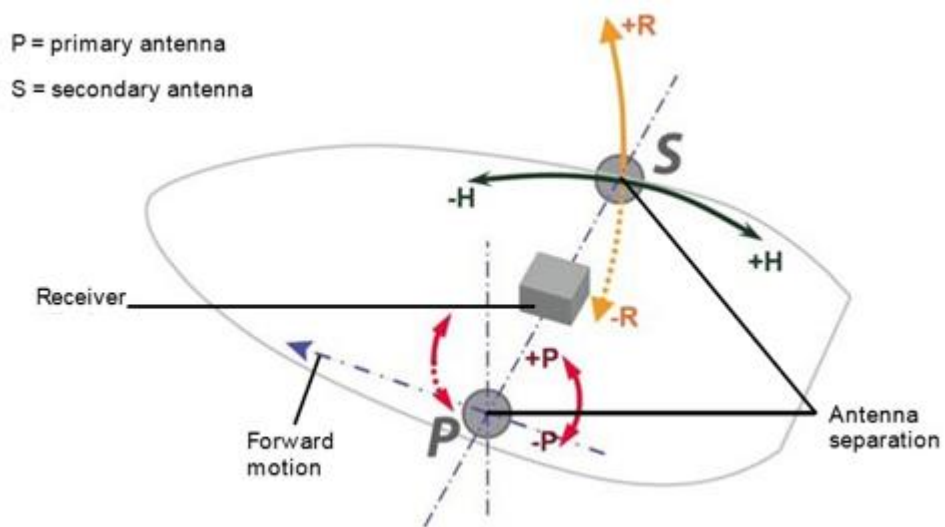


Figure 3-6: Alternate orientation and resulting signs of HPR values

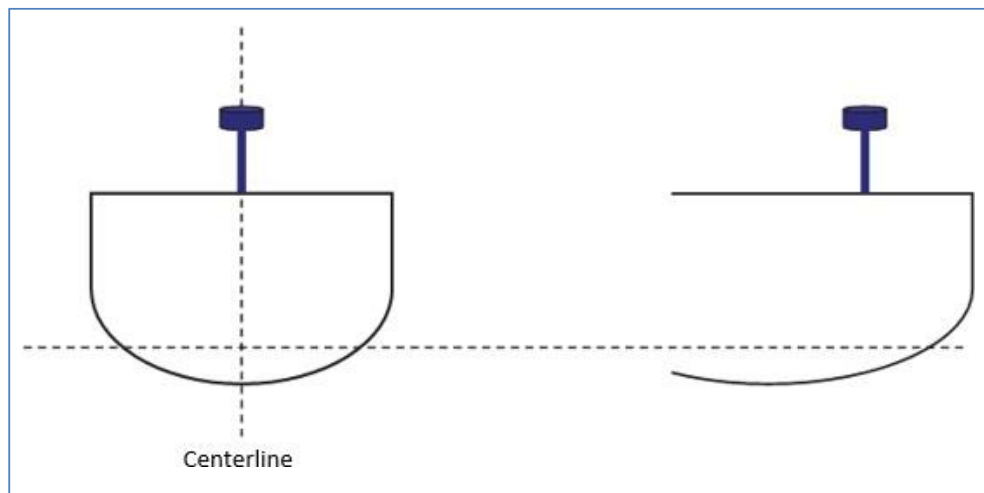


Figure 3-7: Antenna installation: cross-section of boat

Chapter 4: Operating the Vega OEM Boards

Overview

Introduction This chapter provides Vega OEM board operation information, such as communicating with the Vega boards, firmware, and configuration defaults.

Contents

Topic	See Page
Powering the Vega OEM Board On/Off	60
Communicating with the Vega OEM Board Series	61
Configuring the Vega OEM Board Series	62
LED Indicators	63
Configuring the Data Message Output	64
'THIS' Port and the 'OTHER' Port	65
Using Port D for RTCM Input (Vega 60 Board Only)	67
Atlas L-band Message/Commands	68
Saving the Configuration	69
Configuration Defaults	70
Using the WebUI	72

Powering the Vega OEM Board On/Off

Powering the Vega OEM board

The Vega series is powered by a 3.3 VDC power source. After you connect appropriate power, the Vega OEM board is active.

Communicating with the Vega OEM Board Series

Communicating with the Vega OEM board series

The Vega board series features serial ports that can be configured independently from one another.

- Vega 28 (Port A, Port B, Port C)
- Vega 60 (Port A, Port B, Port C, Port D, Port E)

The ports can be configured for NMEA 0183 output, Hemisphere proprietary ASCII and binary messages output, and RTK input/output. You can configure the receiver through any of these ports with Hemisphere GNSS commands (see the [HGNS TRM](#)).

Configuring the Vega OEM Board Series

Configuring the Vega OEM board series

You can configure all aspects of Vega board series operations through any serial port using proprietary commands. For information on these commands refer to the [HGNS TRM](#) .

You can configure one of the two firmware applications, set communication port baud rates, select which messages to output on the serial ports and the update message rate, and set various receiver operating parameters.

To issue commands to the Vega board, connect to a terminal program or Hemisphere GNSS' software applications (SLXMon or PocketMax).

LED Indicators

Vega LED Indicators

The Vega boards feature the following surface-mounted diagnostic LEDs to indicate board status (see Figure 4-1). These indicators are the same for all Vega boards.

LED Indicator	LED name	Color	Board Status
PWR	Power	Red	Power is on
PGNSS	GNSS lock	Orange	Primary GNSS lock, receiver has a position solution
SGNSS	Secondary GNSS	Orange	Secondary GNSS lock
DIFF	Differential lock	Orange	Blinking: acquiring position Solid: the receiver has locked onto the differential source
DGNSS	Differential Position	Green	Blinking: estimated position accuracy does not meet threshold configured in \$JLIMIT command. Solid: receiving and using corrections
HDG	Heading	Green	Heading solution



Figure 4-1: Onboard LEDs for Vega 28

Continued on next page

Configuring the Data Message Output

Configuring the Data Message Output

The Vega boards feature primary bi-directional ports (Ports A, B, C (Vega 28 and Vega 60), and Ports D, E (Vega 60 only)). You can configure messages for all ports by sending proprietary commands to the Vega boards through any port.

For a complete list of commands and messages refer to the [HGNS TRM](#).

'THIS' Port and the 'OTHER' Port

Overview When using Port A and Port B, you can optionally use the phrases "THIS" and "OTHER" when referring to themselves and each other in NMEA messages, in place of using the PORTA and PORTB phrases.

'THIS' port 'THIS' port is the port you are currently connected to for inputting commands.

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

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

'OTHER' port The 'OTHER' port is either Port A or Port B, whichever one you are not using to issue commands.

If you are using Port A to issue commands, then Port B is the 'OTHER' port, and vice versa. To specify the 'OTHER' port for the data output you need to include 'OTHER' in the command.

For example, if you use Port A to request the GPGGA data message be output at 5 Hz on Port B, issue the following command:

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

When using Port A or Port B to request message be output on Ports C, D (Vega 60 only), or E (Vega 60 only) you must specifically indicate (by name) you want the output on the desired port.

Continued on next page

'THIS' Port and the 'OTHER' Port, Continued

'OTHER' port,
continued

For example, if you use Port A to request the GPGLL data message be output at 10 Hz on Port C, issue the following command:

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

Port A or Port B are interchangeable to 'THIS' and 'OTHER.' When entering a command for GLL message on Port B while on Port A, use the following command:

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

This can also be done using Port B for Port A.

Using Port D for RTCM Input (Vega 60 Board Only)

Using Port D for RTCM input In addition to normal serial port functions, Port D has been optimized to interface with the Hemisphere GNSS' SBX-4 beacon board and operates at 9600 bauds (8 data bits, no parity and 1 stop bit – 8-N-1).

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

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

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

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

For a complete list of commands and messages, refer to the online [HGNSS Technical Reference Manual \(TRM\)](#).

Atlas L-band Message/Commands

Atlas L-band messages/commands

To configure the Vega boards to automatically set the L-band frequency parameters, by using the following command:

```
$JFREQ,AUTO<CR><LF>
```

The L-band frequency can also be tuned manually with the command:

```
$JFREQ,freq,symb<CR><LF>
```

where 'freq' is the frequency in kHz and 'symb' is the symbol baud rate.

To enable L-band mode for tracking the Atlas communication satellites, issue the following command:

```
$JDIFF,LBAND,SAVE<CR><LF>
```

To ensure that the Atlas solution is enabled, send the following command:

```
$JDIFF,INCLUDE,ATLAS<CR><LF>
```

Output of the L-band diagnostic message can be enabled by issuing the command:

```
$JASC,RD1,1
```

Saving the Configuration

Saving the configuration

Each time you change the Vega configuration, you should save the configuration to avoid re-configuring the receiver each time you power it on.

To save the configuration, issue the **\$JSAVE** command to the Vega OEM board using a terminal program or Hemisphere GNSS' applications (SLXMon or PocketMax).

The Vega OEM board takes approximately five seconds to save the configuration to non-volatile memory and indicates when the configuration has been saved. Refer to the [HGSS TRM](#) for more information.

Configuration Defaults

Configuration defaults	\$JOFF,ALL
	\$JAGE,2700
	\$JLIMIT,10
	\$JMASK,5
	\$JNP,8
	\$JWAASPRN,AUTO
	\$JDIFF,WAAS
	\$JTAU,COG,0.00
	\$JTAU,SPEED,0.00
	\$JAIR,AUTO
	\$JALT,NEVER
	\$JFREQ,AUTO
	\$JATT,HTAU,0.1
	\$JATT,HRTAU,2.0
	\$JATT,COGTAU,0.0
	\$JATT,MSEP,1.0
	\$JATT,GYROAID,YES
	\$JATT,TILTAID,YES
	\$JATT,LEVEL,NO
	\$JATT,EXACT,NO
	\$JATT,HIGHMP,YES
	\$JATT,FLIPBRD,NO
	\$JATT,MOVEBASE,NO
	\$JATT,HBIAS,0.0
	\$JATT,NMEAHE,0
	\$JATT,PBIAS,0.0
	\$JATT,PTAU,0.5
	\$JATT,ROLL,NO
	\$JATT,SPDTAU,0.0

Continued on next page

Configuration Defaults, Continued

Configuration defaults, continued	\$JASC,GPGGA,1,PORTA
	\$JASC,GPHDT,10,PORTA
	\$JASC,GPROT,10,PORTA
	\$JASC,GPHPR,1,PORTA
	\$JASC,GPGGA,1,PORTB
	\$JASC,GPHDT,10,PORTB
	\$JASC,GPROT,10,PORTB
	\$JASC,GPHPR,1,PORTB
	\$JBAUD,19200,PORTA,SAVE
	\$JBAUD,19200,PORTB,SAVE
	\$JSAVE

Using the WebUI

Overview

The Vega 28 and the Vega 60 come equipped with a WebUI interface which may be accessed via the Ethernet interface.

To enable the Ethernet interface in DHCP mode (where the receiver will automatically get an IP address), check the receiver's assigned IP address, and enable the WebUI, use the following steps:

Step	Action
1	Establish a serial connection to the board.
2	Enable the Ethernet interface with a DHCP-assigned IP address using the following command: \$JETHERNET,MODE,DHCP The receiver will attempt to retrieve an address from the DHCP server on the network.
3	Enable the WebUI on the Ethernet interface using the following command: \$JETHERNET,WEBUI,ON
4	Send the command \$JETHERNET to check the receiver's assigned IP address.

Alternatively, in place of Step 3, you may enable Ethernet support with a statically assigned IP address by sending the command:
\$JETHERNET,MODE,STATIC,IP,SUBNET,GATEWAY,DNS where IP/subnet/gateway/DNS are each replaced with the relevant IP address for the network configuration. The gateway and DNS parameters are optional.

Open a web browser window and type the IP address reported in the **\$JETHERNET** command.

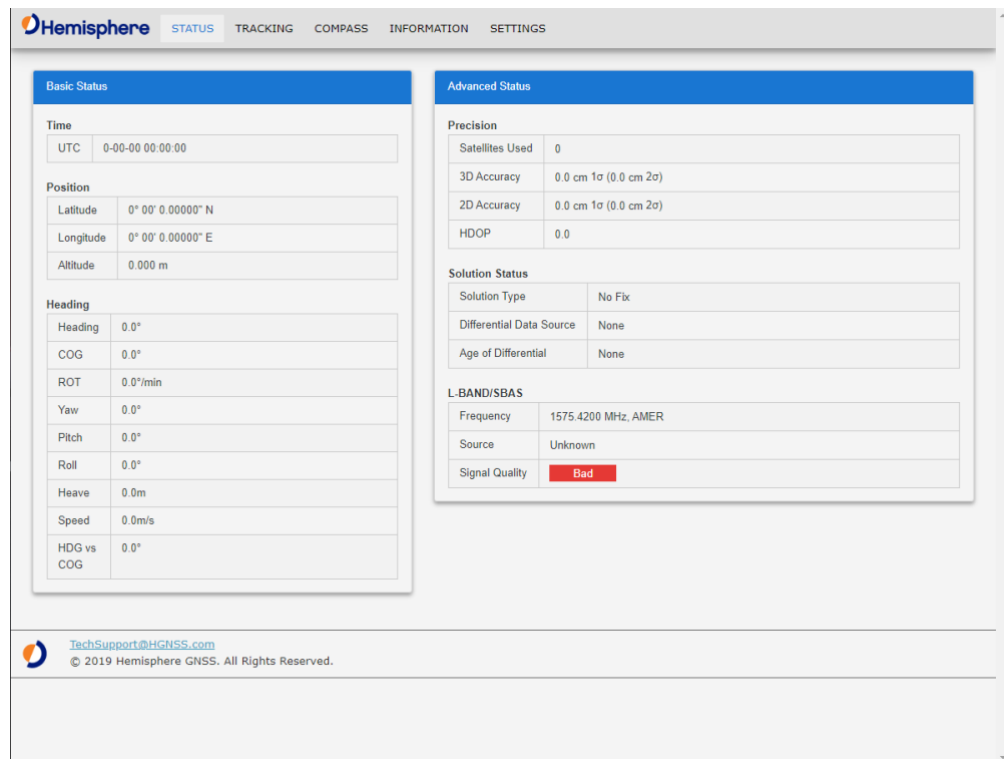
Continued on next page

Using the WebUI, Continued

Configuration defaults, continued

The Vega **Status** window displays. Click the tabs at the top of each screen to navigate throughout the WebUI.

Note: WebUI screens shown as examples in this manual is the Vega 28 WebUI.



The screenshot shows the Hemisphere Status WebUI interface. The top navigation bar includes tabs for STATUS, TRACKING, COMPASS, INFORMATION, and SETTINGS. The main content area is divided into two panels: Basic Status and Advanced Status.

Basic Status Panel:

- Time:** UTC 0-00-00 00:00:00
- Position:**
 - Latitude: 0° 00' 0.00000" N
 - Longitude: 0° 00' 0.00000" E
 - Altitude: 0.000 m
- Heading:**
 - Heading: 0.0°
 - COG: 0.0°
 - ROT: 0.0°/min
 - Yaw: 0.0°
 - Pitch: 0.0°
 - Roll: 0.0°
 - Heave: 0.0m
 - Speed: 0.0m/s
 - HDG vs COG: 0.0°

Advanced Status Panel:

- Precision:**
 - Satellites Used: 0
 - 3D Accuracy: 0.0 cm 1σ (0.0 cm 2σ)
 - 2D Accuracy: 0.0 cm 1σ (0.0 cm 2σ)
 - HDOP: 0.0
- Solution Status:**
 - Solution Type: No Fix
 - Differential Data Source: None
 - Age of Differential: None
- L-BAND/SBAS:**
 - Frequency: 1575.4200 MHz, AMER
 - Source: Unknown
 - Signal Quality: Bad

At the bottom of the interface, there is a footer with the contact information: TechSupport@HGNSS.com and the copyright notice: © 2019 Hemisphere GNSS. All Rights Reserved.

Continued on next page

Using the WebUI, Continued

Status

The **Status** window displays **Basic Status** and **Advanced Status**.

Under the left column **Basic Status**, real time data is displayed for the following:

- Time (UTC and Local)
- Position (Latitude, Longitude, Altitude)
- Heading

Basic Status	
Time	
UTC	2019-08-19 18:54:44
Local	2019-08-19 18:54:44
Position	
Latitude	33° 38' 36.05002" N
Longitude	111° 53' 45.44882" W
Altitude	454.944 m
Heading	
Heading	196.1°
COG	208.5°
ROT	0.8°/min
Yaw	12.4°
Pitch	6.1°
Roll	2.5°
Heave	-0.0m
Speed	0.0m/s
HDG vs COG	-12.4°

Continued on next page

Using the WebUI, Continued

Configuration defaults, continued

The right column of the **Status** screen displays **Advanced Status** information:

- Precision (Satellites Used, 3D Accuracy, 2D Accuracy, HDOP)
- Solution Status (Solution Type, Differential Data Source, Age of Differential)
- L-band/SBAS (Frequency, Source, Signal Quality)

Advanced Status	
Precision	
Satellites Used	22
3D Accuracy	0.6 cm 1 σ (1.3 cm 2 σ)
2D Accuracy	0.4 cm 1 σ (0.7 cm 2 σ)
HDOP	0.6
Solution Status	
Solution Type	RTK Fixed
Differential Data Source	ROX
Age of Differential	1 seconds
L-BAND/SBAS	
Frequency	1575.4200 MHz, AMER
Source	WAAS (131)
Signal Quality	Great

Continued on next page

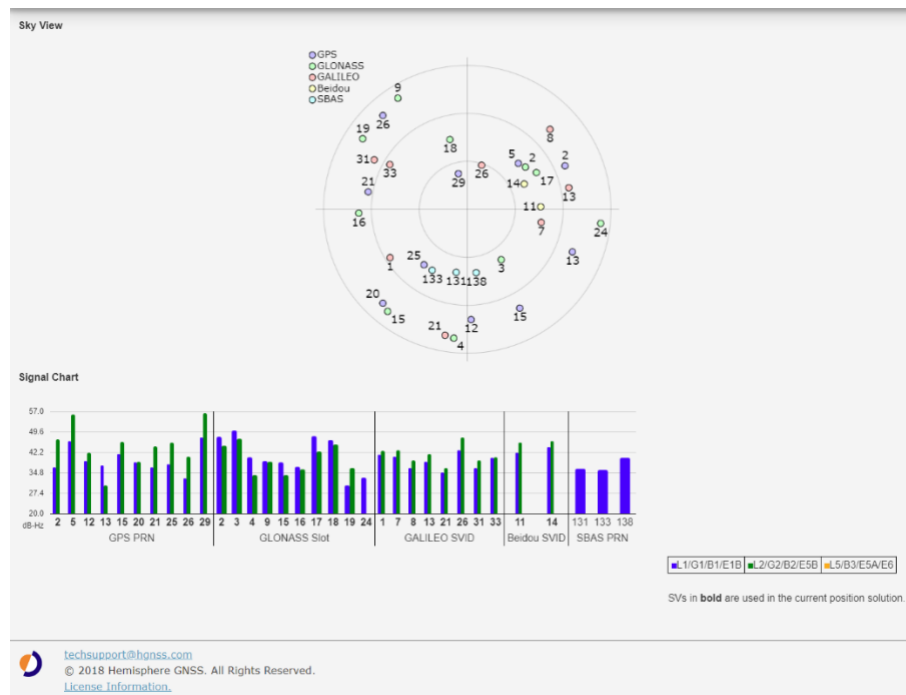
Using the WebUI, Continued

Tracking

The **Tracking** window displays the **Sky View** and the **Signal Chart**.

The **Sky View** plots the azimuth, elevation and SNR values of all tracked satellites (GPS, GLONASS, GALILEO, BeiDou, QZSS, and SBAS).

Note: Sky View plots in **bold** are used in the solution.

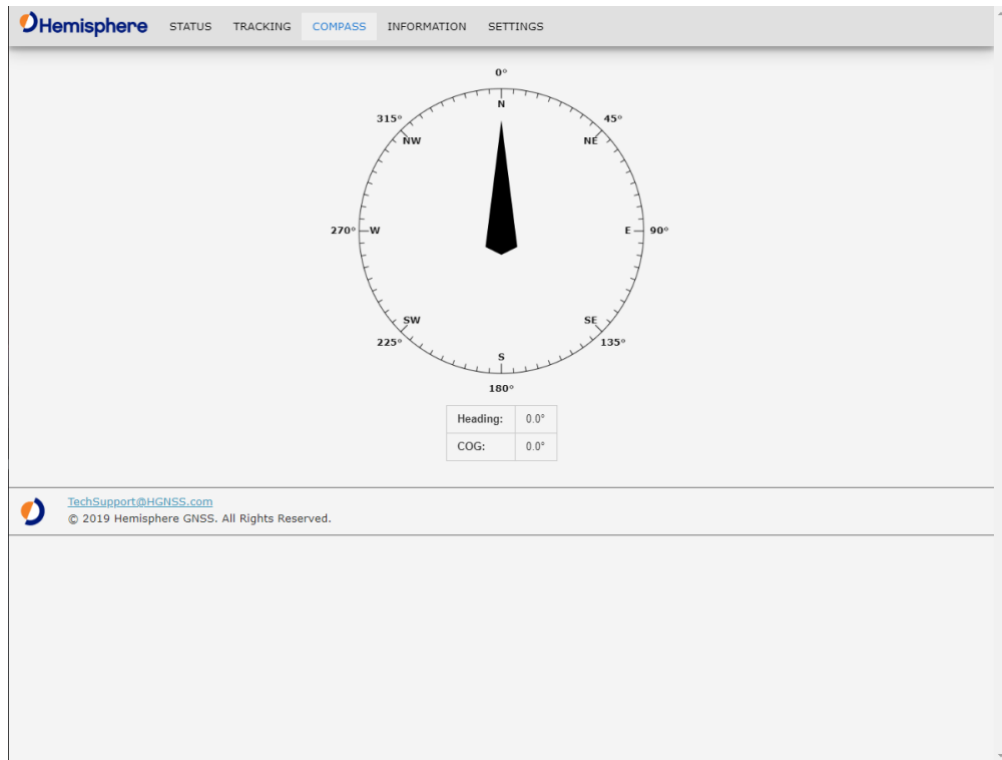


Continued on next page

Using the WebUI, Continued

Compass

Use the **Compass** to read the Heading and COG data displayed in real time.



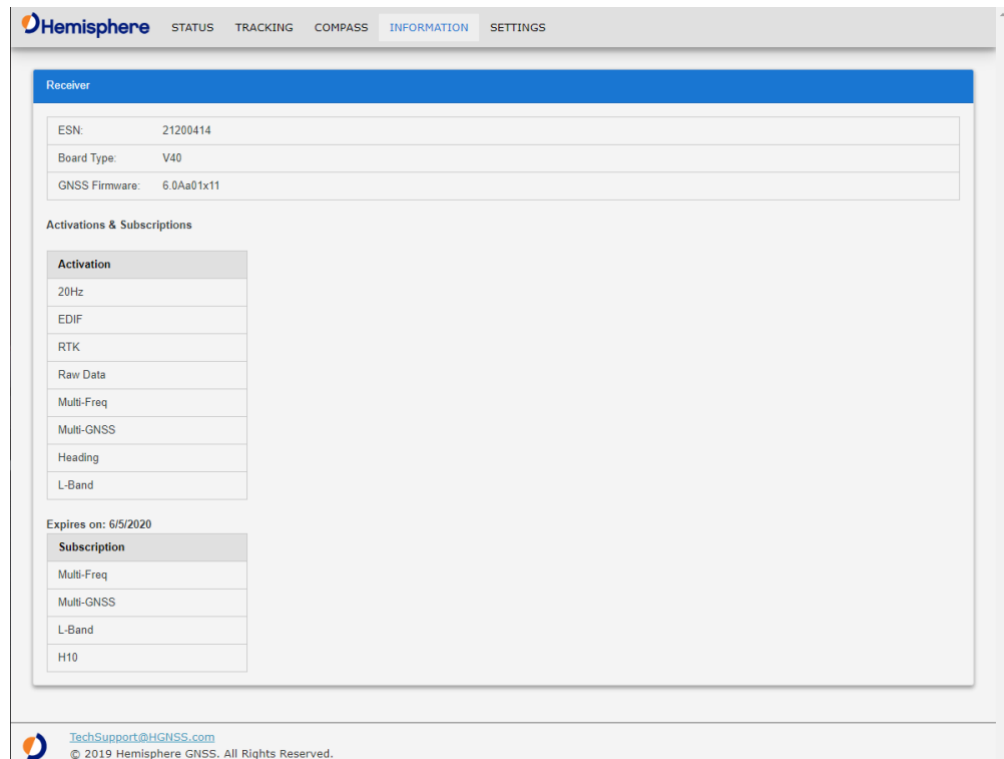
Continued on next page

Using the WebUI, Continued

Information The **Information** window displays the Vega board Receiver and Subscriptions information.

You can find the **ESN**, **Board Type**, and **GNSS Firmware** versions listed at the top of the screen. The **Subscriptions** expiration date is displayed along with your active subscriptions (in green).

Note: If you need to apply an activation or subscription code, go to **Settings** -> **System**.



The screenshot shows the Hemisphere WebUI interface. At the top, there is a navigation bar with the Hemisphere logo and tabs for STATUS, TRACKING, COMPASS, INFORMATION (selected), and SETTINGS. Below the navigation bar, the 'Receiver' section is highlighted in blue. It contains a table with the following information:

ESN:	21200414
Board Type:	V40
GNSS Firmware:	6.0Aa01x11

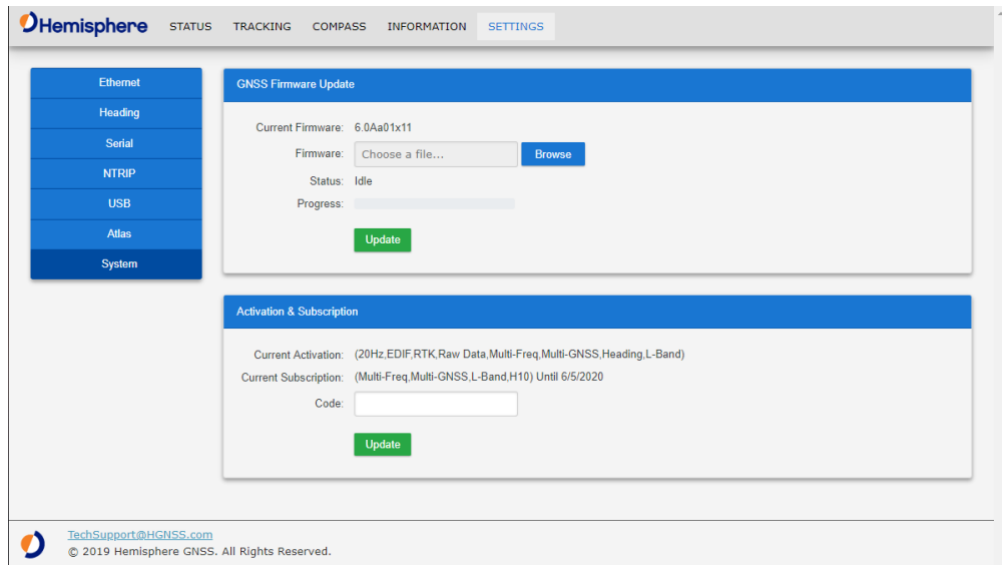
Below the Receiver section, there is a section titled 'Activations & Subscriptions'. It contains two sub-sections: 'Activation' and 'Subscription'. The 'Activation' section lists the following options: 20Hz, EDIF, RTK, Raw Data, Multi-Freq, Multi-GNSS, Heading, and L-Band. The 'Subscription' section lists the following options: Multi-Freq, Multi-GNSS, L-Band, and H10. Above the 'Subscription' section, it says 'Expires on: 6/5/2020'. At the bottom of the page, there is a footer with the Hemisphere logo, the email address TechSupport@HGSS.com, and the copyright notice '© 2019 Hemisphere GNSS. All Rights Reserved.'

Continued on next page

Using the WebUI, Continued

Settings

In the **Settings** window, you can configure the settings for the **Ethernet**, **Serial**, **NTRIP**, **Atlas**, and **System**.



Continued on next page

Using the WebUI, Continued

Settings- Ethernet

The Ethernet properties displayed are:

- IP Address
- Subnet Mask
- Gateway
- Mode

Next to **Mode**, you can click the down-arrow to select from **DHCP** or **Static**. Click **Save** to save your changes, or **Undo** to cancel your changes.

Port I is a TCP/IP port that can be used as either a **Server** mode or **Client** mode. When choosing **Client**, Port I is configured to act as a TCP client, which will connect out to the specified server on the specified port number.

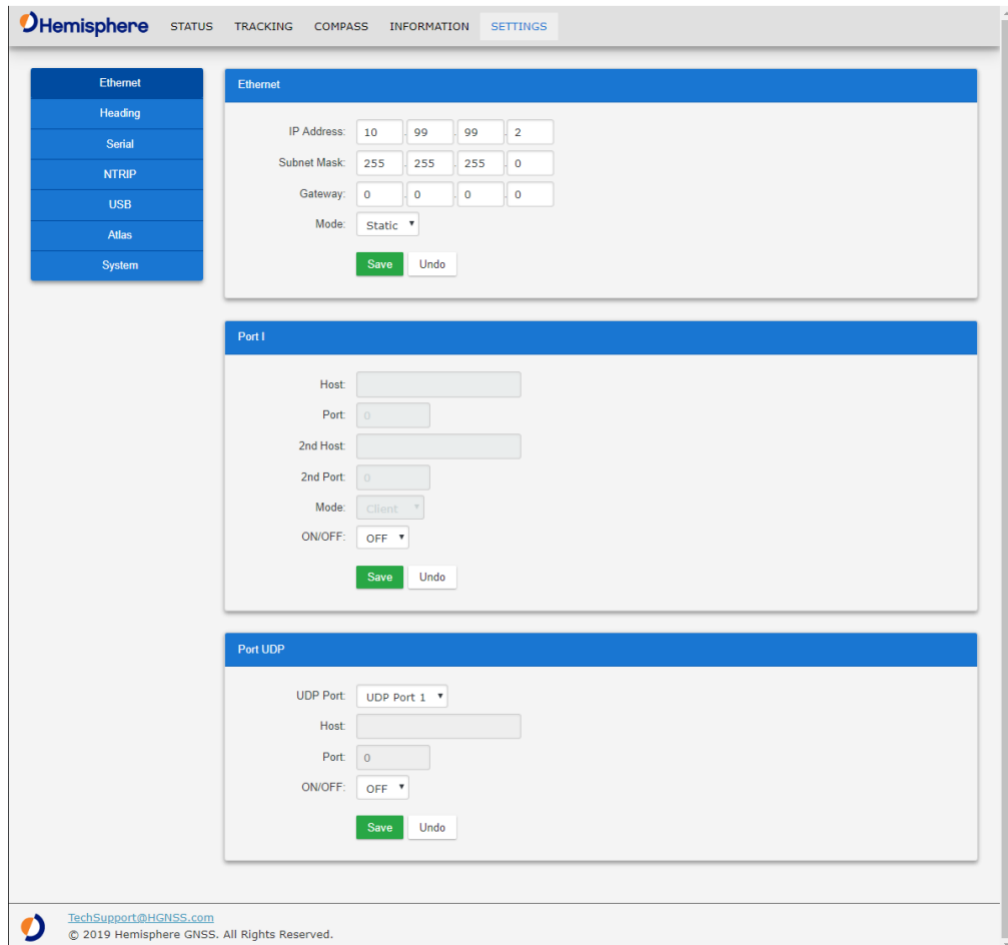
When Port I is set to **Server**, the receiver will act as a TCP server, listening for incoming connections via the specified port number. In both modes this port behaves just like one of the serial port interfaces, and can be used to send or receive corrections, log data, or issue any normal serial commands.

Continued on next page

Using the WebUI, Continued

Settings- Ethernet, continued

Using Port UDP (User Datagram Protocol) provides output of corrections or other messages to be sent in the form of raw UDP packets to a specified **host** and **port**. Individual messages will not be fragmented across UDP packets. The receiver will not respond to any replies via UDP.



The screenshot displays the Hemisphere web interface with the 'SETTINGS' tab selected. A left-hand navigation menu lists various settings categories: Ethernet, Heading, Serial, NTRIP, USB, Alias, and System. The main content area is divided into three sections:

- Ethernet:** Contains fields for IP Address (10, 99, 99, 2), Subnet Mask (255, 255, 255, 0), Gateway (0, 0, 0, 0), and Mode (Static). It includes 'Save' and 'Undo' buttons.
- Port I:** Contains fields for Host, Port (0), 2nd Host, 2nd Port (0), Mode (Client), and ON/OFF (OFF). It includes 'Save' and 'Undo' buttons.
- Port UDP:** Contains a dropdown for UDP Port (UDP Port 1), fields for Host and Port (0), and an ON/OFF (OFF) dropdown. It includes 'Save' and 'Undo' buttons.

At the bottom of the interface, there is a footer with the email TechSupport@HGNS.com and the copyright notice: © 2019 Hemisphere GNSS. All Rights Reserved.

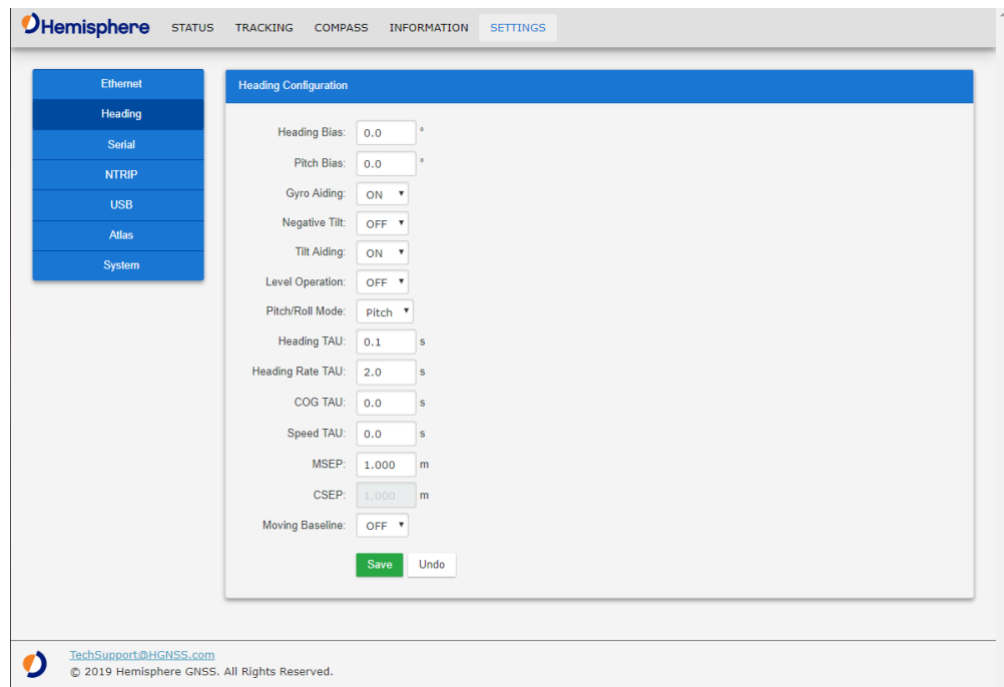
Continued on next page

Using the WebUI, Continued

Settings- Heading Configuration defaults

Note: Default settings can be changed to set the time constants to smooth heading, Course-over-Ground (COG), and speed measurements.

Click **Save** to save your changes or click **Undo** to cancel your changes.



The screenshot displays the Hemisphere web interface. At the top, there is a navigation bar with the Hemisphere logo and tabs for STATUS, TRACKING, COMPASS, INFORMATION, and SETTINGS. The SETTINGS tab is active. On the left side, there is a vertical menu with options: Ethernet, Heading (selected), Serial, NTRIP, USB, Atlas, and System. The main content area is titled "Heading Configuration" and contains the following settings:

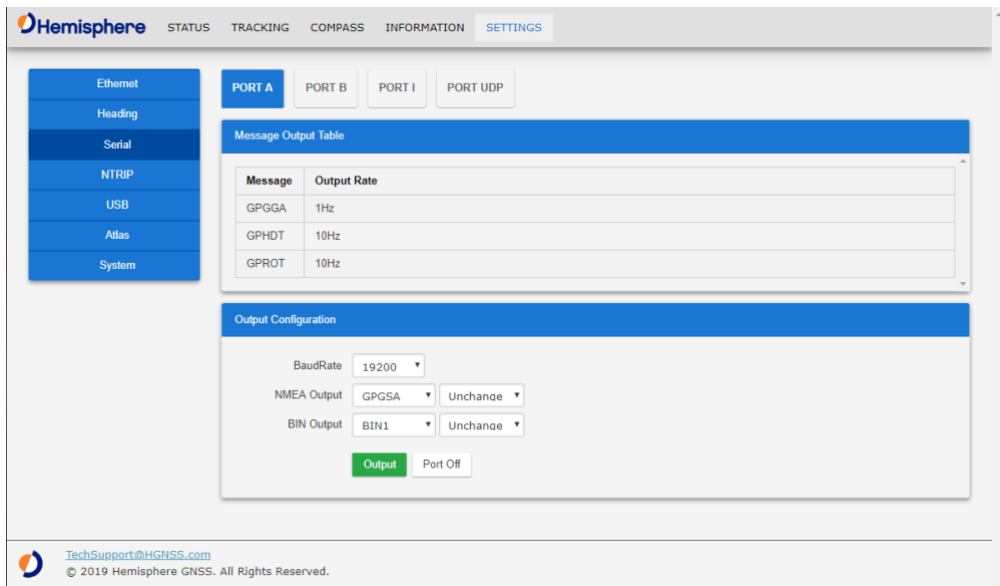
- Heading Bias: 0.0 °
- Pitch Bias: 0.0 °
- Gyro Aiding: ON
- Negative Tilt: OFF
- Tilt Aiding: ON
- Level Operation: OFF
- Pitch/Roll Mode: Pitch
- Heading TAU: 0.1 s
- Heading Rate TAU: 2.0 s
- COG TAU: 0.0 s
- Speed TAU: 0.0 s
- MSEP: 1.000 m
- CSEP: 1.000 m
- Moving Baseline: OFF

At the bottom of the configuration area, there are "Save" and "Undo" buttons. The footer of the page includes the email address TechSupport@HGNSS.com and the copyright notice "© 2019 Hemisphere GNSS. All Rights Reserved."

Continued on next page

Using the WebUI, Continued

Settings, Serial Use **Serial Output** to configure the baud rate of each serial port (Port A, Port B, Port I, and Port UDP) and turn off/on specific NMEA 0183 messages and proprietary Hemisphere BIN messages.



The screenshot shows the Hemisphere web interface with the 'SETTINGS' tab selected. On the left is a navigation menu with options: Ethernet, Heading, Serial (selected), NTRIP, USB, Atlas, and System. The main content area is titled 'PORT A' and contains two sections:

- Message Output Table:** A table with columns 'Message' and 'Output Rate'.

Message	Output Rate
GPGGA	1Hz
GPHDT	10Hz
GPROT	10Hz
- Output Configuration:** A section with the following controls:
 - BaudRate: 19200 (dropdown)
 - NMEA Output: GPGSA (dropdown) with an 'Unchange' button
 - BIN Output: BIN1 (dropdown) with an 'Unchange' button
 - Buttons: 'Output' (green) and 'Port Off' (grey)

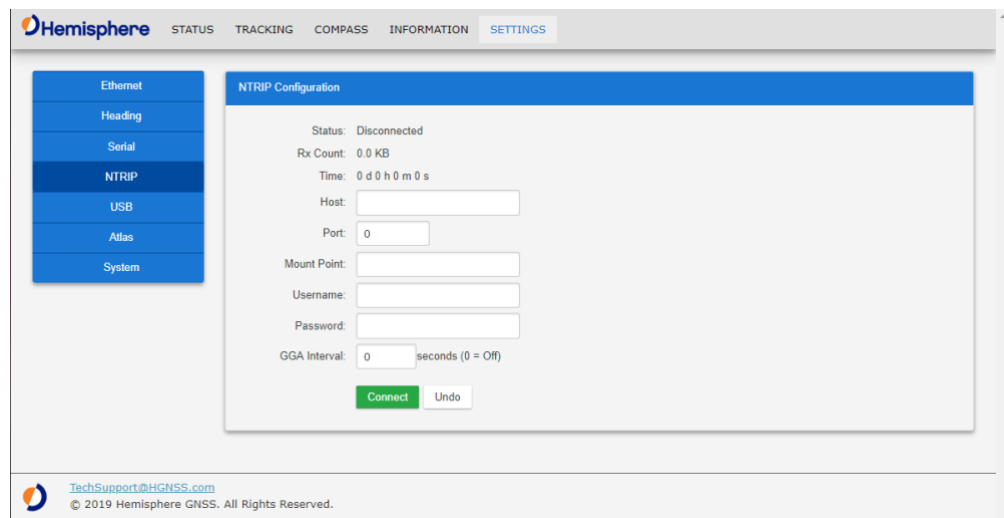
At the bottom of the interface, there is a footer with the email TechSupport@HGNSS.com and the copyright notice: © 2019 Hemisphere GNSS. All Rights Reserved.

Continued on next page

Using the WebUI, Continued

Settings, NTRIP

If your Vega board is on a network that has access to the internet, you can use the built-in NTRIP client and enter credentials for an NTRIP caster.



The screenshot shows the Hemisphere web interface with the 'SETTINGS' tab selected. On the left is a navigation menu with options: Ethernet, Heading, Serial, NTRIP (highlighted), USB, Atlas, and System. The main content area is titled 'NTRIP Configuration' and displays the following information and controls:

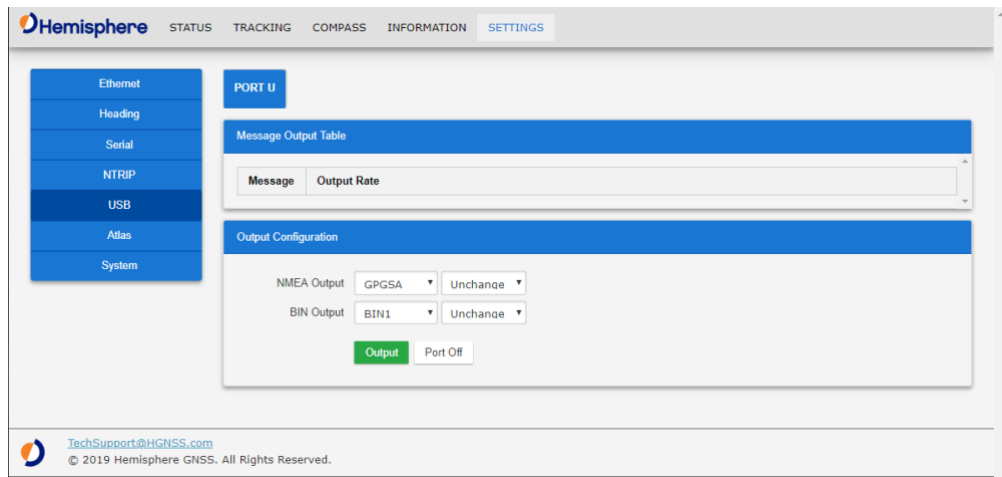
- Status: Disconnected
- Rx Count: 0.0 KB
- Time: 0 d 0 h 0 m 0 s
- Host:
- Port:
- Mount Point:
- Username:
- Password:
- GGA Interval: seconds (0 = Off)
- Buttons:

At the bottom of the interface, there is a footer with the email TechSupport@HGNS.com and the copyright notice: © 2019 Hemisphere GNSS. All Rights Reserved.

Continued on next page

Using the WebUI, Continued

Settings, USB The **USB** window is used for connecting and logging via Port U. Standard NMEA and Binary messages can be selected with various update rates.

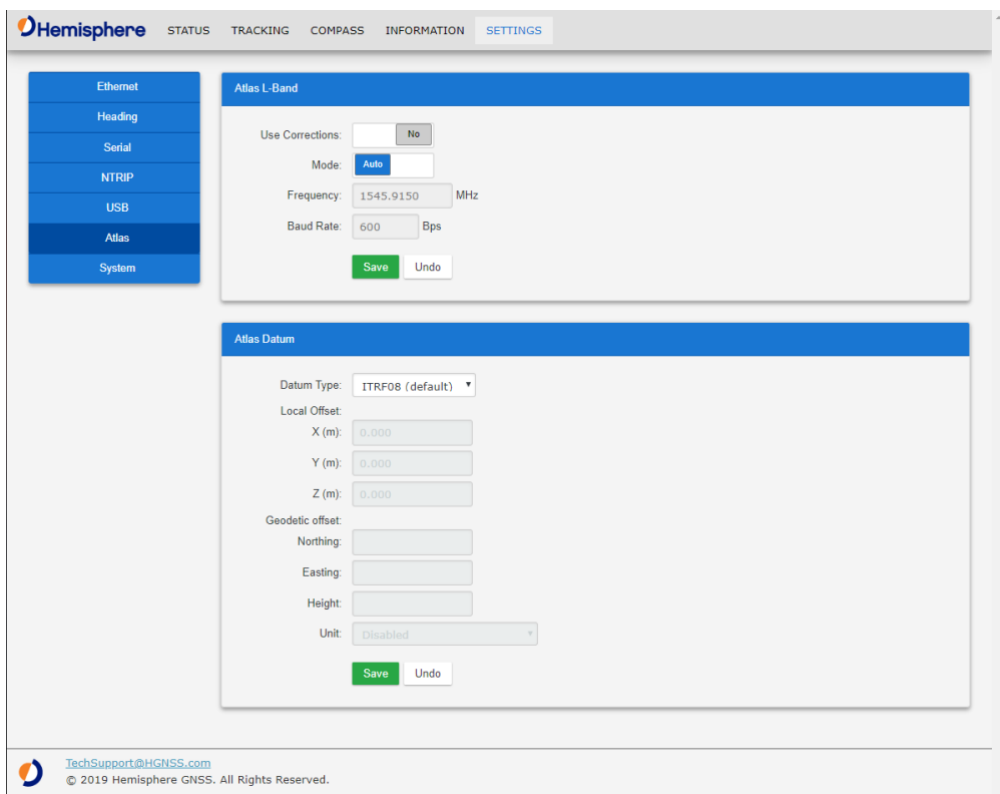


Continued on next page

Using the WebUI, Continued

Settings, Atlas You can configure the receiver to automatically tune to the correct Atlas satellite for your region (suggested), or manually tune to the satellite of your choice.

For datum, you can choose **ITRF08**, **GDA94**, or you can enter custom **X, Y, Z** ECEF Cartesian offsets (from ITRF08).



The screenshot displays the Hemisphere web interface with the 'SETTINGS' tab selected. On the left, a navigation menu lists various settings: Ethernet, Heading, Serial, NTRIP, USB, Atlas (highlighted), and System. The main content area is divided into two sections:

- Atlas L-Band:** This section includes a 'Use Corrections' dropdown set to 'No', a 'Mode' dropdown set to 'Auto', a 'Frequency' input field with the value '1545.9150' and a unit of 'MHz', and a 'Baud Rate' input field with the value '600' and a unit of 'Bps'. There are 'Save' and 'Undo' buttons at the bottom.
- Atlas Datum:** This section includes a 'Datum Type' dropdown set to 'ITRF08 (default)', a 'Local Offset' section with input fields for 'X (m): 0.000', 'Y (m): 0.000', and 'Z (m): 0.000', and a 'Geodetic offset' section with input fields for 'Northing:', 'Easting:', and 'Height:'. A 'Unit' dropdown is set to 'Disabled'. There are 'Save' and 'Undo' buttons at the bottom.

At the bottom of the interface, there is a footer with the email TechSupport@HGNSS.com and the copyright notice '© 2019 Hemisphere GNSS. All Rights Reserved.'

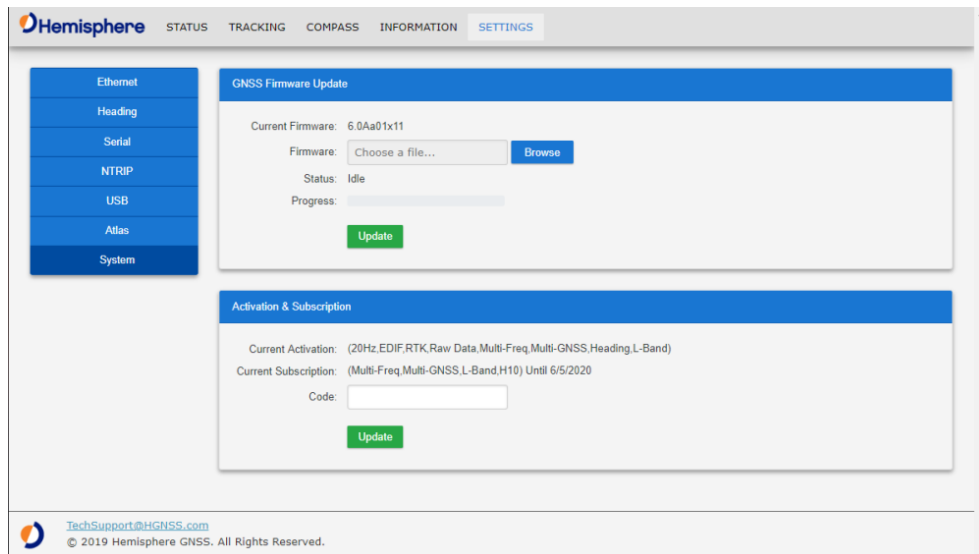
Continued on next page

Using the WebUI, Continued

Settings, System

To update firmware, click **Browse**. Choose the file. Click **Update**.

To add an activation or subscription, type the code, and click **Update**.



Appendix A: Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for frequent questions when operating the Vega boards.

Note: It is important to review each category in detail to eliminate it as a problem.

Contents

	Topic	See Page
	Troubleshooting	89

Troubleshooting

Vega
troubleshooting

Table A-1: Vega Troubleshooting

Issue	Possible Solution
<p>What is the first thing to check if I have a problem with the operation of the Vega board?</p>	<p>Try to isolate the source of the problem. Problems are likely to fall within one of the following categories:</p> <ul style="list-style-type: none"> • Power, communication and configuration • GPS reception and performance • Beacon reception and performance • SBAS reception and performance • External corrections • Installation • Shielding and isolating interference
<ul style="list-style-type: none"> • No data from the Vega board • No communication 	<ul style="list-style-type: none"> • Check receiver power status (this may be done with a multimeter) • Confirm communication with Vega board via Hemisphere query commands: <ul style="list-style-type: none"> – \$JI – \$JSHOW – Verify the Vega board is locked to GPS satellites (this can often be done on the receiving device) – Check integrity and connectivity of power and data cable connections

Continued on next page

Troubleshooting, Continued

Vega
troubleshooting
, continued

Table A-1: Vega Troubleshooting (continued)

Issue	Possible Solution
Random binary data from the Vega board	<ul style="list-style-type: none"> • Verify the RTCM or Bin messages are not being accidentally output (send a \$JSHOW command). • Verify that the baud rate settings of Vega board and remote device match. • Potentially, the volume of data requested to be output by the Vega board could be higher than the current baud rate supports. Try using 19200 or higher for the baud rate for all devices.
No GNSS Lock	<ul style="list-style-type: none"> • Check integrity of antenna cable • Verify antenna's view of the sky • Verify the lock status and signal to noise ratio of GPS satellites (this can often be done on the receiving device or by using SLXMon).
No SBAS	<ul style="list-style-type: none"> • Check antenna cable integrity • Verify antenna's view of the sky, especially towards the SBAS satellites, south in the northern hemisphere. • Verify the bit error rate and lock status of SBAS satellites (this can often be done on the receiving device or by using SLXMon - monitor BER value). • SBAS corrections are only applied to the position, not to the heading. If SBAS lock is lost, you will still have the same heading accuracy, but your position accuracy may be degraded.

Continued on next page

Troubleshooting, Continued

Vega
troubleshooting
, continued

Table A-1: Vega Troubleshooting (continued)

Issue	Possible Solution
No DGPS position in external RTCM mode	<ul style="list-style-type: none"> • 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 (the “ground” pin and pin-out must be connected, and from the “transmit” from the source must connect to the “receiver” of the RTCM input port).
Non-DGPS output	<ul style="list-style-type: none"> • Verify Vega board SBAS and lock status (or external source is locked). • Confirm baud rates match an external source correctly. • Issue a \$JDIF command and see if the expected differential mode is the current mode. • Differential corrections are only applied to the position, not to the heading. If differential lock is lost, you will still have the same heading accuracy, but your position accuracy may be degraded.

Continued on next page

Troubleshooting, Continued

Vega
troubleshooting
, continued

Table A-1: Vega Troubleshooting (continued)

Issue	Possible Solution
No heading or incorrect heading values	<ul style="list-style-type: none"> • Ensure the antennas are connected to the proper ports: J1000 and J2000 are for the primary and secondary antennas. • Heading is from primary to secondary antenna, so the secondary antenna should be toward the bow and primary toward the stern. • Check the measurement of the antenna separation. • The Measured (MSEP) and Calculated (CSEP) values are in meters and should agree to within 1 cm. CSEP continuously changes, so average this reading over several minutes to obtain an approximate value. • Check CSEP value is fairly constant without varying more than 1 cm. Larger variations may indicate a high multipath environment and require moving the antenna locations. • Reduce antenna separation - Hemisphere GNSS recommends the separation between the antennas remain below 5 m for accurate and timely heading reading output on L1-only systems. • \$JATT,SEARCH command forces the Vega board to acquire a new heading solution. This should also be used after entering a new MSEP value. • \$JATT, GYROAID, YES Enables gyro aid as this will give heading for up to 3 minutes in times of GNSS signal loss. • Enable tilt aid to reduce heading search times. • Check the applications receiver using the \$JAPP query; the receiver should answer \$JAPP, MFAATT, 1,2 • Monitor the number of satellites and SNR values for both antennas within SLXMON; at least 3 satellites should have SNR values > 20. • Antenna connectors should both be facing the same direction.

Appendix B: Technical Specifications

Introduction Appendix B provides the Vega series GNSS OEM board technical specifications.

Contents

Topic	See Page
Vega 28 Technical Specifications	94
Vega 60 Technical Specifications	99

Vega 28 Technical Specifications

Vega 28 specifications

Tables B1-B7 provide the technical specifications for the Vega 28 GNSS board.

Vega 28 Receiver specifications

Table B-1: Vega 28 Receiver specifications

Item	Specification
Receiver type	Multi-Frequency GPS, GLONASS, BeiDou, Galileo, QZSS, NavIC (IRNSS) and Atlas
Signals Received	GPS L1CA/L1P/L1C/L2P/L2C/L5 GLONASS G1/G2/G3, P1/P2 BeiDou B1i/B2i/B3i/B1C/B2a/B2b/ACEBOC GALILEO E1BC/E5a/E5b/E5-AltBOC/E6BC QZSS L1CA/L1C/L2C/L5/LEX(L6D and L6E) NavIC (IRNSS) L5 Atlas
Channels	1,100+
GPS sensitivity	-142 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, 1 Hz or 20 Hz optional (with activation)
Timing (PPS) Accuracy	20 ns
Rate of Turn	100°/s maximum
Cold Start	60 s typical (no almanac or RTC)
Warm Start	30 s typical (almanac and RTC)
Hot Start	10 s typical (almanac, RTC and position)
Heading Fix	10 s typical (Hot Start)
Antenna Input Impedance	50 Ω
Maximum Speed	1,850 km/h (999 kts)
Maximum Altitude	18,288 m (60,000 ft)

Continued on next page

Vega 28 Technical Specifications, Continued

Vega 28
Receiver
specifications,
continued

Table B-1: Vega 28 Receiver specifications (continued)

Item	Specification		
		RMS (67%)	2DMRS (95%)
Horizontal accuracy	RTK ¹	8 mm + 1 ppm	15 mm + 2 ppm
	SBAS ²	0.3 m	0.6 m
	Autonomous, no SA ¹	1.2 m	2.5 m
	Atlas H10 ^{1, 3}	0.04 m	0.08 m
	Atlas H30 ^{1, 3}	0.15 m	0.3 m
	Atlas Basic ^{1, 3}	0.50 m	1.0 m
Heading (RMS)	8 mm + 1 ppm 15 mm + 2 ppm 0.16° RMS @ 0.5 m antenna separation 0.08° RMS @ 1.0 m antenna separation 0.04° RMS @ 2.0 m antenna separation 0.02° RMS @ 5.0 m antenna separation		
Pitch/roll (RMS)	0.5° RMS		
Heave (RMS) ¹	30 cm RMS (DGNSS), 5 cm RMS (RTK)		

Continued on next page

Vega 28 Technical Specifications, Continued

Vega 28 Communication specifications

Table B-2: Vega 28 Communication specifications

Item	Specification
Ports	3 x 3.3 V CMOS UART 1 x USB Host/Device 1 x Ethernet 10/100Mbps 2 x CAN (NMEA 2000, ISO 11783) 1 x PPS Output 2 x Event input
Interface Level	3.3 V CMOS
UART Baud Rates	4800 – 460,800
Correction I/O Protocol	Hemisphere GNSS proprietary ROX format, RTCM v2.3, RTCM v3.2, CMR ⁴ , CMR+ ⁴
Data I/O Protocol	NMEA 0183, NMEA 2000, Hemisphere proprietary ASCII and Binary
Timing Output	PPS, CMOS, active high, rising edge sync by default, but can be programmed to active low, falling edge sync. Load and capacitance 10K Ω /10 pF
Event Marker Input	CMOS, programmable rising or falling edge sync

Vega 28 Power specifications

Table B-3: Vega 28 Power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5% typical
Power consumption	< 2.5 W all signals + L-band + Ethernet, typical
Current consumption	757 mA all signals + L-band + Ethernet, typical
Antenna voltage input	5 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 35 dB typical

Continued on next page

Vega 28 Technical Specifications, Continued

Vega 28 Environmental specifications

Table B-4: Vega 28 Environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when in an enclosure)
Mechanical Shock	EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
Vibration	EP455 Section 5.15.1 Random
EMC	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR 22

Vega 28 Mechanical specifications

Table B-5: Vega 28 Mechanical specifications

Item	Specification
Dimensions	71.1 L x 45.7 W x 10 H (mm) 2.80 L x 1.80 W x 0.40 (in)
Weight	24 g (0.85 oz)
Status indication (LED)	Power, Primary and Secondary GNSS lock, Differential lock, DGNSS position, Heading
Power/Data connector	2 x 14-pin male header, 2 mm pitch
Antenna connectors (2)	MMCX, female, straight

Continued on next page

Vega 28 Technical Specifications, Continued

Vega 28 L-band receiver specifications

Table B-6: Vega 28 L-band receiver specifications

Item	Specification
Receiver Type	Dual Channel
Channels	1525 to 1560 MHz
Satellite Selection	Manual and Automatic
Reacquisition Time	15 seconds (typical)

Vega 28 Aiding devices

Table B-7: Vega 28 Aiding devices

Device	Description
Gyro	Provides smooth and fast heading reacquisition. During loss of GNSS signals heading stability is degraded by < 1° per minute for up to 3 minutes.
Tilt Sensor	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, and ionospheric activity.

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

³Hemisphere GNSS proprietary.

⁴CMR and CMR+ do not cover proprietary messages outside of the typical standard.

Vega 60 Technical Specifications

Vega 60 specifications

Tables B-8 through B-14 provide the technical specifications for the Vega 60 board.

Vega 60 Receiver specifications

Table B-8: Vega 60 Receiver specifications

Item	Specification
Receiver type	Multi-Frequency GPS, GLONASS, BeiDou, Galileo, QZSS, NavIC (IRNSS) and Atlas
Signals Received	GPS L1CA/L1P/L1C/L2P/L2C/L5 GLONASS G1/G2/G3, P1/P2 BeiDou B1i/B2i/B3i/B1C/B2a/B2b/ACEBOC GALILEO E1BC/E5a/E5b/E5-AltBOC/E6BC QZSS L1CA/L1C/L2C/L5/LEX(L6D and L6E) NavIC (IRNSS) L5 Atlas
Channels	1,100+
GPS sensitivity	-142 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, 1 Hz or 20 Hz optional (with activation)
Timing (PPS) Accuracy	20 ns
Rate of Turn	100°/s maximum
Cold Start	60 s typical (no almanac or RTC)
Warm Start	30 s typical (almanac and RTC)
Hot Start	10 s typical (almanac, RTC and position)
Heading Fix	10 s typical (Hot Start)
Antenna Input Impedance	50 Ω
Maximum Speed	1,850 km/h (999 kts)
Maximum Altitude	18,288 m (60,000 ft)

Continued on next page

Vega 60 Technical Specifications, Continued

Vega 60
Receiver
specifications,
continued

Table B-8: Vega 60 Receiver specifications (continued)

Item	Specification		
		RMS (67%)	2DMRS (95%)
Horizontal accuracy	RTK ¹	8 mm + 1 ppm	15 mm + 2 ppm
	SBAS ²	0.3 m	0.6 m
	Autonomous, no SA ¹	1.2 m	2.5 m
	Atlas H10 ^{1, 3}	0.04 m	0.08 m
	Atlas H30 ^{1, 3}	0.15 m	0.3 m
	Atlas Basic ^{1, 3}	0.50 m	1.0 m
	Heading (RMS)	8 mm + 1 ppm 15 mm + 2 ppm 0.16° RMS @ 0.5 m antenna separation 0.08° RMS @ 1.0 m antenna separation 0.04° RMS @ 2.0 m antenna separation 0.02° RMS @ 5.0 m antenna separation	
Pitch/roll (RMS)	0.5° RMS		
Heave (RMS) ¹	30 cm RMS (DGNSS), 5 cm RMS (RTK)		

Continued on next page

Vega 60 Technical Specifications, Continued

Vega 60 Communication specifications

Table B-9: Vega 60 Communication specifications

Item	Specification
Ports	5 x full-duplex 3.3V CMOS ⁴ 2 x USB (1 Host, 1 Device) 1 x Ethernet 10/100Mbps 2 x CAN (NMEA2000, ISO 11783) 4 x PPS output 4 x Event input
Interface Level	3.3 V CMOS
UART Baud Rates	4800 – 460,800
Correction I/O Protocol	Hemisphere GNSS proprietary ROX format, RTCM v2.3, RTCM v3.2, CMR ⁴ , CMR+ ⁴
Data I/O Protocol	NMEA 0183, NMEA 2000, Hemisphere proprietary ASCII and Binary
Timing Output	PPS, CMOS, active high, rising edge sync by default, but can be programmed to active low, falling edge sync. Load and capacitance 10K Ω /10 pF
Event Marker Input	CMOS, programmable rising or falling edge sync

Vega 60 Power specifications

Table B-10: Vega 60 Power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5% typical
Power consumption	< 2.5 W all signals + L-band + Ethernet, typical
Current consumption	757 mA all signals + L-band + Ethernet, typical
Antenna voltage input	5 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 35 dB typical

Continued on next page

Vega 60 Technical Specifications, Continued

Vega 60 Environmental specifications

Table B-11: Vega 60 Environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when in an enclosure)
Mechanical Shock	EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
Vibration	EP455 Section 5.15.1 Random
EMC	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR 22

Vega 60 Mechanical specifications

Table B-12: Vega 60 Mechanical specifications

Item	Specification
Dimensions	71.1 L x 45.7 W x 10 H (mm) 2.80 L x 1.80 W x 0.40 (in)
Weight	24 g (0.85 oz)
Status indication (LED)	Power, Primary and Secondary GNSS lock, Differential lock, DGNSS position, Heading
Power/Data connector	2 x 14-pin male header, 2 mm pitch
Antenna connectors (2)	MMCX, female, straight

Continued on next page

Vega 60 Technical Specifications, Continued

Vega 60 L-band receiver specifications

Table B-13: Vega 60 L-band receiver specifications

Item	Specification
Receiver Type	Dual Channel
Channels	1525 to 1560 MHz
Satellite Selection	Manual and Automatic
Reacquisition Time	15 seconds (typical)

Vega 60 Aiding devices

Table B-14: Vega 60 Aiding devices

Device	Description
Gyro	Provides smooth and fast heading reacquisition. During loss of GNSS signals heading stability is degraded by < 1° per minute for up to 3 minutes.
Tilt Sensor	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, and ionospheric activity.

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

³Hemisphere GNSS proprietary.

⁴CMR and CMR+ do not cover proprietary messages outside of the typical standard.

Appendix C: Frequently Asked Questions

Overview

Introduction Appendix C contains the answers to questions pertaining to integrating the Vega board series.

Contents

	Topic	See Page
	Frequently Asked Questions (FAQ)	105

Frequently Asked Questions (FAQ)

Integration

The following is a list of common questions and solutions when integrating the Vega series OEM board.

Question	Solution
Do I need to use the PPS and event marker?	No, these are not necessary for Vega board operation.
What should I do with the PPS signal if I do not want to use it?	We recommend you tie to ground through a 1k resistor.
What should I do with the manual mark input if I am not going to use it?	Do not connect the pin.
Do I need to use the lock indicators?	No, these are present for applications where it is desirable to have an LED visible to the user. These signals need to be transistor-buffered, as these lines can only offer 1 mA. Depending on the product and the application, LEDs can be very useful to the end user. These signals are active low.
Do I need to use a shield-can for the Vega board?	Not necessarily, but you may need to if there are RF interference issues, such as if the Vega board interferes with other devices. A shield-can is a good start in terms of investigating the benefit. If you are designing a smart antenna system, a shield-can is needed. Hemisphere GNSS recommends you always conduct an RF pre-scan when integrating OEM boards.

Continued on next page

Frequently Asked Questions (FAQ), Continued

Integration,
continued

Question	Solution
<p>If my company wishes to integrate this product, what type of engineering resources will I need to do this successfully?</p>	<p>Hemisphere GNSS recommends you have sufficient engineering resources with the appropriate skills in and understanding of the following:</p> <ul style="list-style-type: none"> • Electronic design (including power supplies and level translation) • RF implications of working with GPS equipment • Circuit design and layout • Mechanical design and layout
<p>How do I solve a problem I cannot isolate?</p>	<p>Hemisphere GNSS recommends contacting the dealer first. With their experience with this product, and other products from Hemisphere GNSS, they should be able to help isolate a problem. If the issue is beyond the capability or experience of the dealer, contact Hemisphere GNSS.</p> <p>Hemisphere GNSS Technical Support is available from 8:00 AM to 5:00 PM Mountain Standard Time, Monday through Friday. See “Technical Support” for Technical Support contact information.</p>

Support and repair

Continued on next page

Frequently Asked Questions (FAQ), Continued

**Power,
communication,
and
configuration**

Question	Solution
<p>My Vega board system does not appear to be communicating.</p>	<p>This could be one of a few issues:</p> <ul style="list-style-type: none"> • Examine the Vega board cables and connectors for signs of damage or offset. • Ensure the Vega board system is properly powered with the correct voltage. • Ensure there is a good connection to the power supply since it is required to terminate the power input with the connector. • Check the documentation of the receiving device, if not a PC, to ensure the transmit line from the Vega board is connected to the receive line of the other device. Also, ensure the signal grounds are connected. • If the Vega board is connected to a custom or special device, ensure the serial connection to it does not have any incompatible signal lines present which prevent proper communication. • Make sure the baud rate of the Vega board matches the other device. The other device must also support an 8-data bit, 1 stop bit, no parity port configuration (8-N-1). Some devices support different settings and may be user configurable. Ensure the settings match. • Consult the troubleshooting section of the other device's documentation to determine if there may be a problem with the equipment.

Continued on next page

Frequently Asked Questions (FAQ), Continued

**Power,
communication,
and
configuration,
continued**

Question	Solution
Am I able to configure two serial ports with different baud rates?	Yes, all the ports are independent. For example, you may set one port to 4800 and another port to 19200.
Am I able to have the Vega board output different NMEA messages through multiple ports?	Yes, different NMEA messages can be sent to the serial ports you choose. These NMEA messages may also be at different update rates. A high enough baud rate is needed to transmit all the data; otherwise, some data may not be transmitted.
How can I determine the current configuration of the Vega board?	The \$JSHOW command will request the configuration information from the Vega board. The response will be similar to: \$>JSHOW,BAUD,19200 \$>JSHOW,BIN,1,5.0 \$>JSHOW,BAUD,4800,OTHER \$>JSHOW,ASC,GPGGA,1.0,OTHER \$>JSHOW,ASC,GPVTG,1.0,OTHER \$>JSHOW,ASC,GPGSA,1.0,OTHER
How can I be sure the configuration will be saved for the subsequent power cycle?	Query the receiver to make sure the current configuration is correct by issuing a \$JSHOW command. If not, make the necessary changes and reissue the \$JSHOW command. Once the current configuration is acceptable, issue a \$JSAVE command and wait for the receiver to indicate the save is complete. Do not power off the receiver until the “save complete” message appears.

Continued on next page

Frequently Asked Questions (FAQ), Continued

Power,
communication,
and
configuration,
continued

Question	Solution
How do I change the baud rate of a port from that port?	Connect at the current baud rate of the Vega board port and then issue a \$JBAUD command to change the port baud rate to the desired rate. Now change the baud rate in your application to the desired rate.
What is the best software tool to use to communicate with the Vega board and configure it?	<p>Hemisphere GNSS uses different software applications:</p> <ul style="list-style-type: none"> • SLXMon - Available at HTTPS://WWW.HGNSS.COM/. This application is a very useful tool for graphically viewing tracking performance and position accuracy, and for recording data. It can also configure message output and port settings. SLXMon runs on multiple Windows platforms. • PocketMax - Available at HTTPS://WWW.HGNSS.COM/ Similar to SLXMon, you can use this application to graphically view tracking performance and position accuracy, record data, and configure message output and port settings. PocketMax runs on multiple Windows platforms using the Windows .NET framework.

Continued on next page

Frequently Asked Questions (FAQ), Continued

GNSS reception and performance

Question	Solution
How do I know what the Vega board is doing?	<p>The Vega boards support standard NMEA data messages. The \$GPGSV and Bin99 data messages contain satellite tracking and SNR information.</p> <p>If available, the contained in the \$GPGGA message. Additionally, the Vega boards have surface-mounted status LEDs that indicate receiver status.</p>
Do I have to be careful when using the Vega board to ensure it tracks properly?	<p>For best performance, the Vega board antenna must have a clear view of the sky for satellite tracking.</p> <p>The Vega board can tolerate a certain amount of signal blockage because redundant satellites are often available. Only four satellites are required for a position; however, the more satellites are used, the greater the positioning accuracy.</p>
How do I know if the Vega board has acquired an SBAS signal?	<p>The Vega board outputs the \$RD1 message which contains the SBAS Bit Error Rate (BER) for each SBAS channel. The BER value describes the rate of errors received from SBAS. Ideally, this should be zero. However, the Vega board performs well up to 150 BER. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.</p>

Continued on next page

Frequently Asked Questions (FAQ), Continued

SBAS reception and performance

Question	Solution
<p>How do I know if the Vega board is offering a differentially corrected or RTK- corrected position?</p>	<p>The Vega board outputs the \$GPGGA message as the main positioning data message. This message contains a quality fix value which describes the GPS status. If this value is 2, the position is differentially corrected; if this value is 4 or 5, the position is RTK (or Atlas)-corrected.</p> <p>The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.</p>
<p>How do I select an SBAS satellite?</p>	<p>By default, the Vega board will automatically attempt to track the appropriate SBAS satellites. If multiple satellites are available, the one with the lowest BER value is selected to be used to decode the corrections.</p> <p>You can manually select which SBAS satellites to track (not recommended). Refer to the HGNSS TRM Manual.</p>
<p>Do I need a dual frequency antenna for SBAS?</p>	<p>Hemisphere GNSS recommends using a dual frequency antenna with the Vega board.</p> <p>While some receiver function is possible with an L1-only antenna, full receiver performance will only be realized with a dual frequency antenna.</p>

Continued on next page

Frequently Asked Questions (FAQ), Continued

External corrections

Question	Solution
<p>My Vega board system does not appear to be using DGPS or RTK corrections from an external correction source. What could be the problem?</p>	<p>This could be due to several factors. To isolate the issue:</p> <ul style="list-style-type: none"> • Make sure DGPS corrections are RTCM v2.3 protocol. • Make sure RTK corrections are either ROX, RTCM v3, CMR, or CMR+ protocol. • Verify the baud rates used by the Vega board match the external correction source. • The external correction should be using an 8-data bit, no parity, 1 stop bit (8-N-1) serial port configuration. • Inspect the cable connection to ensure there is no damage. • Check the pin-out information for the cables to ensure the transmit line of the external correction source is connected to the receive line of the Vega board's serial port and the signal grounds are connected. • Make sure the Vega board has been set to receive external corrections by issuing the \$JDIFF command. Refer to the HGNSS TRM.

Continued on next page

Frequently Asked Questions (FAQ), Continued

Installation

Question	Solution
How will the antenna selection and mounting affect Vega board performance?	<p data-bbox="938 489 1390 638">For best results select a multipath-resistant antenna. Ensure the antenna tracks all the available signals for the receiver.</p> <p data-bbox="938 684 1370 833">Mount the antenna with the best possible view of the sky and in a location with the lowest possible multipath.</p> <p data-bbox="938 879 1349 987">Using a magnetic mount for the antenna will not affect performance.</p> <p data-bbox="938 1033 1395 1329">If you are using an antenna from another manufacturer, be mindful all specifications provided in this manual are based off of Hemisphere GNSS antennas, and the results may vary with if you are using an antenna from another manufacturer.</p>

Continued on next page

Frequently Asked Questions (FAQ), Continued

Installation, continued

Question	Solution
<p>I could not install my antennas at the same height. How do I calibrate for the height offset?</p>	<p>You may enter a non-level bias calculation which adjusts the pitch/roll output to calibrate the measurement if the antenna array is not installed on a horizontal plane.</p> <p>To calibrate the pitch/roll reading, send the following command:</p> <p>\$JATT,PBIAS,x<CR><LF></p> <p>where x is a bias (in degrees) which will be added to the pitch/roll measurement. The acceptable pitch bias range is -15.0° to 15.0° (default is 0.0°).</p> <p>To determine the current pitch compensation angle, send the following command:</p> <p>\$JATT,PBIAS<CR><LF></p>

End User License Agreement

End User license agreement

IMPORTANT - This is an agreement (the "**Agreement**") between you, the end purchaser ("**Licensee**") and Hemisphere GNSS Inc. ("**Hemisphere**") which permits Licensee to use the Hemisphere software (the "**Software**") that accompanies this Agreement. This Software may be licensed on a standalone basis or may be embedded in a Product. Please read and ensure that you understand this Agreement before installing or using the Software Update or using a Product.

In this agreement any product that has Software embedded in it at the time of sale to the Licensee shall be referred to as a "**Product**". As well, in this Agreement, the use of a Product shall be deemed to be use of the Software which is embedded in the Product.

BY INSTALLING OR USING THE SOFTWARE UPDATE OR THE PRODUCT, LICENSEE THEREBY AGREES TO BE LEGALLY BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THESE TERMS, (I) DO NOT INSTALL OR USE THE SOFTWARE, AND (II) IF YOU ARE INSTALLING AN UPDATE TO THE SOFTWARE, DO NOT INSTALL THE UPDATE AND PROMPTLY DESTROY IT.

HEMISPHERE PROVIDES LIMITED WARRANTIES IN RELATION TO THE SOFTWARE. AS WELL, THOSE WHO USE THE EMBEDDED SOFTWARE DO SO AT THEIR OWN RISK. YOU SHOULD UNDERSTAND THE IMPORTANCE OF THESE AND OTHER LIMITATIONS SET OUT IN THIS AGREEMENT BEFORE INSTALLING OR USING THE SOFTWARE OR THE PRODUCT.

1. **LICENSE.** Hemisphere hereby grants to Licensee a non-transferable and non-exclusive license to use the Software as embedded in a Product and all Updates (collectively the "**Software**"), solely in binary executable form.
2. **RESTRICTIONS ON USE.** Licensee agrees that Licensee and its employees will not directly or indirectly, in any manner whatsoever:
 - a. install or use more copies of the Software than the number of copies that have been licensed;
 - b. use or install the Software in connection with any product other than the Product the Software was intended to be used or installed on as set out in the documentation that accompanies the Software.
 - c. copy any of the Software or any written materials for any purpose except as part of Licensee's normal backup processes;
 - d. modify or create derivative works based on the Software;
 - e. sub-license, rent, lease, loan or distribute the Software;
 - f. permit any third party to use the Software;
 - g. use or operate Product for the benefit of any third party in any type of service outsourcing, application service, provider service or service bureau capacity;
 - h. reverse engineer, decompile or disassemble the Software or otherwise reduce it to a human perceivable form;
 - i. Assign this Agreement or sell or otherwise transfer the Software to any other party except as part of the sale or transfer of the whole Product.
3. **UPDATES.** At Hemisphere's discretion Hemisphere may make Updates available to Licensee. An update ("**Update**") means any update to the Software that is made available to Licensee including error corrections, enhancements and other modifications. Licensee may access, download and install Updates during the Warranty Period only. All Updates that Licensee downloads, installs or uses shall be deemed to be Software and subject to this Agreement. Hemisphere reserves the right to modify the Product without any obligation to notify, supply or install any improvements or alterations to existing Software.
4. **SUPPORT.** Hemisphere may make available directly or through its authorized dealers telephone and email support for the Software. Contact Hemisphere to find the authorized dealer near you. As well, Hemisphere may make available user and technical documentation regarding the Software. Hemisphere reserves the right to reduce and limit access to such support at any time.

Continued on next page

Frequently Asked Questions (FAQ), Continued

Installation, continued

5. **BACKUPS AND RECOVERY.** Licensee shall back-up all data used, created or stored by the Software on a regular basis as necessary to enable proper recovery of the data and related systems and processes in the event of a malfunction in the Software or any loss or corruption of data caused by the Software. Licensee shall assume all risks of loss or damage for any failure to comply with the foregoing.
6. **OWNERSHIP.** Hemisphere and its suppliers own all rights, title and interest in and to the Software and related materials, including all intellectual property rights. The Software is licensed to Licensee, not sold.
7. **TRADEMARKS.** Hemisphere GNSS[®], the Hemisphere GNSS logo, TRACER[™], Crescent[®], Eclipse[™], e-Dif[®], L-Dif[™], PocketMax[™], S320[™], SBX-4[™], Vector[™], Vega[™], Phantom[™] XF1[™], XF2[™], Cygnus[™], Atlas[™] aRTK, SureFix[™], Athena[™], Aquila[™], Lyra[™], Outback Guidance[™], and EDRIVE[™] are proprietary trademarks of Hemisphere GNSS, Inc. Other trademarks are the properties of their respective owners. and the associated logos are trademarks of Hemisphere. Other trademarks are the property of their respective owners. Licensee may not use any of these trademarks without the consent of their respective owners.
8. **LIMITED WARRANTY.** Hemisphere warrants solely to the Licensee, subject to the exclusions and procedures set forth herein below, that for a period of one (1) year from the original date of purchase of the Product in which it is embedded (the "Warranty Period"), the Software, under normal use and maintenance, will conform in all material respects to the documentation provided with the Software and any media will be free of defects in materials and workmanship. For any Update, Hemisphere warrants, for 90 days from performance or delivery, or for the balance of the original Warranty Period, whichever is greater, that the Update, under normal use and maintenance, will conform in all material respects to the documentation provided with the Update and any media will be free of defects in materials and workmanship. Notwithstanding the foregoing, Hemisphere does not warrant that the Software will meet Licensee's requirements or that its operation will be error free.
9. **WARRANTY EXCLUSIONS.** The warranty set forth in Section (8) will not apply to any deficiencies caused by (a) the Product not being used as described in the documentation supplied to Licensee, (b) the Software having been altered, modified or converted in any way by anyone other than Hemisphere approved by Hemisphere, (c) any malfunction of Licensee's equipment or other software, or (d) damage occurring in transit or due to any accident, abuse, misuse, improper installation, lightning (or other electrical discharge) or neglect other than that caused by Hemisphere. Hemisphere GNSS does not warrant or guarantee the precision or accuracy of positions obtained when using the Software (whether standalone or embedded in a Product). The Product and the Software is not intended and should not be used as the primary means of navigation or for use in safety of life applications. The potential positioning and navigation accuracy obtainable with the Software as stated in the Product or Software documentation serves to provide only an estimate of achievable accuracy based on specifications provided by the US Department of Defense for GPS positioning and DGPS service provider performance specifications, where applicable.
10. **WARRANTY DISCLAIMER.** EXCEPT AS EXPRESSLY SET OUT IN THIS AGREEMENT, HEMISPHERE MAKES NO REPRESENTATION, WARRANTY OR CONDITION OF ANY KIND TO LICENSEE, WHETHER VERBAL OR WRITTEN AND HEREBY DISCLAIMS ALL REPRESENTATIONS, WARRANTIES AND CONDITIONS OF ANY KIND INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, ACCURACY, RELIABILITY OR THAT THE USE OF THE SOFTWARE WILL BE UNINTERRUPTED OR ERROR-FREE AND HEREBY DISCLAIMS ALL REPRESENTATIONS, WARRANTIES AND CONDITIONS ARISING AS A RESULT OF CUSTOM, USAGE OR TRADE AND THOSE ARISING UNDER STATUTE.
11. **LIMITS ON WARRANTY DISCLAIMER.** Some jurisdictions do not allow the exclusion of implied warranties or conditions, so some of the above exclusions may not apply to Licensee. In that case, any implied warranties or conditions which would then otherwise arise will be limited in duration to ninety (90) days from the date of the license of the Software or the purchase of the Product. The warranties given herein give Licensee specific legal rights and Licensee may have other rights which may vary from jurisdiction to jurisdiction.

Continued on next page

Frequently Asked Questions (FAQ), Continued

Installation, continued

12. **CHANGE TO WARRANTY.** No employee or agent of Hemisphere is authorized to change the warranty provided or the limitation or disclaimer of warranty provisions. All such changes will only be effective if pursuant to a separate agreement signed by senior officers of the respective parties.
13. **WARRANTY CLAIM.** In the event Licensee has a warranty claim Licensee must first check for and install all Updates that are made available. The warranty will not otherwise be honored. Proof of purchase may be required. Hemisphere does not honor claims asserted after the end of the Warranty Period.
14. **LICENSEE REMEDIES.** In all cases which involve a failure of the Software to conform in any material respect to the documentation during the Warranty Period or a breach of a warranty, Hemisphere's sole obligation and liability, and Licensee's sole and exclusive remedy, is for Hemisphere, at Hemisphere's option, to (a) repair the Software, (b) replace the Software with software conforming to the documentation, or (c) if Hemisphere is unable, on a reasonable commercial basis, to repair the Software or to replace the Software with conforming software within ninety (90) days, to terminate this Agreement and thereafter Licensee shall cease using the Software. Hemisphere will also issue a refund for the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.
15. **LIMITATION OF LIABILITY.** IN NO EVENT WILL HEMISPHERE BE LIABLE TO LICENSEE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES INCLUDING ARISING IN RELATION TO ANY LOSS OF DATA, INCOME, REVENUE, GOODWILL OR ANTICIPATED SAVINGS EVEN IF HEMISPHERE HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH LOSS OR DAMAGE. FURTHER, IN NO EVENT WILL HEMISPHERE'S TOTAL CUMULATIVE LIABILITY HEREUNDER, FROM ALL CAUSES OF ACTION OF ANY KIND, EXCEED THE TOTAL AMOUNT PAID BY LICENSEE TO HEMISPHERE TO PURCHASE THE PRODUCT. THIS LIMITATION AND EXCLUSION APPLIES IRRESPECTIVE OF THE CAUSE OF ACTION, INCLUDING BUT NOT LIMITED TO BREACH OF CONTRACT, NEGLIGENCE, STRICT LIABILITY, TORT, BREACH OF WARRANTY, MISREPRESENTATION OR ANY OTHER LEGAL THEORY AND WILL SURVIVE A FUNDAMENTAL BREACH.
16. **LIMITS ON LIMITATION OF LIABILITY.** Some jurisdictions do not allow for the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply to Licensee and Licensee may also have other legal rights which may vary from jurisdiction to jurisdiction.
17. **BASIS OF BARGAIN.** Licensee agrees and acknowledges that Hemisphere has set its prices and the parties have entered into this Agreement in reliance on the limited warranties, warranty disclaimers and limitations of liability set forth herein, that the same reflect an agreed-to allocation of risk between the parties (including the risk that a remedy may fail of its essential purpose and cause consequential loss), and that the same forms an essential basis of the bargain between the parties. Licensee agrees and acknowledges that Hemisphere would not have been able to sell the Product at the amount charged on an economic basis without such limitations.
18. **PROPRIETARY RIGHTS INDEMNITY.** Hemisphere shall indemnify, defend and hold harmless Licensee from and against any and all actions, claims, demands, proceedings, liabilities, direct damages, judgments, settlements, fines, penalties, costs and expenses, including royalties and attorneys' fees and related costs, in connection with or arising out of any actual infringement of any third party patent, copyright or other intellectual property right by the Software or by its use, in accordance with this Agreement and documentation, PROVIDED THAT: (a) Hemisphere has the right to assume full control over any action, claim, demand or proceeding, (b) Licensee shall promptly notify Hemisphere of any such action, claim, demand, or proceeding, and (c) Licensee shall give Hemisphere such reasonable assistance and tangible material as is reasonably available to Licensee for the defense of the action, claim, demand or proceeding. Licensee shall not settle or compromise any of same for which Hemisphere has agreed to assume responsibility without Hemisphere's prior written consent. Licensee may, at its sole cost and expense, retain separate counsel from the counsel utilized or retained by Hemisphere. 19. **INFRINGEMENT.** If use of the Software may be enjoined due to a claim of infringement by a third party then, at its sole discretion and expense, Hemisphere may do one of the following: (a)

Continued on next page

Frequently Asked Questions (FAQ), Continued

Installation, continued

19. negotiate a license or other agreement so that the Product is no longer subject to such a potential claim, (b) modify the Product so that it becomes non-infringing, provided such modification can be accomplished without materially affecting the performance and functionality of the Product, (c) replace the Software, or the Product, with non-infringing software, or product, of equal or better performance and quality, or (d) if none of the foregoing can be done on a commercially reasonable basis, terminate this license and Licensee shall stop using the Product and Hemisphere shall refund the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.
20. The foregoing sets out the entire liability of Hemisphere and the sole obligations of Hemisphere to Licensee in respect of any claim that the Software or its use infringes any third party rights.
21. **INDEMNIFICATION.** Except in relation to an infringement action, Licensee shall indemnify and hold Hemisphere harmless from any and all claims, damages, losses, liabilities, costs and expenses (including reasonable fees of lawyers and other professionals) arising out of or in connection with Licensee's use of the Product, whether direct or indirect, including without limiting the foregoing, loss of data, loss of profit or business interruption. **TERMINATION.** Licensee may terminate this Agreement at any time without cause. Hemisphere may terminate this Agreement on 30 days notice to Licensee if Licensee fails to materially comply with each provision of this Agreement unless such default is cured within the 30 days. Any such termination by a party shall be in addition to and without prejudice to such rights and remedies as may be available, including injunction and other equitable remedies. Upon receipt by Licensee of written notice of termination from Hemisphere or termination by Licensee, Licensee shall at the end of any notice period (a) cease using the Software; and (b) return to Hemisphere (or destroy and provide a certificate of a Senior Officer attesting to such destruction) the Software and all related material and any magnetic or optical media provided to Licensee. The provisions of Sections 6), 7), 8), 9), 10), 15), 21), 26) and 27) herein shall survive the expiration or termination of this Agreement for any reason.
22. **EXPORT RESTRICTIONS.** Licensee agrees that Licensee will comply with all export control legislation of Canada, the United States, Australia and any other applicable country's laws and regulations, whether under the Arms Export Control Act, the International Traffic in Arms Regulations, the Export Administration Regulations, the regulations of the United States Departments of Commerce, State, and Treasury, or otherwise as well as the export control legislation of all other countries.
23. **PRODUCT COMPONENTS.** The Product may contain third party components. Those third party components may be subject to additional terms and conditions. Licensee is required to agree to those terms and conditions in order to use the Product.
24. **FORCE MAJEURE EVENT.** Neither party will have the right to claim damages as a result of the other's inability to perform or any delay in performance due to unforeseeable circumstances beyond its reasonable control, such as labor disputes, strikes, lockouts, war, riot, insurrection, epidemic, Internet virus attack, Internet failure, supplier failure, act of God, or governmental action not the fault of the non-performing party.
25. **FORUM FOR DISPUTES.** The parties agree that the courts located in Calgary, Alberta, Canada and the courts of appeal there from will have exclusive jurisdiction to resolve any disputes between Licensee and Hemisphere concerning this Agreement or Licensee's use or inability to use the Software and the parties hereby irrevocably agree to attorn to the jurisdiction of those courts. Notwithstanding the foregoing, either party may apply to any court of competent jurisdiction for injunctive relief.
26. **APPLICABLE LAW.** This Agreement shall be governed by the laws of the Province of Alberta, Canada, exclusive of any of its choice of law and conflicts of law jurisprudence.
27. **CISG.** The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement or any transaction hereunder.

GENERAL. This is the entire agreement between Licensee and Hemisphere relating to the Product and Licensee's use of the same, and supersedes all prior, collateral or contemporaneous oral or written representations, warranties or agreements regarding the same. No amendment to or modification of this Agreement will be binding unless in writing and signed by duly authorized representatives of the parties. Any and all terms and conditions set out in any correspondence between the parties or set out in a purchase order which are different from or in addition to the terms and conditions set forth herein, shall have no application and no written notice of same shall be required. In the event that one or more of the provisions of this Agreement is found to be illegal or unenforceable, this Agreement shall not be rendered inoperative but the remaining provisions shall continue in full force and effect.

Warranty Notice

Warranty notice

COVERED PRODUCTS: This warranty covers all products manufactured by Hemisphere GNSS and purchased by the end purchaser (the "Products"), unless otherwise specifically and expressly agreed in writing by Hemisphere GNSS.

LIMITED WARRANTY: Hemisphere GNSS warrants solely to the end purchaser of the Products, subject to the exclusions and procedures set forth below, that the Products sold to such end purchaser and its internal components shall be free, under normal use and maintenance, from defects in materials, and workmanship and will substantially conform to Hemisphere GNSS's applicable specifications for the Product, for a period of 12 months from delivery of such Product to such end purchaser (the "Warranty Period"). Repairs and replacement components for the Products are warranted, subject to the exclusions and procedures set forth below, to be free, under normal use and maintenance, from defects in material and workmanship, and will conform to Hemisphere GNSS's applicable specifications for the Product, for 90 days from performance or delivery, or for the balance of the original Warranty Period, whichever is greater.

EXCLUSION OF ALL OTHER WARRANTIES. The LIMITED WARRANTY shall apply only if the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS relevant User's Manual and Specifications, AND the Product is not modified or misused. The Product is provided "AS IS" and the implied warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and ALL OTHER WARRANTIES,

express, implied or arising by statute, by course of dealing or by trade usage, in connection with the design, sale, installation, service or use of any products or any component thereof, are EXCLUDED from this transaction and shall not apply to the Product. The LIMITED WARRANTY is IN LIEU OF any other warranty, express or implied, including but not limited to, any warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, title, and non-infringement.

LIMITATION OF REMEDIES. The purchaser's EXCLUSIVE REMEDY against Hemisphere GNSS shall be, at Hemisphere GNSS's option, the repair or replacement of any defective Product or components thereof. The purchaser shall notify Hemisphere GNSS or a Hemisphere GNSS's approved service center immediately of any defect. Repairs shall be made through a Hemisphere GNSS approved service center only. Repair, modification or service of Hemisphere GNSS products by any party other than a Hemisphere GNSS approved service center shall render this warranty null and void. The remedy in this paragraph shall only be applied in the event that the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS's relevant User's Manual and Specifications, AND the Product is not modified or misused. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE

TO PURCHASER, even if Hemisphere GNSS has been advised of the possibility of such damages. Without limiting the foregoing, Hemisphere GNSS shall not be liable for any damages of any kind resulting from installation, use, quality, performance or accuracy of any Product.

HEMISPHERE IS NOT RESPONSIBLE FOR PURCHASER'S NEGLIGENCE OR UNAUTHORIZED USES OF THE PRODUCT.

IN NO EVENT SHALL Hemisphere GNSS BE IN ANY WAY RESPONSIBLE FOR ANY DAMAGES RESULTING FROM PURCHASER'S OWN NEGLIGENCE, OR FROM OPERATION OF THE PRODUCT IN ANY WAY OTHER THAN AS SPECIFIED IN Hemisphere GNSS's RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GNSS is NOT RESPONSIBLE for defects or performance problems resulting from (1) misuse, abuse, improper installation, neglect of Product; (2) the utilization of the Product with hardware or software products, information, data, systems, interfaces or devices not made, supplied or specified by Hemisphere GNSS; (3) the operation of the Product under any specification other than, or in addition to, the specifications set forth in Hemisphere GNSS's relevant User's Manual and Specifications; (4) damage caused by accident or natural events, such as lightning (or other electrical discharge) or fresh/ salt water immersion of Product; (5) damage occurring in transit; (6) normal wear and tear; or (7) the operation or failure of operation of any satellite-based positioning system or differential correction service; or the availability or performance of any satellite-based positioning signal or differential correction signal.

THE PURCHASER IS RESPONSIBLE FOR OPERATING THE VEHICLE SAFELY. The purchaser is solely responsible for the safe operation of the vehicle used in connection with the Product, and for maintaining proper system control settings. UNSAFE DRIVING OR SYSTEM CONTROL SETTINGS CAN RESULT IN PROPERTY DAMAGE, INJURY, OR DEATH.

Continued on next page

Warranty Notice, Continued

Warranty notice, continued

The purchaser is solely responsible for his/her safety and for the safety of others. The purchaser is solely responsible for maintaining control of the automated steering system at all times. THE PURCHASER IS SOLELY RESPONSIBLE FOR ENSURING THE PRODUCT IS PROPERLY AND CORRECTLY INSTALLED, CONFIGURED, INTERFACED, MAINTAINED, STORED, AND OPERATED IN ACCORDANCE WITH Hemisphere GNSS's RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GNSS does not warrant or guarantee the positioning and navigation precision or accuracy obtained when using Products. Products are not intended for primary navigation or for use in safety of life applications. The potential accuracy of Products as stated in Hemisphere GNSS literature and/or Product specifications serves to provide only an estimate of achievable accuracy based on performance specifications provided by the satellite service operator (i.e. US Department of Defense in the case of GPS and differential correction service provider. Hemisphere GNSS reserves the right to modify Products without any obligation to notify, supply or install any improvements or alterations to existing Products.

GOVERNING LAW. This agreement and any disputes relating to, concerning or based upon the Product shall be governed by and interpreted in accordance with the laws of the State of Arizona.

OBTAINING WARRANTY SERVICE. In order to obtain warranty service, the end purchaser must bring the Product to a Hemisphere GNSS approved service center along with the end purchaser's proof of purchase. Hemisphere GNSS does not warrant claims asserted after the end of the warranty period. For any questions regarding warranty service or to obtain information regarding the location of any of Hemisphere GNSS approved service center, contact Hemisphere GNSS at the following address:

Hemisphere GNSS

8515 E. Anderson Drive Scottsdale, AZ 85255, USA

Phone: +1-480-348-6380

Fax: +1-480-270-5070

TECHSUPPORT@HREGNSS.COM WWW.HGNSS.COM



Hemisphere GNSS Inc.
8515 East Anderson Drive
Scottsdale, Arizona, US 85255
Phone: 480-348-6380
Fax: 480-270-5070
PRECISION@HGNSS.COM
WWW.HGNSS.COM