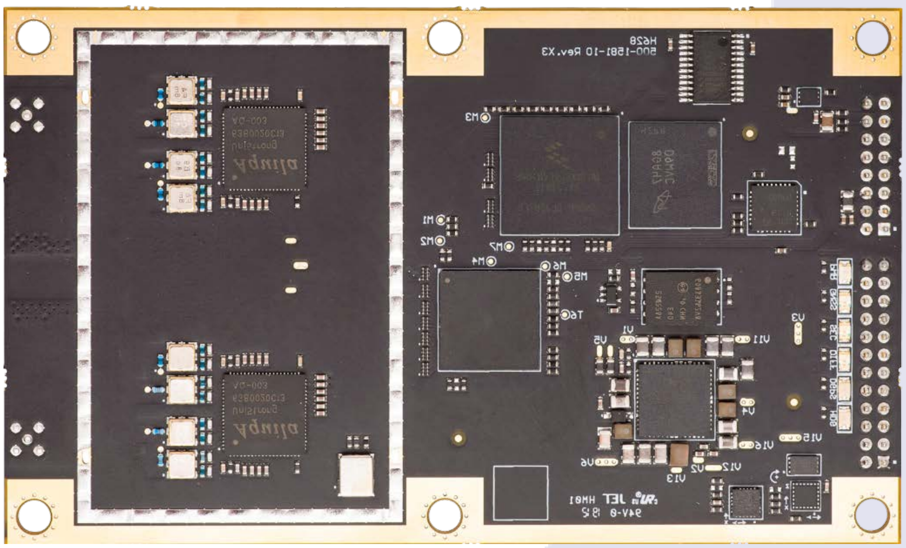

875-0420-10

Integrator Guide
Revision: A3
October 22, 2020

Vega™ 40
GNSS Compass Board

Table of Contents

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.

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

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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
HTTPS://WWW.HEMISPHEREGNSS.COM/

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Vega 40 Terms & Definitions

Introduction

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

Vega 40 terms & definitions

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
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	This is the distance, in meters, that the receiver has calculated between the primary and secondary antenna. This value should always be accurate to within 2cm.
dB	Decibel. The unit of measurement used to express signal-to-noise ratio (SNR).
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 40 Terms & Definitions, Continued

Vega 40 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 (NavIC) and the 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

Continued on next page

Vega 40 Terms & Definitions, Continued

Vega 40 terms & definitions, continued

Term	Definition
PPS	Pulse-per-second is a pulse output by the receiver precisely aligned to the GNSS time. Default output every one second.
QZSS	Quasi-Zenith Satellite System (QZSS) is a regional satellite navigation system deployed and maintained by Japan.
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.

Continued on next page

Vega 40 Terms & Definitions, Continued

Vega 40 terms & definitions, continued

Term	Definition
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 40 OEM board with your heading and positioning product. 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 HGNSS proprietary messages). For information on these subjects refer to the Hemisphere GNSS (HGNSS) Technical Reference Manual (TRM).

Contents

Product Overview

Product overview

The Vega 40 GNSS OEM Board is one of Hemisphere's most advanced GNSS heading and positioning boards. The Vega 40 uses dual antennas 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.

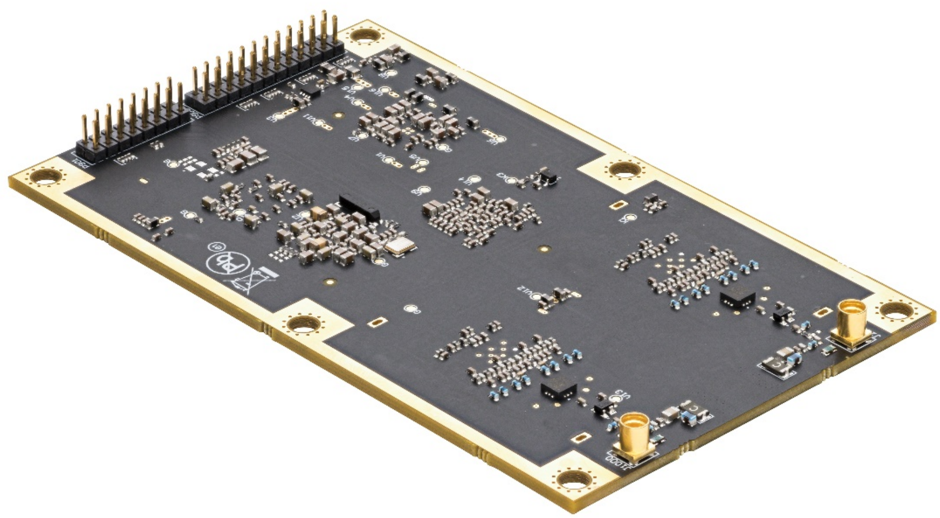

Figure 1-1: Vega 40 GNSS OEM board

With the Vega 40, 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.

Key Features

Vega 40 key features

The Vega 40 OEM GNSS board is offered in the common industry form factor (100L x 60W mm), with low power consumption, and simple on-board firmware with integrated L-band. The reliable positioning performance of Vega 40 is enhanced by Athena RTK, Atlas corrections, aRTK, SureFix and TRACER™ technology.

The Vega 40 is 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).

* NavIC (IRNSS) will be available with a future firmware update.

The dual antenna Vega 40 provides accurate heading with an on-board gyro and tilt sensor that provides heading during short GNSS outages.

Key features of the Vega 40 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 interference rejection	• New multi-axis gyro and tilt sensor for reliable coverage during short GNSS outages

For complete specifications of the Vega 40 board, see Appendix B Technical Specifications.

What's Included in Your Kit

Kit contents

The Vega 40 board is available in two configurations:

- Vega 40 OEM board only - designed for integrators who are familiar with Hemisphere board integration (P/N 725-1593-10).
- Vega 40 OEM board and Vega 40 adapter board (by request only P/N 725-1521-0).

For more information on requesting the Vega 40 adapter board, go to the HGNSS OEM Products page, or contact your local dealer.

Firmware

Firmware

The software that runs the Vega 40 OEM board is often referred to as firmware, since it operates at a low level.

The Vega 40 currently ships loaded with the Athena-based firmware. Refer to the HGNSS TRM for information on querying and communicating with the Vega 40 board.

You can upgrade the firmware when in the field through Ports A, B, or C when new firmware versions become available.

Using PocketMax to Communicate with the Vega 40

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 the Vega 40 via the COM port and open PocketMax.

The screens within PocketMax allow you to easily interface with the Vega 40 to:

- Select the internal SBAS or RTCM correction source, and monitor reception (beacon optional)
- Configure GPS message output and port settings
- Record various types of data
- Monitor the Vega 40 status and function

PocketMax is available for download from the Hemisphere GNSS website (WWW.HGNSS.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 was 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 40 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

Atlas L-band

Atlas L-band is Hemisphere's industry leading correction service and can be added to the Vega 40 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 -** Industry-leading 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://HGNSS.COM/ATLAS

aRTK Position Aiding

aRTK position aiding	aRTK is an innovative feature available in Hemisphere's Vega 40 that greatly 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 40 receives 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 40 OEM Board

Overview

Introduction

This chapter provides instructions on how to integrate your Vega 40 board with your heading and positioning product.

Contents

Vega 40 Integration

Introduction

Successful integration of the Vega 40 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 knowledge

Vega 40 integration requirements

The Vega 40 is a low-level module intended for custom integration with the following general requirements:

- Regulated power supply input: (3.3 VDC ± 5%) and 850 mA continuous maximum
- Support for one or more communication ports (i.e., serial, USB, CAN or ethernet)
- 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 @ 75ma for amplified antenna

Message interface

The Vega 40 can be configured (message output and receiver configuration) over serial (3.3V UART and RS-232/RS-422), USB, CAN, or Ethernet with ASCII commands published in the HGNSS TRM.

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 40 mechanical layout

Figure 2-1 shows the mechanical layout for the Vega 40 OEM board. Dimensions are in millimeters for all layouts.

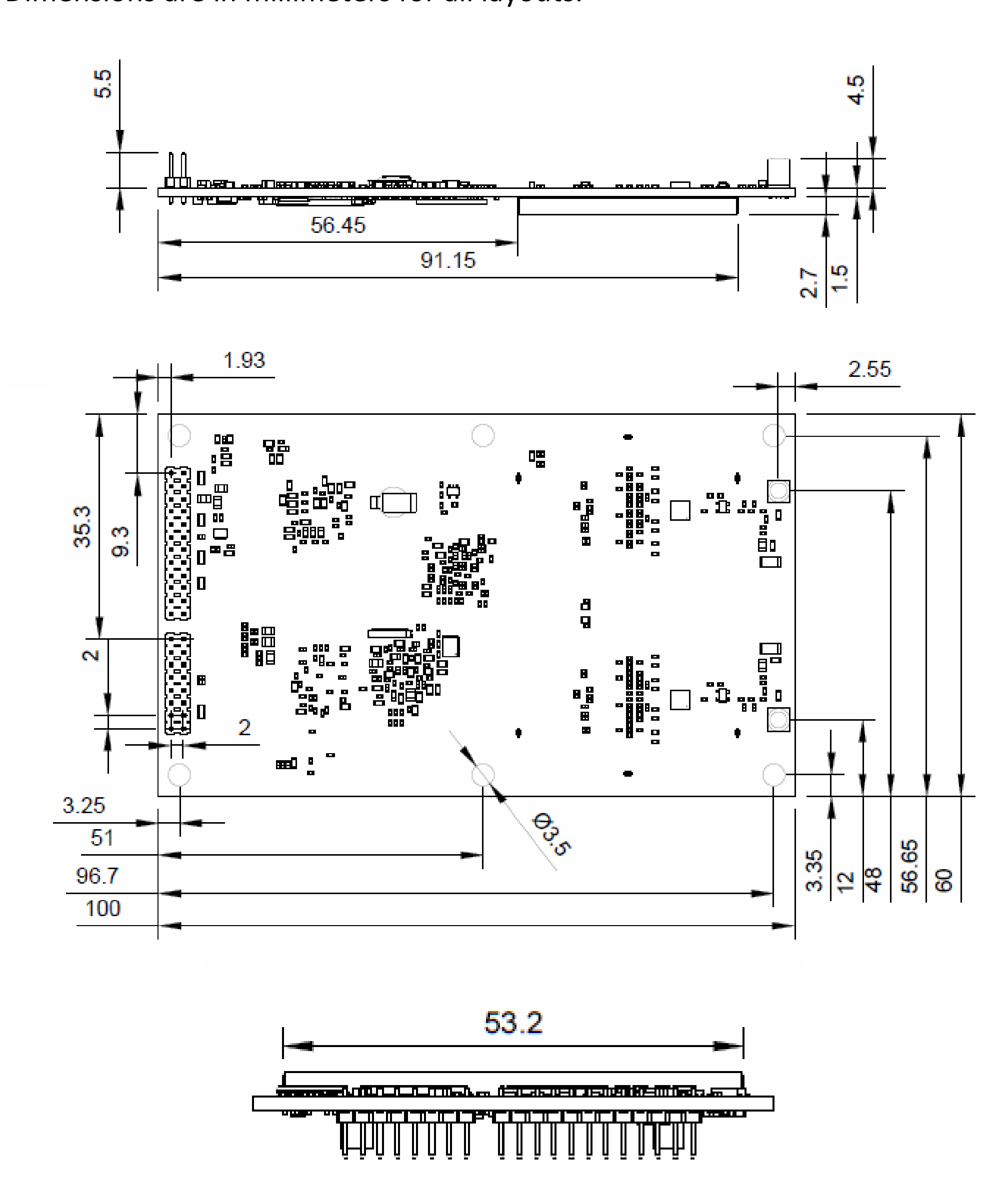

Figure 2-1: Vega 40 mechanical layout

Connectors

Vega 40 connectors

Table 2-1 lists the Vega 40 connectors and the mating connectors. You can use different compatible connectors; however, the requirements may be different. The antenna input impedance is 50 Ω.

Table 2-1: Vega 40 connectors

GNSS Board and Connector Type		Through-Hole Connector	Mating Connector
Vega 40	RF	MMCX, female straight jack Emerson (Johnson) 135-3701-211	MMCX, male straight plug
	Power / data	24-pin (12x2) male header, 0.0787 in (2 mm) pitch Samtec TMM-112-03-G-D	Board Mates: Samtec CLT, ESQT, MMS, SMM, SQT, SQW, TLE E.g.: Samtec TLE-112-01-G-DV-K Cable Mates: TCSD
	Power / data	16-pin (8x2) male header 0.0787 in (2 mm) pitch Samtec TMM-108-03-G-D	Board Mates: Samtec CLT, ESQT, MMS, SMM, SQT, SQW, TLE E.g.: Samtec TLE-108-01-G-DV-K Cable Mates: TCSD

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Vega 40 connectors, continued

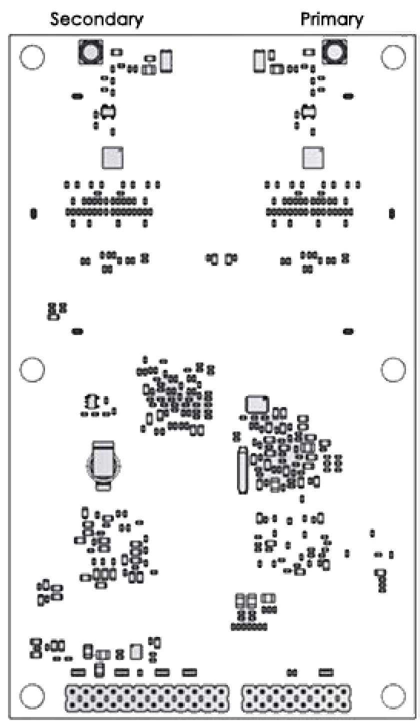


Figure 2-2: Vega 40 Mechanical drawing

Mounting Options

Overview

There are two options for mounting the Vega 40:

1. Direct Electrical Connection method
2. Indirect Electrical Connection (cable) method

Direct electrical connection

Place the RF connector, the header connector, and the mounting holes on the carrier board, and then mount the Vega 40 on the standoffs and RF and header connectors. This method is very cost effective because it eliminates cable assemblies to interface with the Vega 40.

> **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.

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 40 uses a standoff height of 7.93 mm (0.3125 in). With this height, there should be no washers between either the standoff and the Vega 40 or the standoff and the carrier board. You may need to change the standoff height if you select a different header connector.

There are two common methods to create a direct electrical connection:

1. Use a right angle MMCX connector. You must use a taller header than the Samtec part number suggested in this guide. This provides the clearance to for a right-angle cable-mount connector and eliminates the need for the carrier board to handle the RF signals.
2. Use the standard headers and create a PCB cutout for the antenna connector.

> **Note:** See Table 2-1 for Vega 40 connector information. The mounting holes of the Vega 40 have a standard inner diameter of 3.50 mm (0.138 in).

Continued on next page

Mounting Options, Continued

Indirect electrical connection (cable) method

The second method is to mount the Vega 40 mechanically, so you can connect a ribbon power/data cable to the Vega 40. This requires cable assemblies and there is a reliability factor present with cable assemblies in addition to increased expense.

Header Layouts and Pinouts

Overview

The Vega 40 uses a dual-row header connector to interface with power, communications, and other signals.

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 2-2). The pins are then sequentially numbered per row from top to bottom.

Figure 2-3 shows the Vega 40 24-pin header layout.

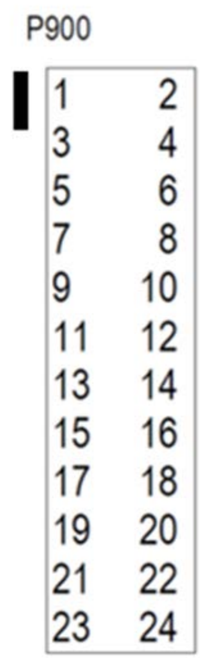


Figure 2-3: Vega 40 24-pin header layout

Continued on next page

Header Layouts and Pinouts, Continued

Vega 40 Header and 24-pin-out

The Vega 40 board has a 24-pin header. Table 2-2 provides the 24-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 2-2: Vega 40 24-Pin header pin-out

Pin	Signal Name	Signal Type	Signal Direction	Description
1	GND	Power	-	Ground reference
2	USER1	3.3V CMOS	Input/ Output	User GPIO Internal 10 kΩ pulldown.
3	VARF	3.3V CMOS	Output	Variable Frequency Output. Edges can be synchronized to the GNSS time reference. Internal 10 kΩ pullup
4	PPS	3.3V CMOS	Output	Pulse Per Second output. (1,2,5, or 10Hz programmable width, rising or falling edge) This signal defaults to one pulse per second but may be altered across a wide range of frequencies using software commands. Edges can be synchronized to GNSS time reference.
5	3.3V	Power	-	3.3 V ±5% supply input
6	3.3V	Power	-	3.3 V ±5% supply input

Continued on next page

Vega 40 Header and 24-pin-out, continued

Table 2-2: Vega 40 24-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
7	Port C (default) RX/ EVENT2	3.3V CMOS	Input	Dual use pin: Port-C (UART), Receive data input Event2 Manual Mark input: Rising or falling edge triggered. This input is used to provide a position or time data log based on an external trigger. Internal 10 kΩ pullup.
8	EVENT 1	3.3V CMOS	Input	Event1 Manual Mark input: Rising or falling edge triggered. This input is used to provide a position or time data log based on an external trigger. Internal 10 kΩ pullup.
9	ERROR	3.3V CMOS	Output	Error output Normally low. A high output on this pin indicates that the receiver is in an error state. Internal 10 kΩ pulldown.

Continued on next page

Vega 40 Header and 24-pin-out, continued

Table 2-2: Vega 40 24-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
10	PV	3.3V CMOS	Output	Position Valid output A high output on this pin indicates that the receiver has computed a valid GNSS position. Internal 10 kΩ pulldown.
11	Port B (default) CTS	3.3V CMOS	Input	Port B (UART), Clear to Send* input This is an optional flow control* signal for the Port B. Internal weak (40 kΩ to 100 kΩ) pullup.
12	RESET	3.3V CMOS	Input	Active Low. Resets the Phantom 40 receiver card. This pin must be held low for a minimum of 100 microseconds to guarantee operation. Internal 10 kΩ pullup.
13	Port B (default) RTS	3.3V CMOS	Output	Port B (UART), Request to Send*output. This is an optional flow control* signal for the Port B RTS.

Continued on next page

Vega 40 Header and 24-pin-out, continued

Table 2-2: Vega 40 24-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
14	Port B RX	3.3V CMOS	Input	Port B (UART), Receive data input. Internal weak (40 kΩ to 100 kΩ) pullup.
15	Port A (default)CTS / Port A RXD-	RS-232/RS-422*	Input	Dual use pin: Port A RS-232 CTS is the default. Clear to Send* input. This is an optional flow control* signal for the Port A CTS. Port A RXD- RS-422*. This is one half of the Port A RS-422* receive differential pair (2V differential typical).
16	Port B TX	3.3V CMOS	Output	Port B (UART), Data Transmit output
17	Port A (default)RTS / Port A TXD-	RS-232/RS-422*	Output	Dual use pin: Port A RTS RS-232 Request to Send* output. This is an optional flow control* signal for Port A. Port A TXD- RS-422. This is one half of the Port A RS-422 transmit differential pair. (2V differential typical)

Continued on next page

Header Layouts and Pinouts, Continued

Vega 40 Header and 24-pin-out continued

Table 2-2: Vega 40 24-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
18	Port A RX / Port A RXD+	RS-232/RS-422*	Input	Dual use pin: Port A RX is the default. Port A RX: Port A Receive Data input Port A RXD+: This is one half of the Port A RS-422* receive differential pair. (2V differential typical)
19	Port C TX / USER0	3.3V CMOS	Output/ Input	Dual use pin: Default: Port C TX (UART) Port C TX: Port C Transmit Data output. USER0: User GPIO. Internal 10 kΩ pulldown.
20	Port A TX / Port A TXD+	RS-232/RS-422*	Output	Dual use pin: Default: Port A TX Port A TX: Port A Transmit Data output. (±25V tolerant) Port A TXD+: This is one half of the Port A RS-422* transmit differential pair (2V differential typical)

Continued on next page

Vega 40 Header and 24-pin-out continued

Table 2-2: Vega 40 24-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
21	USB D-	Analog	Input/ Output	USB device signal. This is one half of a USB differential pair. USB_D+ and USB_D- must be length-matched and route as 90 Ω differential pair.
22	USB D+	Analog	Input/ Output	USB device signal. This is one half of the USB differential pair. USB_D+ and USB_D- must be length-matched and routed as a 90 Ω differential pair.
23	GND	Power	-	Ground reference
24	GND	Power	-	Ground reference

*Requires a future firmware update.

Continued on next page

Vega 40 Header and 16-pin out

The Vega 40 board has a 16-pin header. Figure 2-4 shows the Vega 40 16-pin header layout and Table 2-3 provides the Vega 40 16-pin header pin-out.

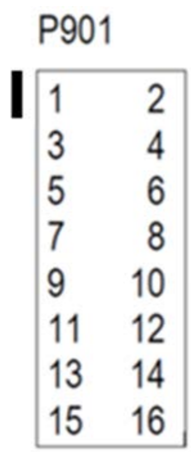


Figure 2-4: Vega 40 16-pin header layout

Continued on next page

Header Layouts and Pinouts, Continued

Vega 40 Header and 16-pin out, continued

Table 2-3: Vega 40 16-Pin header pin-out

Note: 3.3 V CMOS 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.

Pin	Signal Name	Signal Type	Signal Direction	Description
1	ENET RD-	Ethernet	Input	This is one half of the Ethernet receive differential pair (100 Ω pair).
2	ENET RD+	Ethernet	Input	This is one half of the Ethernet receive differential pair (100 Ω pair).
3	ENET BIAS	Ethernet	-	Center tap power for Ethernet magnetics.
4	ENET TD+	Ethernet	Output	This is one half of the Ethernet transmit differential pair (100 Ω pair).
5	ENET TD-	Ethernet	Output	This is one half of the Ethernet transmit differential pair (100 Ω pair).
6	ENET BIAS	Ethernet	-	Center tap power for Ethernet magnetics.
7	ENET LED	3.3V CMOS	Output	Activity/Link indicator output. Polarity of the indicator signal is low. When there is an active link, the pin is low. When there is activity on the link, the pin outputs a blink signal.

Continued on next page

Header Layouts and Pinouts, Continued

Vega 40 Header and 16-pin out, continued

Table 2-3: Vega 40 16-Pin header pin-out (continued)

Pin	Signal Name	Signal Type	Signal Direction	Description
8	USER2			Reserved for future use
9	GND	Power	-	Ground reference
10	CANA TX	3.3V CMOS	Output	CAN Port A Transmit data
11	CANA RX	3.3V CMOS	Input	CAN Port A Receive data
12	CANB TX	3.3V CMOS	Output	CAN Port B Transmit data
13	CANB RX	3.3V CMOS	Input	CAN Port B Receive data
14	USB ID	3.3V CMOS	Input	USB Port Mode USB-ID is read at boot to determine USB host or device. USB-ID high – Device mode USB-ID low – Host mode Leave this pin floating to ensure the USB port is in Device mode. Internal 10 kΩ pull up
15	USB VBUS	Power	-	5V output for USB Host Only devices
16	GND	Power	-	Ground reference

Signals

Overview

This section provides information on the signals available on the Vega 40 via connectors.

RF Input

The Vega 40 is designed to work with active GNSS antennas with an LNA gain range of 10 to 35 dB.

The purpose of the range is to accommodate for losses in the cable system. There is a maximum cable loss budget of 20 dB for a 35 dB gain antenna. Depending on the chosen antenna, the loss budget may be lower.

When designing the internal and external cable assemblies and choosing the RF connectors, do not exceed the loss budget.

Ports

Serial ports

The Vega 40 has three serial communication ports:

- **Port A-** RS-232/RS-422* Pin 18 (RX), input
  Pin 20 (TX), output Pin 15, input Pin 17, output
- **Port B-** 3.3V CMOS Pin 14 (RX), input
  Pin 16 (TX), output Pin 11, input Pin 13, output
- **Port C-** 3.3V CMOS
  Pin 7 (RX), input Pin 19 (TX), output

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

*RS-422 requires a future firmware update.

Continued on next page

Ports, Continued

USB ports

The Vega 40 USB port serves as a high-speed data communications port.

The Vega 40 USB data lines are bi-directional. The USB data lines should be laid out on a printed circuit board (PCB) as a differential pair with 90 Ω±15% differential impedance.

The traces should be over a solid continuous ground plane to maintain parallel traces and symmetry. There should 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. USB Transient Voltage Suppressors (TVS's) should be considered on D+ and D- for transient and electrostatic discharge protection.

Continued on next page

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.

To enable Ethernet support with a statically assigned IP address, use the command:
$JETHERNET,MODE,STATIC,ip,subnet,gateway,dns

Continued on next page

Enabling / disabling ethernet, continued

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 40 (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

Continued on next page

Enabling ethernet services

With Ethernet enabled, you can test sending an Internet Control Message Protocol (ICMP) ping to the Vega 40 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 40 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**

Chapter 3: Understanding the Vega 40 OEM Board

Overview

Introduction

This chapter provides information you need to better understand the Vega 40 OEM board and functions.

Contents

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

The Vega 40 supports 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 40 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 µs (microseconds)>,[SAVE]

Continued on next page

PPS timing signal, continued

The width command parameter is in µs (microseconds).

$JPPS,ACTIVE_EDGE,<RISE | FALL>,[SAVE]

Controls which edge of the PPS signal is synchronized to the GNSS second.

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, active low with falling edge synchronization. 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 is higher than 10 kΩ 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 40. These are not separate analog and digital grounds which require separate attention. Refer to Table 2-2 and Table 2-3 for pin-out ground information for the Vega 40.

Shielding

Shielding

The Vega 40 is a sensitive instrument. When integrated into an enclosure, the Vega 40 requires shielding from other electronics to ensure optimal operation.

The Vega 40 shield design consists of a thin piece of metal which prevents interference.

Receiver Mounting

Receiver mounting	The Vega 40 is a precision instrument. To ensure optimal operation, mount the receiver in a way to minimize vibration and shock. When mounting the Vega 40 immediately adjacent to the GPS antenna, Hemisphere GNSS highly recommends shielding the board from the low noise amplifiers (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.

Antenna Mounting

Antenna mounting	The Vega 40 is compatible with the following Hemisphere GNSS single and dual frequency antennas: • **Single frequency:** A21, A25, and A31 (beacon) • **Dual frequency:** A42, A43 (beacon), A45, and A52 When mounting the antennas consider mounting orientation (pitch or roll) and proper antenna placement.

Mounting Orientation

Mounting orientation	The Vega 40 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 angle calculated between the primary and secondary antenna is the pitch, send **$JATT,ROLL,NO, $JATT,NEGTILT,NO,** and **$JATT,HBIAS,0** to the receiver to tell the receiver the antennas are calculating pitch instead of roll (**$JATT,ROLL,NO**) and that a heading bias is not necessary. If the pitch is calculated from the secondary to the primary antenna, send **$JATT,ROLL,NO, $JATT,NEGTILT,YES,** and **$JATT,HBIAS,180** to the receiver to tell the receiver the antennas are calculating pitch. Pitch is calculated from the primary to the secondary antenna but needs to be calculated from the secondary to the primary antenna. Swap the sign of the angle with **$JATT,NEGTILT,YES**. Heading is calculated from the primary to secondary antenna, it will be out by 180 degrees. Therefore, send the **$JATT,HBIAS,180** command.

Continued on next page

Mounting Orientation, Continued

Roll orientation

If the angle calculated between the primary and secondary antenna is the roll, send **$JATT,ROLL,YES, $JATT,NEGTILT,NO,** and **$JATT,HBIAS,-90** to the receiver. This tells the receiver the antennas are calculating roll instead of pitch (**$JATT,ROLL,NO**).

When heading should be 0 degrees, the heading output will be 90 (since the antennas are calculating roll). Therefore, set the heading bias to -90 with the **$JATT,HBIAS,-90** command.

If the roll is calculated from the secondary to the primary antenna, send **$JATT,ROLL,YES, $JATT,NEGTILT,YES,** and **$JATT,HBIAS,90** to the receiver. This tells the receiver the antennas are calculating roll.

Roll is calculated from the primary to the secondary antenna. Swap the sign of the angle with the **$JATT,NEGTILT,YES** command.

Heading is also calculated from the primary to secondary antenna. Heading will show as 270 degrees when it should be 0. Add a heading bias of 90 with the **$JATT,HBIAS,90** command.

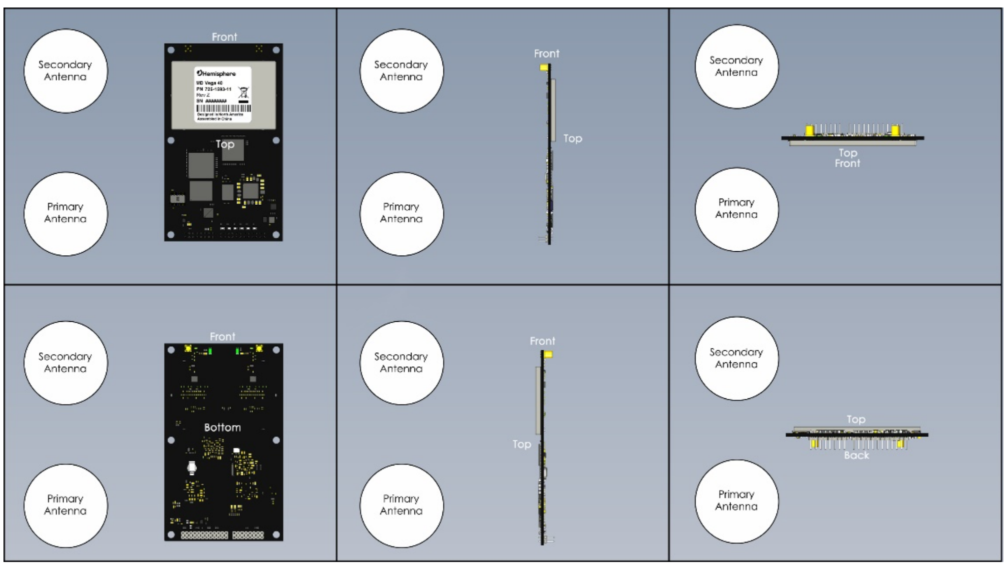
Note: Regardless of which mounting orientation you use, the Vega 40 provides the ability to output the heave of the machine via the **$GPHEV** message. For more information on this message refer to the HGNSS TRM.

Vega 40 Orientation and Sensor Calibration

Vega 40 orientation and sensor calibration

The Vega 40 can determine mounting orientation in 90-degree steps using integrated inertial sensors. This allows the receiver installation 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.



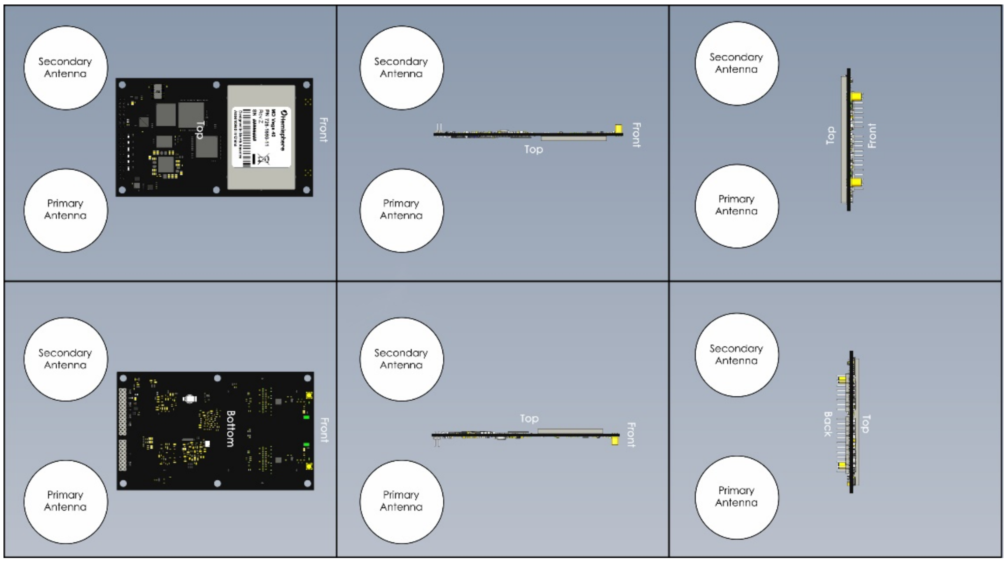
$JATT,ACC90,NO
$JATT,ACC180,NO

Figure 3-1: Group A

Continued on next page

Vega 40 Orientation and Sensor Calibration, Continued

Vega 40 orientation and sensor calibration, continued



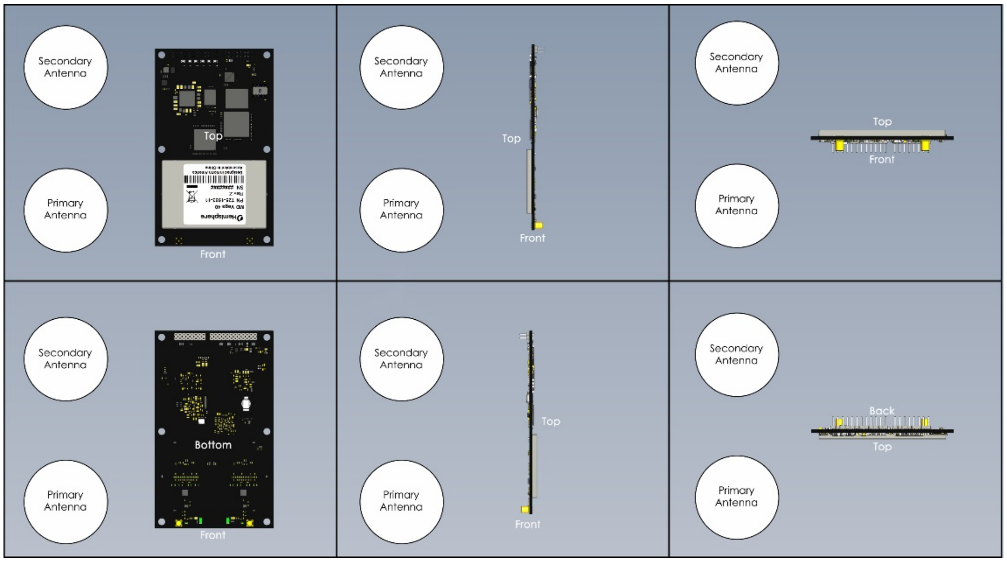
$JATT,ACC90,YES
$JATT,ACC180,NO

Figure 3-2: Group B

Continued on next page

Vega 40 Orientation and Sensor Calibration, Continued

Vega 40 orientation and sensor calibration, continued



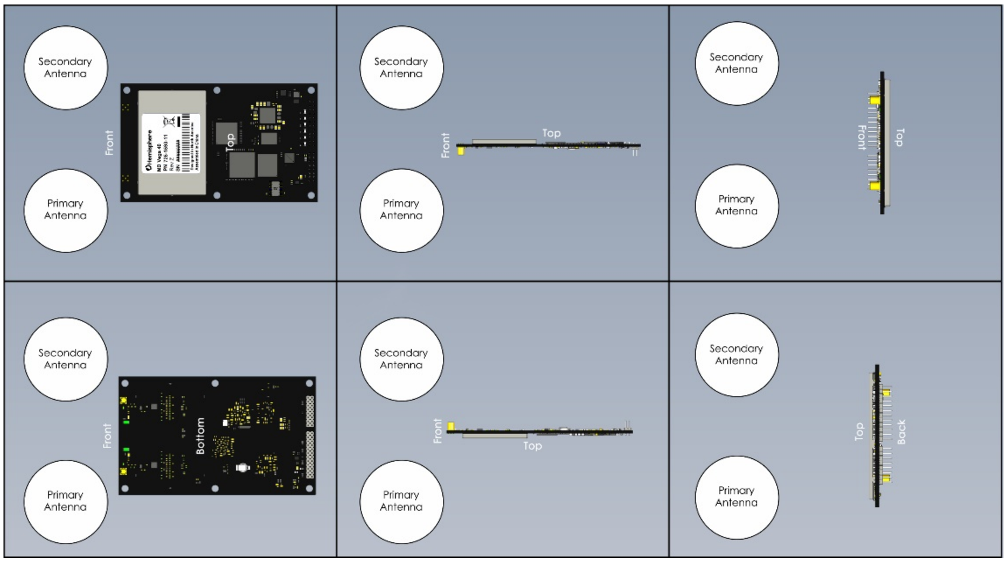
$JATT,ACC90,NO
$JATT,ACC180,YES

Figure 3-3: Group C

Continued on next page

Vega 40 Orientation and Sensor Calibration, Continued

Vega 40 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 radio frequencies as high as possible. For optimal performance, orient the antennas so the antennas' connectors face the same direction.

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

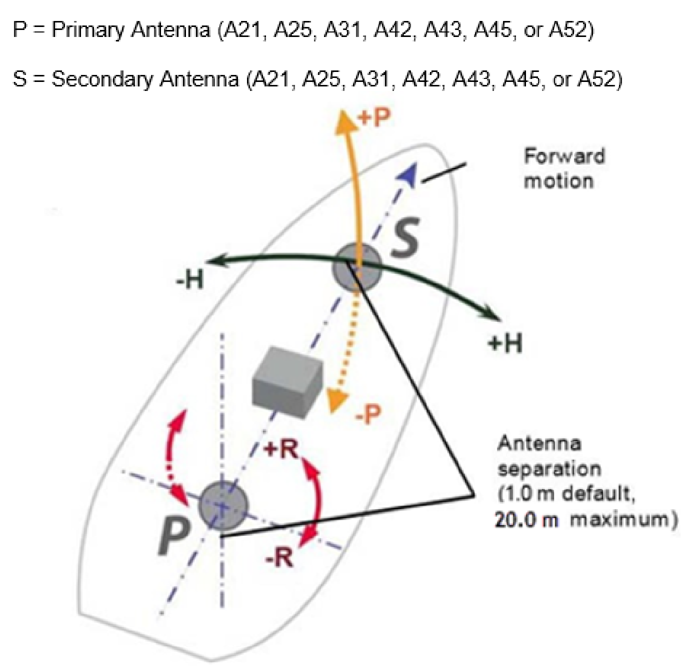


Figure 3-5: Recommended orientation and resulting signs of HPR values

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Planning the optimal antenna placement, continued

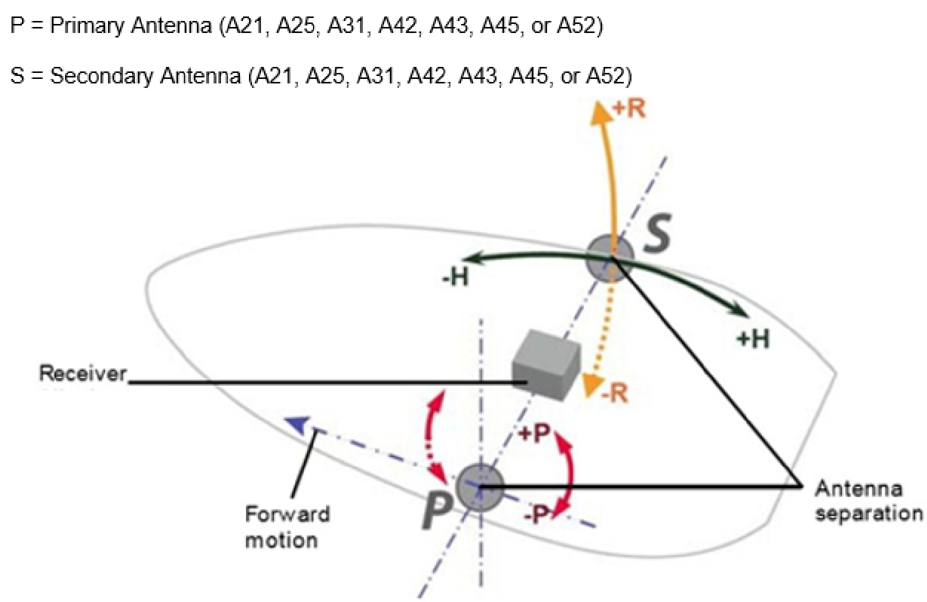


Figure 3-6: Alternate orientation and resulting signs of HPR values

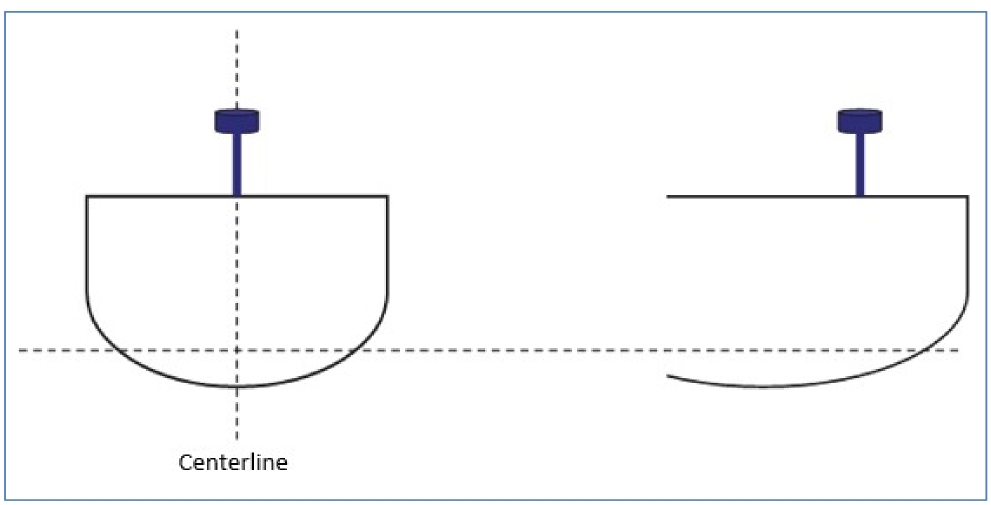


Figure 3-7: Antenna installation: cross-section of boat

Chapter 4: Operating the Vega 40 OEM Board

Overview

Introduction

This chapter provides Vega 40 operation information, such as communicating with the Vega 40, firmware, and configuration defaults.

Contents

Powering the Vega 40 On/Off

Powering the Vega 40	The Vega 40 is powered by a 3.3 VDC power source. After you connect appropriate power, the Vega 40 is active.

Communicating with the Vega 40

Communicating with the Vega 40	The Vega 40 features three serial ports (3.3V UART and RS-232/RS-422), USB, CAN, and Ethernet. 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 HGNSS TRM).

Configuring the Vega 40

Configuring the Vega 40

You can configure all aspects of Vega 40 operation through any serial port using proprietary commands. For information on these commands refer to the HGNSS 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.

For a complete list of commands and messages refer to the HGNSS TRM.

To issue commands to the Vega 40, connect to a terminal program or Hemisphere GNSS' software applications (SLXMon or PocketMax).

LED Indicators

Overview

The Vega 40 features the following surface-mounted diagnostic LEDs to indicate board status (see Figure 4-1).

LED Indicator	LED name	Color	Board Status
PWR	Power	Red	Power is on
PRI	Primary GNSS	Yellow	Primary GNSS lock • SteadyOn : GNSS-position Lock
SEC	Secondary GNSS	Yellow	Secondary GNSS lock • SteadyOn : Secondary Antenna tracking signals
DIFF	Differential Lock	Yellow	Differential Data input • Blinking : Receiving Differential • SteadyOn : Differential Lock
DGNSS	Differential Position	Green	Differential Solution Lock • Blinking : 2D-Differential Solution • SteadyOn : 3D-Differential Solution
HDG	Heading	Green	Heading • SteadyOn : Valid Heading Solution

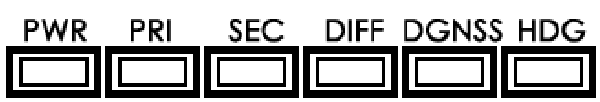


Figure 4-1: Onboard LEDs

Configuring the Data Message Output

Configuring the data message output	The Vega 40 features three primary bi-directional ports (Ports A, B, and C). You can configure messages for all ports by sending proprietary commands to the Vega 40 through any port. For a complete list of commands and messages refer to the HGNSS TRM.

'THIS' Port and the 'OTHER' Port

Overview	Both Port A and Port B use the phrases "THIS" and "OTHER" when referring to themselves and each other in NMEA messages.
'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>**

Continued on next page

‘OTHER’ port

The ‘OTHER’ port is either Port A or Port B, whichever port 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 Port C, you must specifically indicate you want the output on Port C.

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.

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

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

Saving the Vega 40 Configuration

Saving the Vega 40 configuration	Each time you change the Vega 40 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 40 using a terminal program or Hemisphere GNSS' applications (SLXMon or PocketMax). The Vega 40 takes approximately thirty seconds to save the configuration to non-volatile memory and indicates when the configuration has been saved. Refer to the HGNSS TRM.

Configuration Defaults

Configuration defaults

Below is the standard configuration for the Vega 40. For more information on these commands refer to the HGNSS TRM.

$JOFF,ALL
$JOFF,PORTA
$JOFF,PORTB
$JOFF,PORTC
$JOFF,PORTD

$JAGE,2700

$JLIMIT,10

$JMASK,5

$JNP,8

$JWAASPRN,AUTO

$JDIFF,WAAS
$JPOS,51.0,-114.0
$JSMOOTH,LONG
$JTAU,COG,0.00
$JTAU,SPEED,0.00
$JAIR,AUTO
$JALT,NEVER
$JFREQ,AUTO

Continued on next page

Configuration Defaults, Continued

Configuration defaults, continued

```
$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,NEGTILT,NO
$JATT,NMEAHE,0
$JATT,PBIAS,0.0
$JATT,PTAU,0.5
$JATT,ROLL,NO
$JATT,SPDTAU,0.0

$JASC,GPGGA,1,PORTA
$JASC,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 Vega 40 WebUI

Overview

The Vega 40 comes 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.

Note: There is no password required to log in to the Web UI.

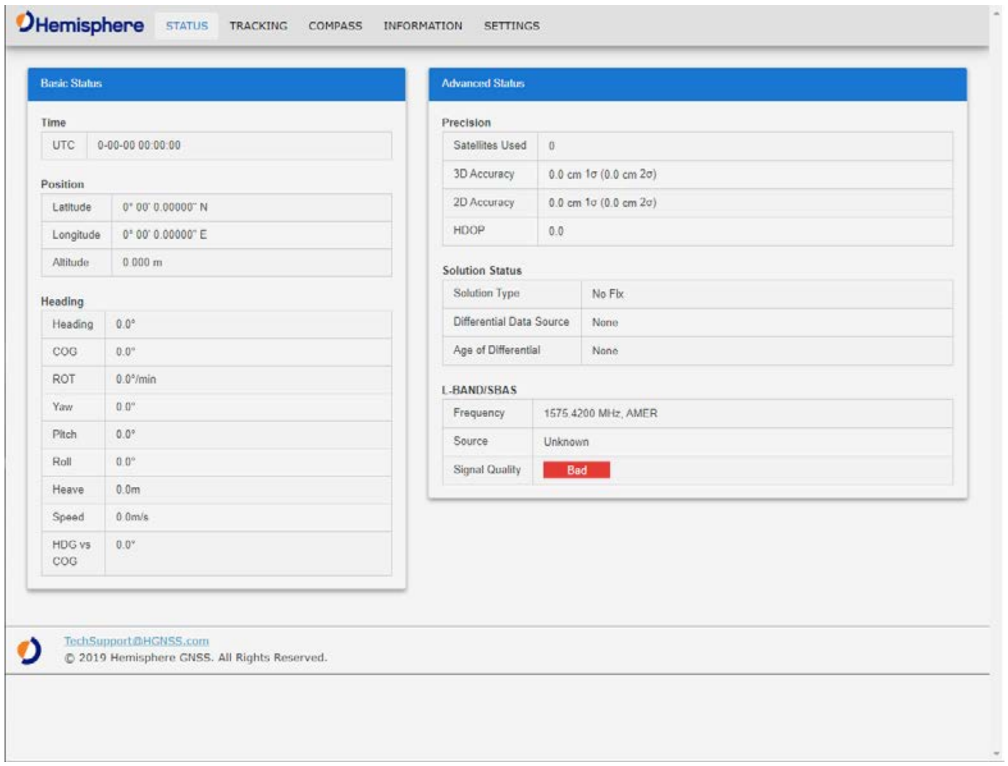
Open a web browser window and type the IP address reported in the **$JETHERNET** command.

Continued on next page

Using the Vega 40 WebUI, Continued

Overview, continued

The Vega 40 **Status** window displays. Click the tabs at the top of each screen to navigate throughout the WebUI.



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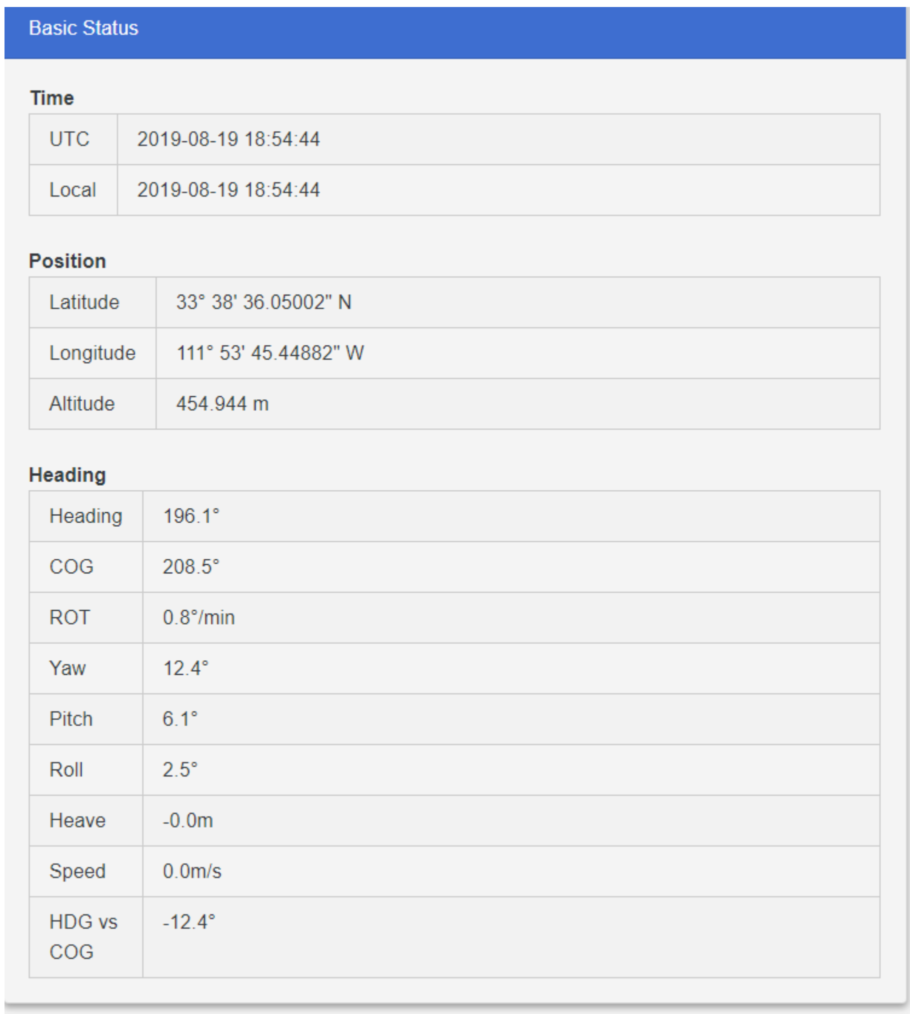
Using the Vega 40 WebUI, Continued

Status

The Status 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

Status , 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 1σ (1.3 cm 2σ)
2D Accuracy	0.4 cm 1σ (0.7 cm 2σ)
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

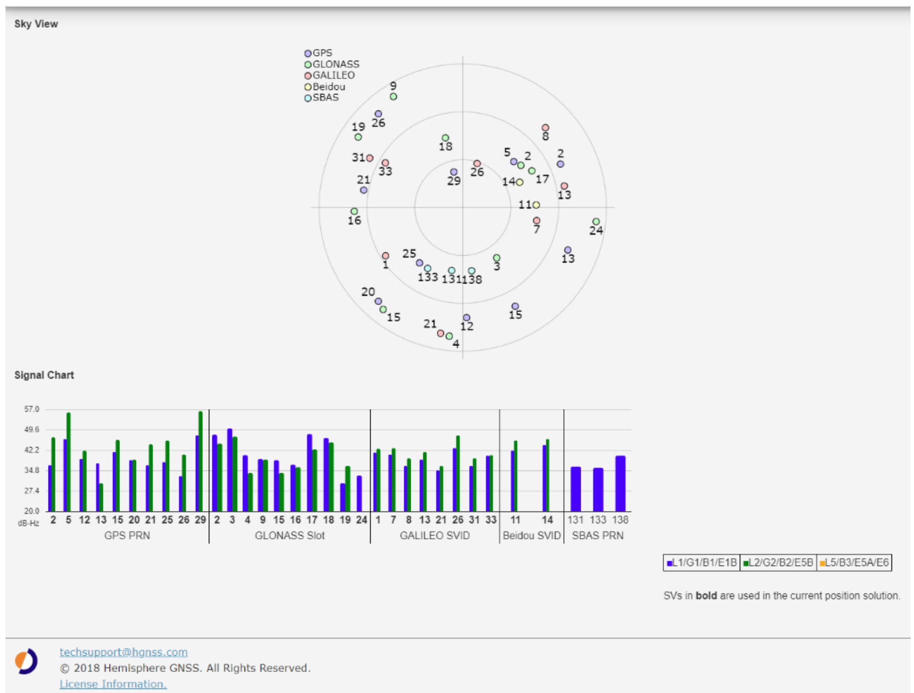
Continued on next page

Tracking

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

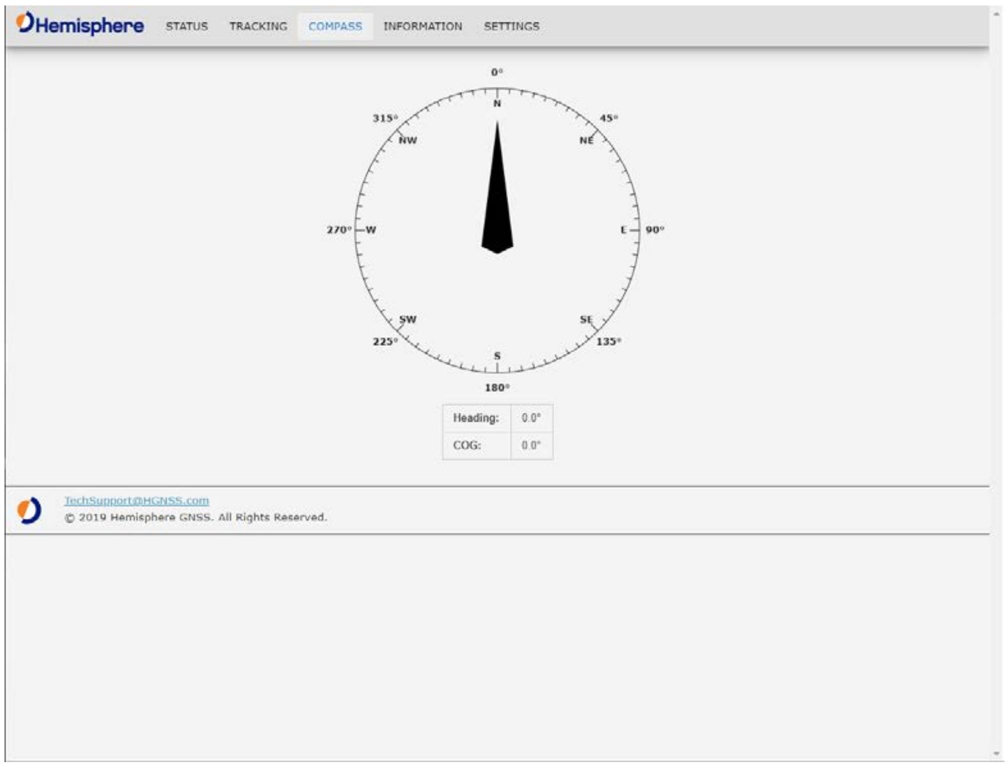
The Sky View plots the azimuth, elevation and SNR values of all tracked satellites (GPS, GLONASS, GALILEO, BeiDou, QZSS, and SBAS).

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



Continued on next page

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



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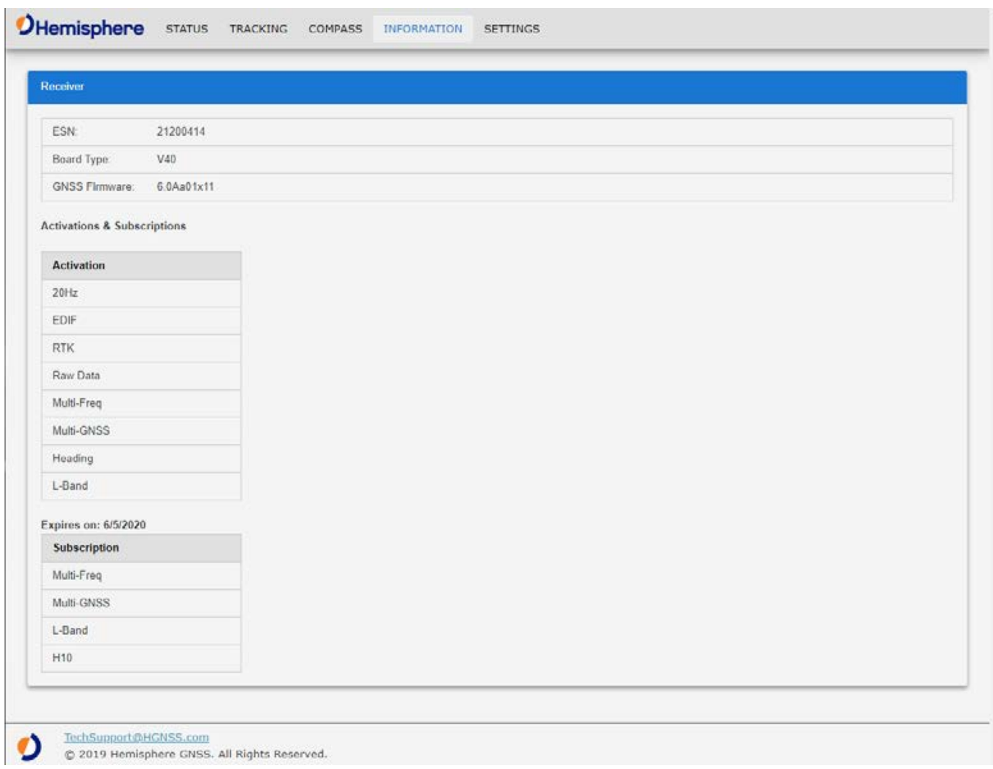
Using the Vega 40 WebUI, Continued

Information

The Information window displays the Vega 40 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**.



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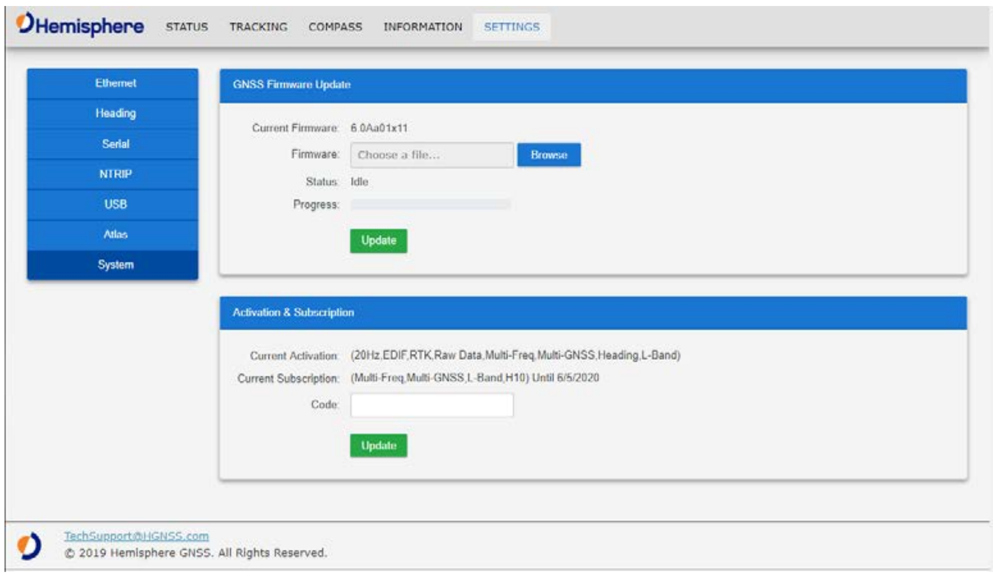
Using the Vega 40 WebUI, Continued

Settings

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



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Using the Vega 40 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.

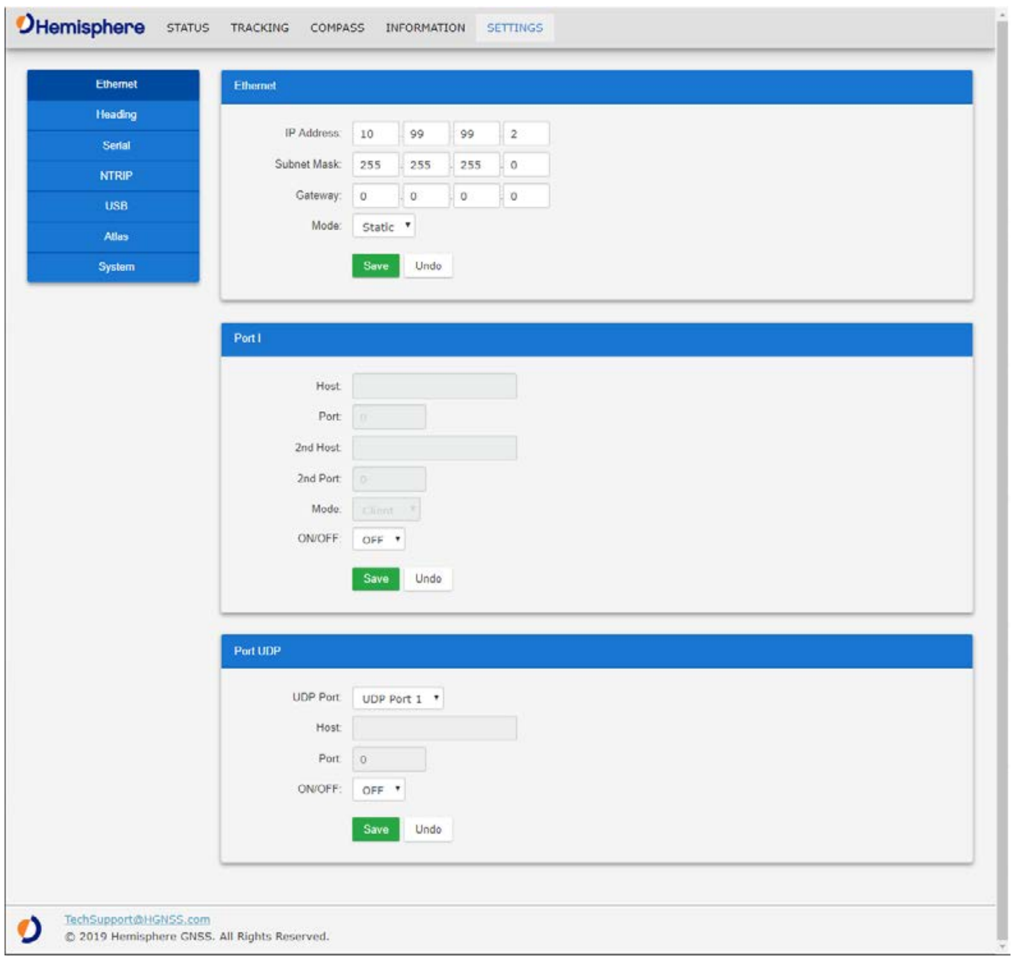
Port I is a TCP/IP port that can be used as either a **Server** mode or **Client** mode. When choosing **Client**, Port I is configured to act as a TCP client, which will connect out to the specified server on the specified port number. When Port I is set to **Server**, the receiver will act as a TCP 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 Vega 40 WebUI, Continued

Settings-Ethernet, continued

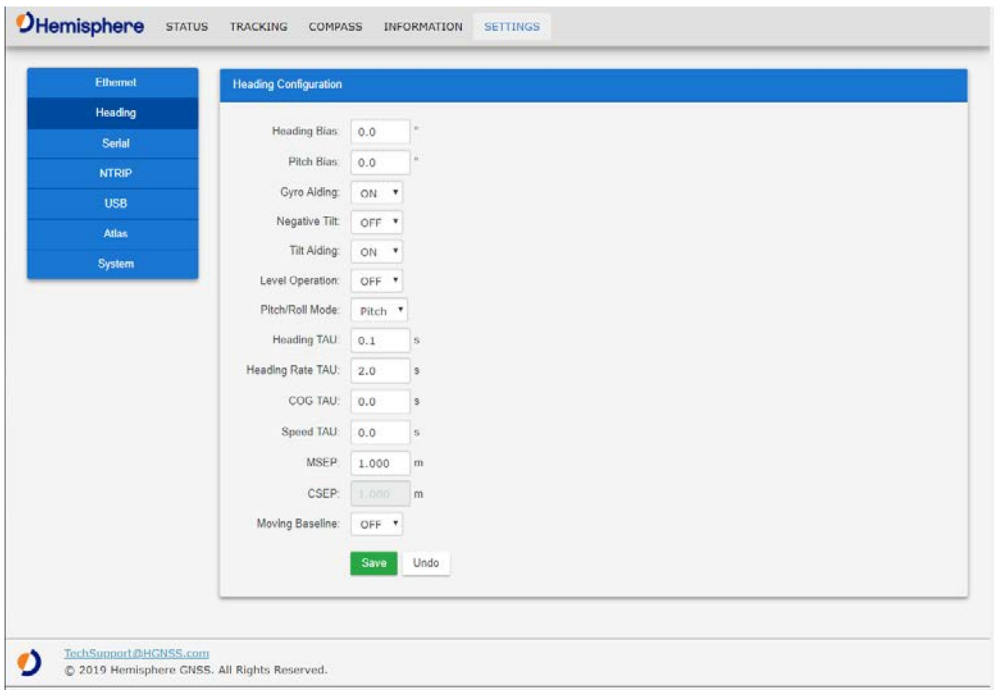
Using Port UDP (User Datagram Protocol) provides output of corrections or other messages to be sent in the form of raw UDP packets to a specified **host** and **port**. Individual messages will not be fragmented across UDP packets. The receiver will not respond to any replies via UDP.



Settings-Heading, continued

> **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.



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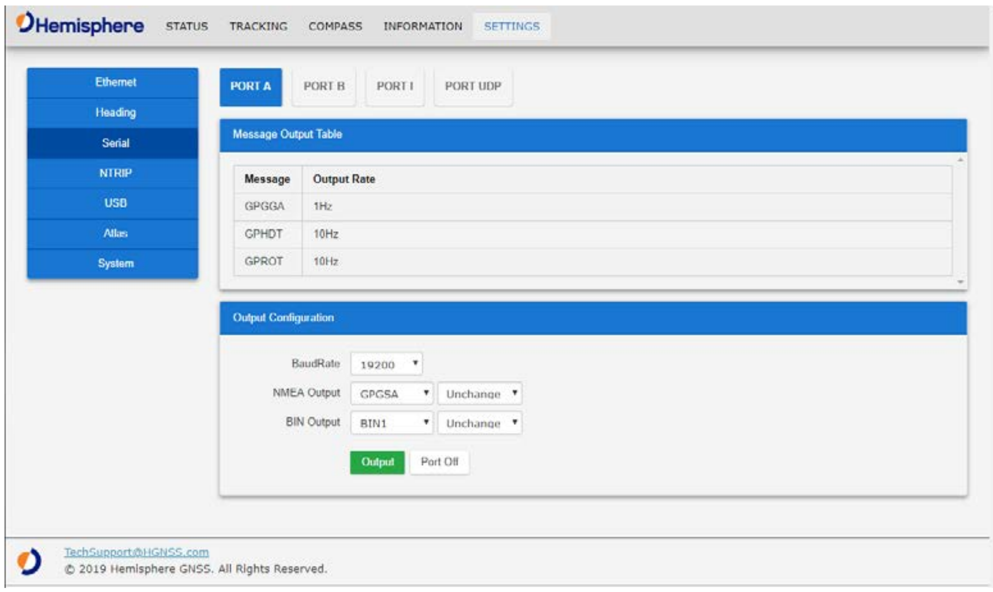
Settings, Serial

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



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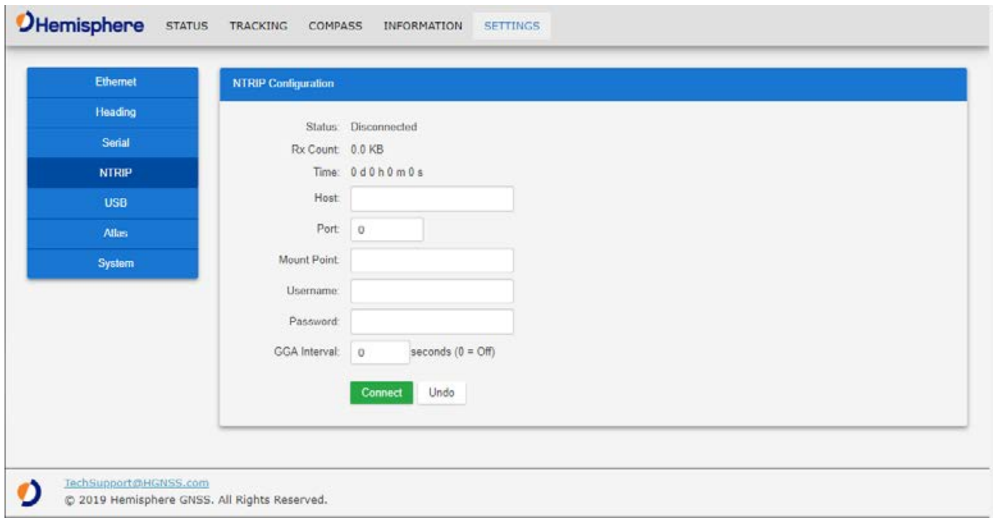
Settings, NTRIP

If your Vega 40 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.



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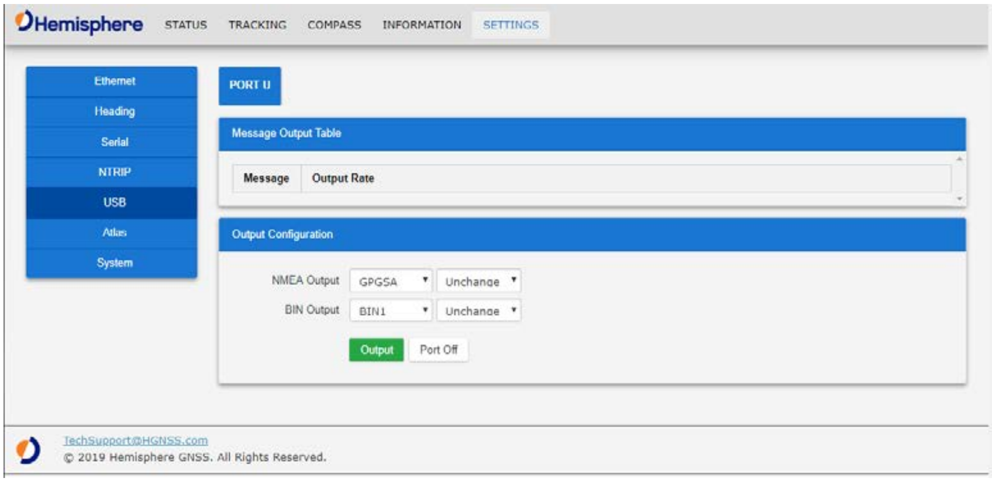
Settings, USB

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



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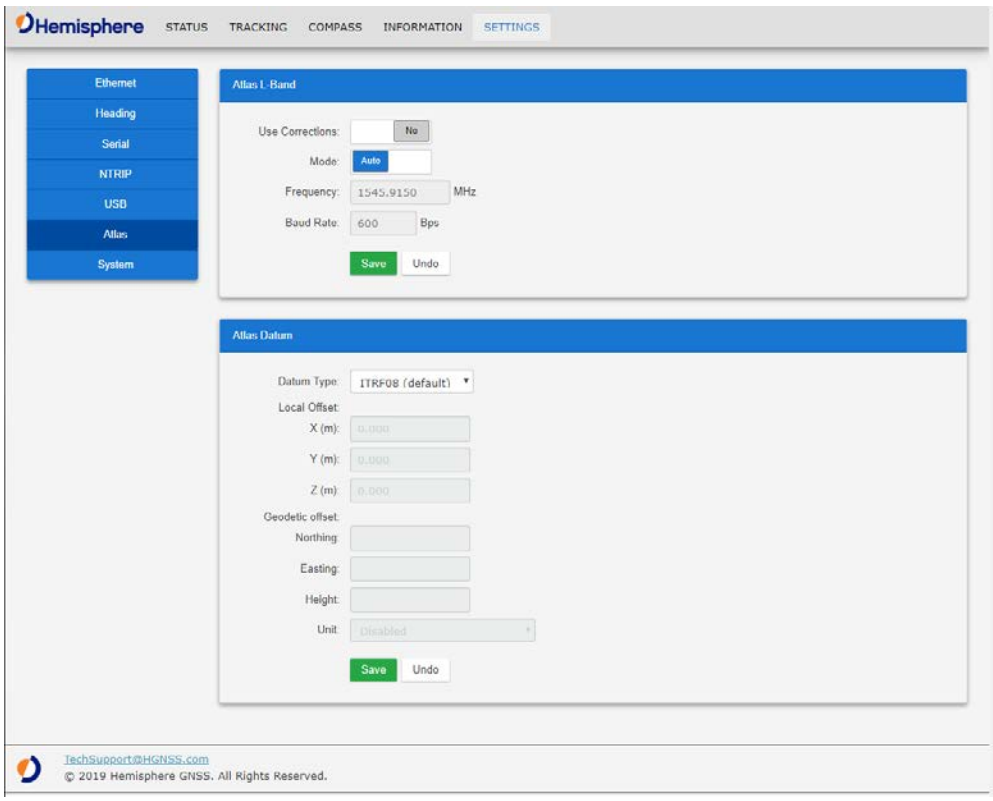
Settings, Atlas

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).



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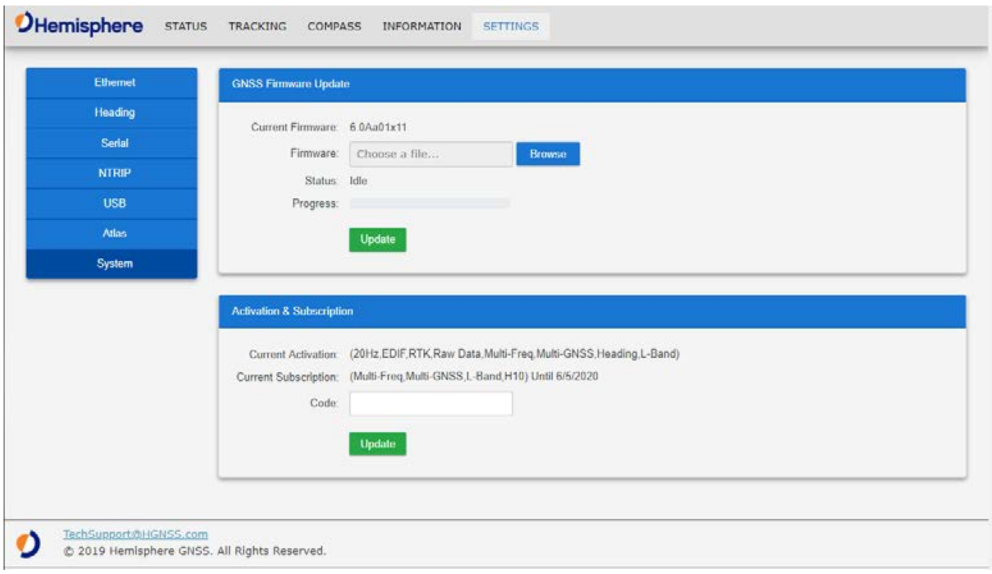
Using the Vega 40 WebUI, Continued

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 common questions when operating the Vega 40.

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

Contents

Troubleshooting

Vega 40 troubleshooting

Table A-1: Vega 40 Troubleshooting

Issue	Possible Solution
What is the first thing to check if I have a problem with the operation of the Vega 40?	Try to isolate the source of the problem. Problems are likely to fall within one of the following categories: • Power, communication and configuration • GPS reception and performance • SBAS reception and performance • External corrections • Installation • Shielding and isolating interference
• No data from the Vega 40 • No communication	• Check receiver power status (this may be done with a multimeter) • Check the LED power indicator to see if it is illuminated • Confirm communication with Vega 40 via Hemisphere query commands ▪ $JI ▪ $JSHOW • Verify that Vega 40 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

Vega 40 troubleshooting, continued

Table A-1: Vega 40 Troubleshooting (continued)

Issue	Possible Solution
Random binary data from the Vega 40	• Verify that the RTCM or Bin messages are not being accidentally output (send a **$JSHOW** command) • Verify that the baud rate settings of Vega 40 and remote device match • Check the serial grounding
No GNSS Lock	• 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	• 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).

Continued on next page

Troubleshooting, Continued

Vega 40 troubleshooting, continued

Table A-1: Vega 40 Troubleshooting (continued)

Issue	Possible Solution
No DGNSS or RTK	• Verify that the baud rate of the correction input port matches the baud rate of the external source. • Verify the pinout between the correction source and the correction input port (the "ground" pin and pinout must be connected, and from the "transmit" from the source must connect to the "receiver" of the correction input port). • Use the **$JDIFFX,INCLUDE** command to verify that RTCM2, RTCM3, CMR, or ROX (whichever one is applicable) is enabled.
Non-DGPS output	• Verify Vega 40 SBAS and lock status (or external source is locked). • Confirm baud rates match an external source correctly. • Issue a **$JDIFF** command and see if the expected differential mode is the current mode.

Continued on next page

Vega 40 troubleshooting, continued

Table A-1: Vega 40 Troubleshooting (continued)

Issue	Possible Solution
No heading or incorrect heading values	• Ensure the antennas are connected to the proper ports: J1000 and J2000 are for the primary and secondary antennas. • Heading is from primary to secondary antenna, so the secondary antenna should be toward the bow and primary toward the stern. • Check the measurement of the antenna separation. • The Measured (MSEP) and Calculated (CSEP) values are in meters and should agree to within 1 cm. CSEP continuously changes, so average this reading over several minutes to obtain an approximate value. • Check CSEP value is fairly constant without varying more than 1 cm. Larger variations may indicate a high multipath environment and require moving the antenna locations. • Reduce antenna separation - Hemisphere GNSS recommends the separation between the antennas remain below 5 m for accurate and timely heading reading output. • Verify a valid activation/subscription to ensure capability issue **$JK,SHOW** command. • **$JATT,SEARCH** command forces the Vega 40 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 40 GNSS Compass board technical specifications.

Contents

Vega 40 Technical Specifications

Vega 40 specifications

Tables B1-B6 provide the technical specifications for the Vega 40 GNSS board.

Vega 40 sensor specifications

Table B-1: Vega 40 Sensor 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/B10C/B2A/B2B/ACEBOC **GALILEO** E1BC/E5a/E5b/E5-AltBOC/E6BC **QZSS** L1CA/L1C/L2C/L5/LEX(L6D and L6E) **NavIC** (IRNSS)* L5 Atlas
Channels	1100+
GPS sensitivity	-142 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, 1 Hz or 20 Hz optional (with activation)
Timing (1 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 kph (999 kts)
Maximum Altitude	18,288 m (60,000 ft)

*NavIC (IRNSS) will be available with a future firmware update.

Continued on next page

Vega 40 Technical Specifications, Continued

Vega 40 sensor specifications, continued

Table B-1: Vega 40 Sensor specifications (continued)

Item	Specification		
Positioning		**RMS (67%)**	**2DMRS (95%)**
	Autonomous, no SA: 1	1.2m	2.5m
	SBAS[1]	0.3m	0.6m
	Atlas H10 [1, 2]	0.04m	0.08m
	Atlas H30 [1, 2]	0.15m	0.3m
	Atlas Basic [1, 2]	0.50m	1.0m
	RTK[1]	8 mm + 1 ppm	15 mm + 2 ppm
Heading (RMS)	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 40 Technical Specifications, Continued

L-band receiver Specifications

Table B-2: L-band Receiver specifications

Item	Specification
Receiver Type	Single Channel
Channels	1525 to 1560 MHz
Sensitivity	-130 dBm
Channel Spacing	5.0 kHz
Satellite Selection	Manual and Automatic
Reacquisition Time	15 seconds (typical)

Vega 40 communication specifications

Table B-3: Vega 40 Communication specifications

Item	Specification
Ports	3 x full duplex (2 x 3.3V CMOS, 1 x RS-232/RS-422*) 1 x USB Host/Device 1 x Ethernet 10/100Mbps 2 x CAN (NMEA 2000, ISO 11783)
Interface Level	3.3V CMOS
Baud Rates	4800 - 460,800
Correction I/O Protocol	Hemisphere GNSS proprietary ROX format, RTCM v2.3, RTCM v3.2, CMR[3], CMR+[3]
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, active low, falling edge sync

*RS-422 requires a future firmware update.
**Active High, VIH (MIN) 2.1V, Active Low, VIL (MAX) 0.7V

Continued on next page

Vega 40 Technical Specifications, Continued

Vega 40 power specifications

Table B-4: Vega 40 Power specifications

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

Continued on next page

Vega 40 Technical Specifications, Continued

Vega 40 environmental specifications

Table B-5: Vega 40 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 40 mechanical specifications

Table B-6: Vega 40 Mechanical specifications

Item	Specification
Dimensions	100 L x 60 W x 10 H (mm) 3.9 L x 2.4 W x 0.4 (in)
Weight	44 g (1.56 oz)
Status indication (LED)	Power, Primary and Secondary GNSS lock, Differential lock, DGNSS position, Heading
Power/Data connector	24-pin male header, 2 mm pitch 16-pin male header, 2 mm pitch
Antenna connector	MMCX, female, straight

Continued on next page

Vega 40 Technical Specifications, Continued

Vega 40 aiding devices

Table B-7: Vega 40 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 multi-path environment, number of satellites in view, satellite geometry, and ionospheric activity
[2] Hemisphere GNSS proprietary

Appendix C: Frequently Asked Questions (FAQ)

Contents

Appendix C: Frequently Asked Questions (FAQ)

Integration

The following is a list of common questions and solutions when integrating the Vega 40 OEM board.

Question	Solution
Do I need to use the 1 PPS and event marker?	No, these are not necessary for Vega 40 operation.
What should I do with the 1 PPS signal if I do not want to use it?	Do not connect.
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. For using ERROR and PVALID pins as indicators, these pins will be active high.
Do I need to use a shield-can for the Vega 40?	Not necessarily, but you may need to if there are RF interference issues, such as if the Vega 40 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 likely needed. Hemisphere GNSS recommends you always conduct an RF pre- scan when integrating OEM boards.

Continued on next page

Appendix C: Frequently Asked Questions (FAQ), Continued

Integration, continued

Question	Solution
If my company wishes to integrate this product, what type of engineering resources will I need to do this successfully?	Hemisphere GNSS recommends you have sufficient engineering resources with the appropriate skills in and understanding of the following: • Electronic design (including power supplies and level translation) • RF implications of working with GPS equipment • Circuit design and layout • Mechanical design and layout

Continued on next page

Appendix C: Frequently Asked Questions (FAQ), Continued

Support and repair

Question	Solution
How do I solve a problem I cannot isolate?	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. 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.

Continued on next page

Power, communication, and configuration

Question	Solution
My Vega 40 system does not appear to be communicating.	This could be one of a few issues: • Examine the Vega 40 cables and connectors for signs of damage or offset. • Ensure the Vega 40 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 40 is connected to the receive line of the other device. Also, ensure the signal grounds are connected. • If the Vega 40 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 40 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

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 40 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 40?	The **$JSHOW** command will request the configuration information from the Vega 40. The response will be similar to: **$>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

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 40 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 40 and configure it?	Hemisphere GNSS uses different software applications: • 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 Windows 95 or higher. • 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.

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Appendix C: Frequently Asked Questions (FAQ), Continued

GNSS reception and performance

Question	Solution
How do I know what the Vega 40 is doing?	The Vega 40 supports standard NMEA data messages. The **$GPGSV** and **Bin99** data messages contain satellite tracking and SNR information. The Vega 40 has surface-mounted status LEDs that indicate receiver status.
Do I have to be careful when using the Vega 40 to ensure it tracks properly?	For best performance, the Vega 40 antenna must have a clear view of the sky for satellite tracking. The Vega 40 can tolerate a certain amount of signal blockage because redundant satellites are often available. Only four satellites are required for a position; however, the more satellites are used, the greater the positioning accuracy and stability.
How do I know if the Vega 40 has acquired an SBAS signal?	The Vega 40 outputs the **$GPGGA** message as the main positioning data message. This message contains a quality fix value that 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. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.

Continued on next page

SBAS reception and performance

Question	Solution
How do I know if the Vega 40 is offering a differentially corrected or RTK- corrected position?	The Vega 40 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. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.
How do I select an SBAS satellite?	By default, the Vega 40 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. You can manually select which SBAS satellites to track (not recommended). Refer to the HGNSS TRM Manual.
Do I need a dual frequency antenna for SBAS?	Hemisphere GNSS recommends using a dual frequency antenna with the Vega 40. While some receiver function is possible with an L1-only antenna, full receiver performance will only be realized with a dual frequency antenna.

Continued on next page

External corrections

Question	Solution
My Vega 40 system does not appear to be using DGPS or RTK corrections from an external correction source. What could be the problem?	This could be due to several factors. To isolate the issue: • 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 40 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 40's serial port and the signal grounds are connected. • Make sure the Vega 40 has been set to receive external corrections by issuing the **$JDIFF** command. Refer to the HGNSS TRM.

Continued on next page

Installation

Question	Solution
How will the antenna selection and mounting affect Vega 40 performance?	For best results select a multipath-resistant antenna. Ensure the antenna tracks all the available signals for the receiver. Mount the antenna with the best possible view of the sky and in a location with the lowest possible multipath. Using a magnetic mount for the antenna will not affect performance. If you are using an antenna from another manufacturer, be mindful all specifications provided in this manual are based off Hemisphere GNSS antennas, and the results may vary with if you are using an antenna from another manufacturer.

Continued on next page

Appendix C: Frequently Asked Questions (FAQ), Continued

Installation, continued

Question	Solution
I could not install my antennas at the same height. How do I calibrate for the height offset?	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. To calibrate the pitch/roll reading, send the following command: **$JATT,PBIAS,x<CR><LF>** where x is a bias (in degrees) which will be added to the pitch/roll measurement. The acceptable pitch bias range is -15.0º to 15.0º (default is 0.0º). To determine the current pitch compensation angle, send the following command: **$JATT,PBIAS<CR><LF>** The pitch/roll bias is added after the negation of the pitch/roll measurement (if so, invoked with the **$JATT,NEGTILT** command).

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End User license agreement

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End User license agreement, continued

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End User license agreement, continued

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21. **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.
22. **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.
23. **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.
24. **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.
25. **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.
26. **CISG.** The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement or any transaction hereunder.

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Warranty Notice

Warranty notice

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Warranty notice, continued

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