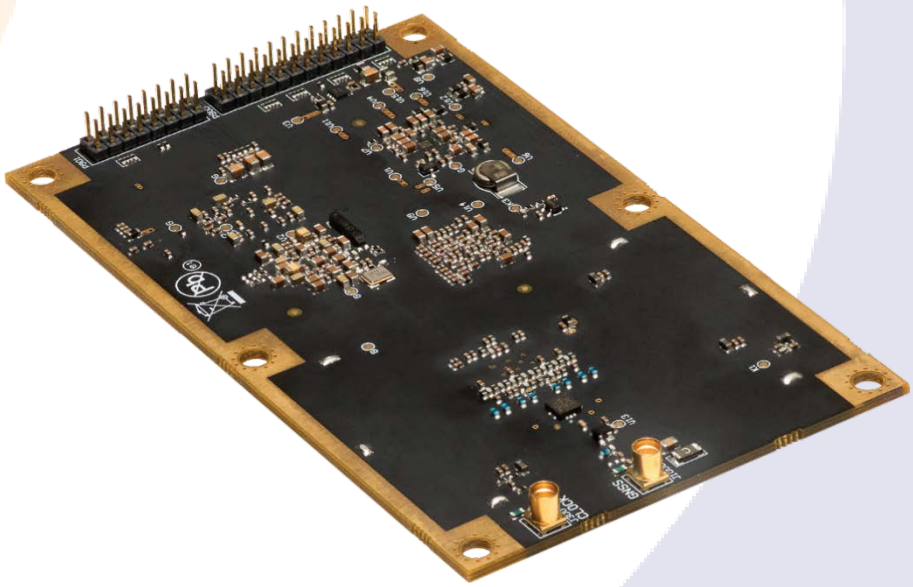
Hemisphere®



875-0421-10

Phantom™ 40 GNSS OEM Board

Integrator Guide
Revision: A3
October 22, 2020

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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6539303	7292185	7689354	8138970
6549091	7292186	7808428	8140223
6711501	7373231	7835832	8174437
6744404	7388539	7885745	8184050
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8214111	8217833	8265826	8271194
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Australia Patents	
2002244539	2002325645
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Continued on next page

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

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Phantom 40 Terms & Definitions

Introduction

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

Phantom 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
dB	Decibel. The unit of measurement used to express signal-to-noise ratio (SNR).
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

Phantom 40 Terms & Definitions, Continued

Phantom 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.
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
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. 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 once per second and is used for hardware synchronization.
QZSS	Quasi-Zenith Satellite System (QZSS) is a regional satellite navigation system deployed and maintained by Japan.
RF	Radio Frequency

Continued on next page

Phantom 40 Terms & Definitions, Continued

Phantom 40 terms & definitions, continued

Term	Definition
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
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 Phantom 40 GNSS OEM Board with your positioning product. You can download this manual from the Hemisphere GNSS website at WWW.HGNSS.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 Phantom 40 is Hemisphere's most advanced GNSS positioning board. Phantom 40 leverages full performance and fast RTK initialization times over long distances with multi-frequency, multi-constellation GNSS signals.

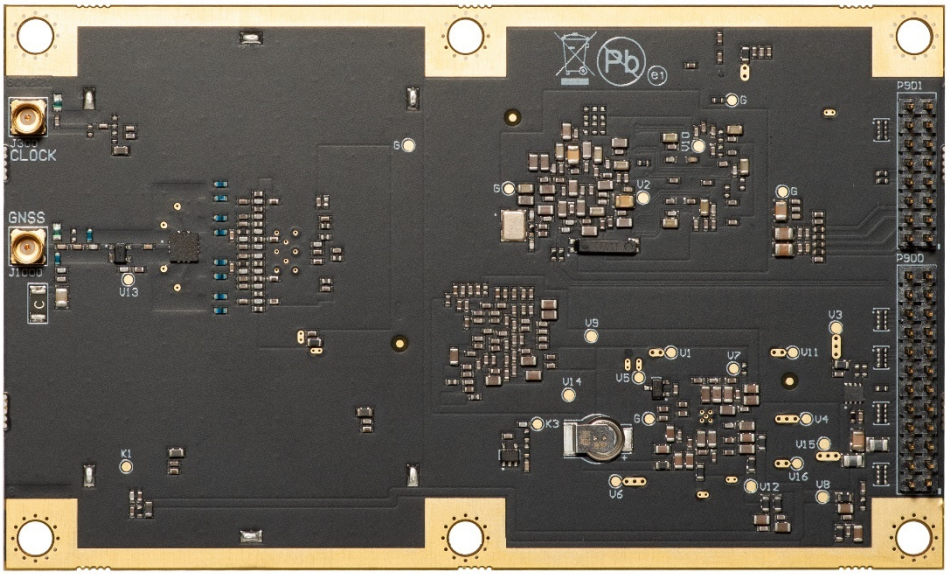

Figure 1-1: Phantom 40 GNSS OEM Board

The Phantom 40 is an accurate and reliable OEM module with two advanced technology features and aRTK™. Hemisphere's aRTK technology, powered by Atlas®, allows the Phantom 40 to operate with RTK accuracies when RTK corrections fail. Tracer uses specialized algorithms to sustain positioning in the absence of correction data.

Continued on next page

Product overview, continued

The Phantom 40 uses centimeter-level accuracy in either single frequency mode or employs the full performance and fast RTK initialization times over long distances with multi-frequency, multi-constellation GNSS signals.

The Phantom 40's high-accuracy L-band positioning from meter to sub-decimeter levels is available via the HGNSS Atlas GNSS correction service.

For information on these subjects refer to the HGNSS TRM.

Key Features

Phantom 40 key features

The Phantom 40 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 Phantom 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 reliable positioning performance of Phantom 40 is enhanced by Athena™ RTK, Atlas corrections and aRTK technology.

With the Phantom 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.

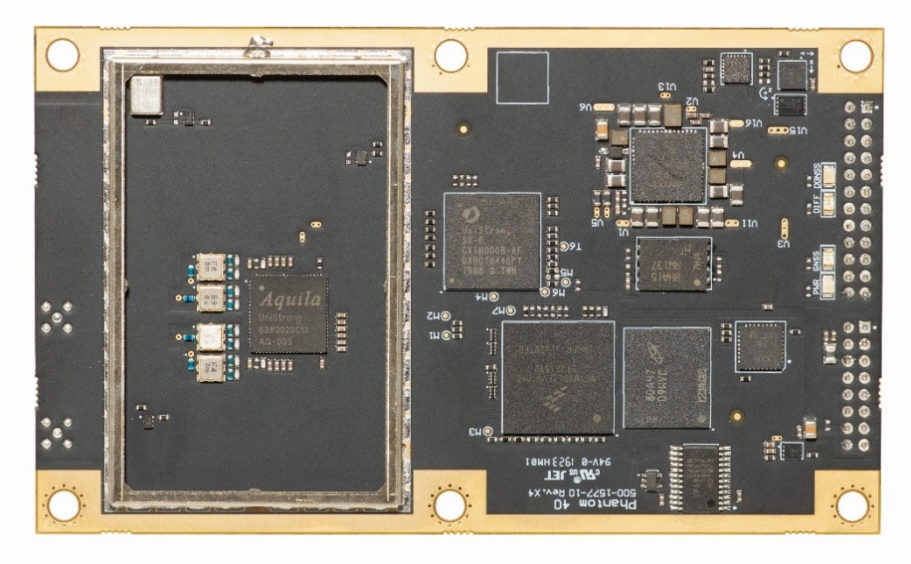

Figure 1-2: Phantom 40 GNSS OEM Board

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Key Features, Continued

Phantom 40 key features

Key features of the Phantom 40 include:

• Multi-Frequency GPS, GLONASS, BeiDou, Galileo, and QZSS	• Mechanically and electrically (pin-for-pin) compatible with many other manufacturers' modules
• Long-range RTK baselines up to 50 km with fast acquisition times	• Atlas® L-band capable to 4 cm RMS
• Compatible with many RTK sources including Hemisphere GNSS' ROX format, RTCM, CMR, CMR+	• Athena™ GNSS engine providing best-in-class RTK performance
• Serial, USB, Ethernet, and CAN connectivity	

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

What's Included in Your Kit

Kit contents

The Phantom 40 board is available in two configurations:

- Phantom 40 OEM board only - designed for integrators who are familiar with Hemisphere board integration (P/N 725-1592-10).
- Phantom 40 OEM board and Phantom 40 adapter board (by request only P/N 725-1521-0).

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

Firmware

Firmware

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

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

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

Using PocketMax™ to Communicate with the Phantom 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 Phantom 40 via the COM port and open PocketMax.

The screens within PocketMax allow you to easily interface with the Phantom 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 Phantom 40 status and function

PocketMax is available for download from the Hemisphere GNSS website (HTTPS://WWW.HEMISPHEREGNSS.COM/FIRMWARE-SOFTWARE/).

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 Phantom 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 Phantom 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 Phantom 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.

Phantom 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 your Phantom 40 OEM Board

Overview

Introduction

This chapter provides instructions on how to integrate your Phantom 40 board with your positioning product.

Contents

Phantom 40 Integration

Overview

Successful integration of the Phantom 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

Phantom 40 integration requirements

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

- Regulated power supply input (3.3 VDC ± 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)
- The Phantom 40 supplies 5V for the antenna (no separate source is required)
- Antenna input impedance is 50 Ω

Message interface

The Phantom 40 can be configured (message output and receiver configuration) over serial (3.3V UART), USB, 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 as well as 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

Phantom 40 mechanical layout

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

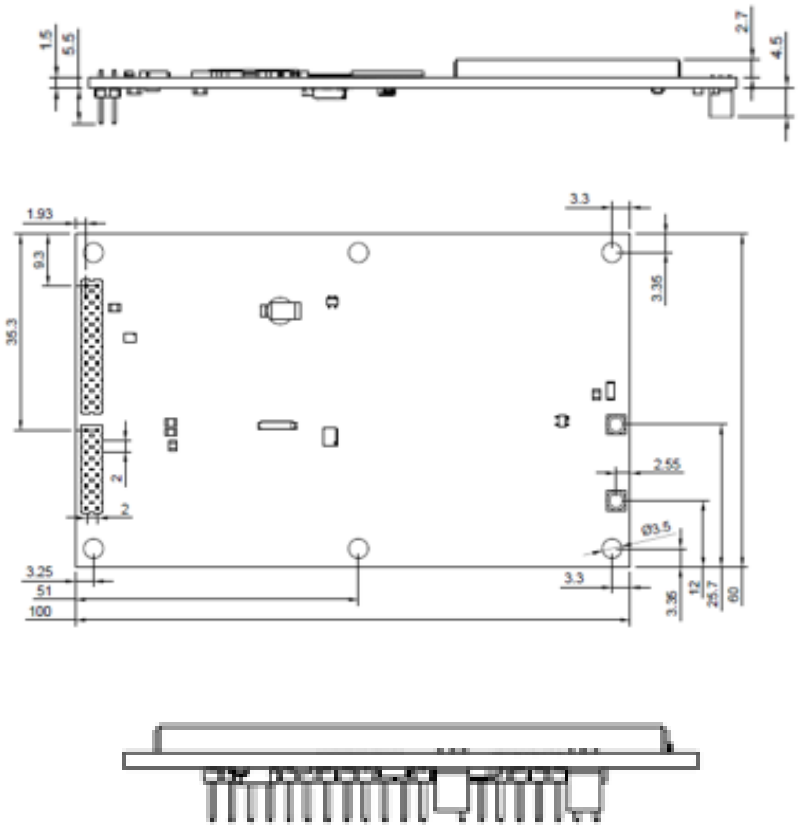

Figure 2-1: Phantom 40 mechanical layout

Connectors

Phantom 40 connectors

Table 2-1 lists the Phantom 40 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: Phantom 40 connectors

Eclipse™ Board and Connector Type		SMT Connector	Mating Connector
Phantom 40	RF	MMCX, female straight jack Emerson (Johnson) 133-3711-202	MMCX, male straight plug Samtec RSP-127824-01
	Power / data	24-pin (12x2) male header 0.078 in (2 mm) pitch Samtec TMM-112-03- T-D	Board Mates: CLT, ESQT, MMS, SMM, SQT, SQW, TLE Cable Mates: TCSD
	Power /data	16-pin (8x2) male header, 0.078 in (2 mm) pitch Samtec TMM-108-03- G-D	Board Mates: Samtec CLT, ESQT, MMS, SMM, SQT, SQW, TLE Eg: Samtec TLE-108-01-G-DV-K Cable Mates: TCSD

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Phantom 40 connectors, continued

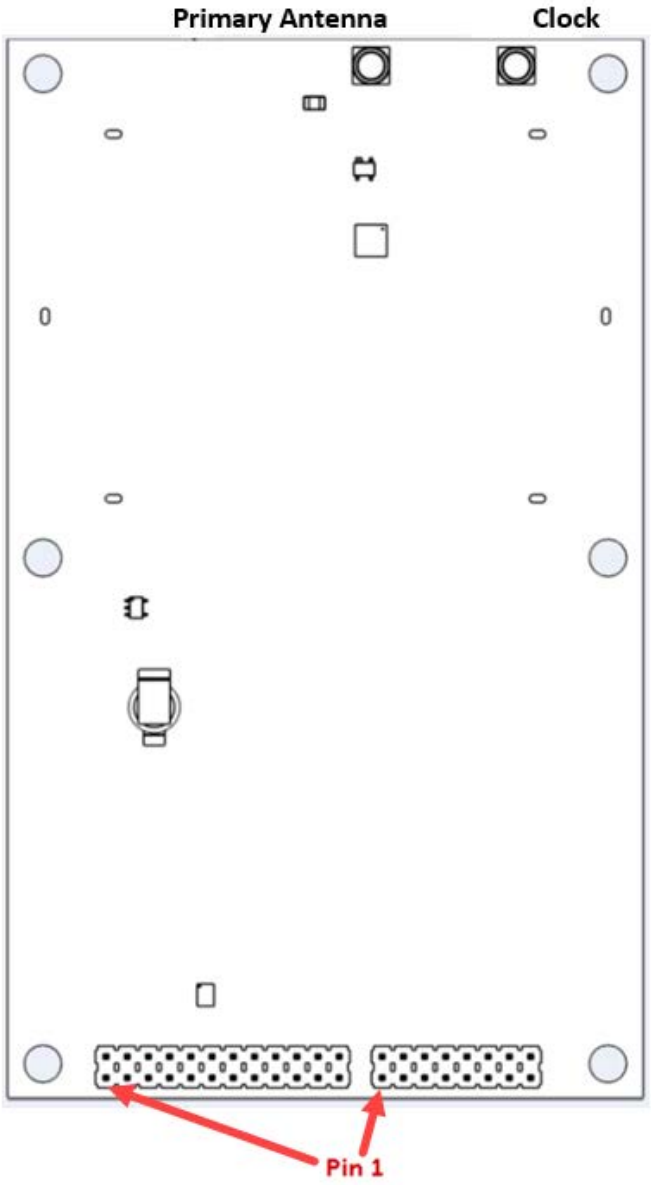

Figure 2-2: Phantom 40 Connectors

Mounting Options

Overview

There are two options for mounting the Phantom 40:

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

Direct electrical connection

Place an RF connector, the header connector, and the mounting holes on the carrier board, and then mount the Phantom 40 on the standoffs and RF and header connectors. This method is very cost effective because it eliminates cable assemblies to interface with the Phantom 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 Phantom 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 Phantom 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 Phantom 40 connector information. The mounting holes of the Phantom 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 Phantom 40 mechanically, so you can connect a ribbon power/data cable to the Phantom 40. This requires cable assemblies and there is a reliability factor present with cable assemblies in addition to increased expense.

Header Layouts and Pin-outs

Phantom 40 pin-outs

The Phantom 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 Phantom 40 24-pin header layout.

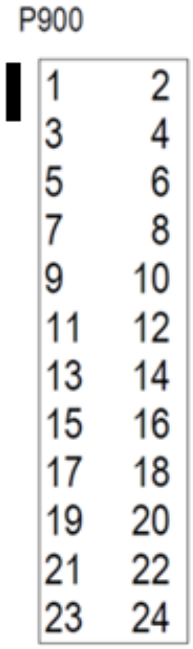

Figure 2-3: Phantom 40 24-pin header layout

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Header Layouts and Pin-outs, Continued

Phantom 40 pin-outs, continued

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: Phantom 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

Phantom 40 pin-outs, continued

Table 2-2: Phantom 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.

Continued on next page

Phantom 40 pin-outs, continued

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

Pin	Signal Name	Signal Type	Signal Direction	Description
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.
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.

Continued on next page

Phantom 40 pin-outs, continued

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

Pin	Signal Name	Signal Type	Signal Direction	Description
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.
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 RS-422 differential receive RXD. This is one half of the PortA-RS-422 receive differential pair (2V differential typical)

*Requires a future firmware update.

Continued on next page

Phantom 40 pin-outs, continued

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

Pin	Signal Name	Signal Type	Signal Direction	Description
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).
18	Port A RX (default) / Port A RX-	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 (default)/ USER0	3.3V CMOS	Output/ Input	Dual use pin: Default: Port C TX (UART) Port C TX: Transmit Data output. USER0: User GPIO. Internal 10 kΩ pulldown.

*Requires a future firmware update.

Continued on next page

Phantom 40 pin-outs, continued

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

Pin	Signal Name	Signal Type	Signal Direction	Description
20	Port A TX (default)/ Port A TX+	RS-232/RS-422*	Output	Dual use pin: Default: Port A TX Port A TX: Port A Transmit Data output. Port A TXD+: This is one half of the Port A RS-422* transmit differential pair (2V differential typical).
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

Header Layouts and Pin-outs, Continued

Phantom 40 pin-outs, continued

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

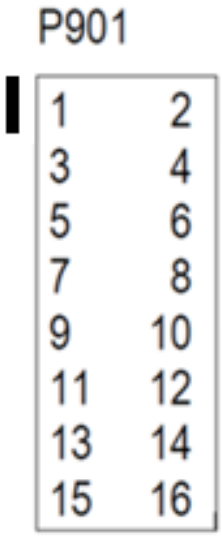


Figure 2-4: Phantom 40 16-pin header layout

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.

Continued on next page

Phantom 40 pin-outs, continued, continued

Table 2-3: Phantom 40 16-pin header pin-out

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 TX+	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.
8	CORR			Reserved for future use

Continued on next page

Phantom 40 pin-outs, continued, continued

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

Pin	Signal Name	Signal Type	Signal Direction	Description
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 hosted USB devices
16	GND	Power	-	Ground reference

Signals

Overview

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

RF Input

The Phantom 40 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 1m to 30m antenna cables which have between 2dB and 12 dB loss. This still allows a few dB margin for additional interconnection items and short interface cables in integrated products.

Ports

Serial ports

The Phantom 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 port

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

The Phantom 40 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 Ω±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 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.

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

Continued on next page

Ports, Continued

Enabling / disabling Ethernet

To enable Ethernet, determine if the receiver can be assigned an IP address automatically via DHCP, or statically assigned. If you are unsure, please contact your 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

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 Phantom 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

Ports, Continued

Enabling Ethernet services

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

CAN

CAN transceiver

A CAN transceiver is required. The Phantom 40 CAN RX and CAN TX are 3.3V CMOS signals. The Phantom 40 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 Phantom 40 does not connect to this portion of the transceiver.

Note: Resistor values can vary based on application.

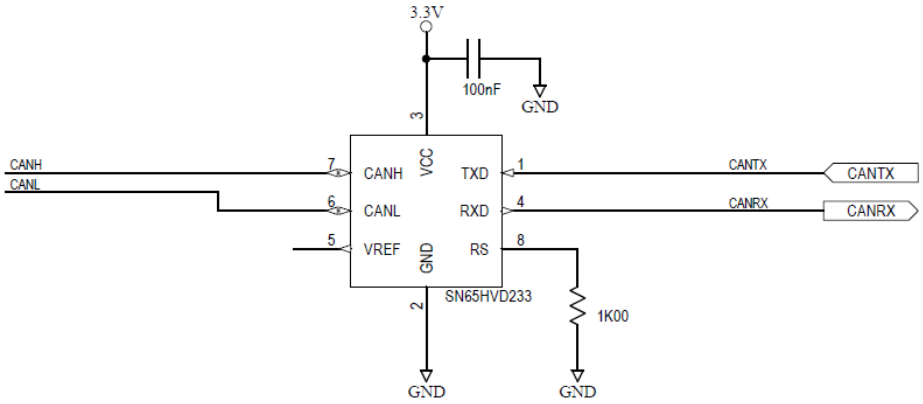


Figure 2-5: Phantom 40 CAN design example

Chapter 3: Understanding the Phantom 40 OEM Board

Overview

Introduction

Chapter 3 contains the information you need to understand the Phantom 40 OEM board signals and mounting.

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 is essential to normal receiver operation. Do not connect this pin if you do not need this function.

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 1 ms.

The Phantom 40 supports a programmable PPS. Users can select the frequency to be 1, 2, 5 or 10Hz. The pulse can be programmed as either active high (rising edge synchronized) or active low (falling edge synchronized). The Phantom 40 can support pulse widths as wide as 900 ms.

$JPSS, 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]

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 must 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 is 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 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 Phantom 40. These are not separate analog and digital grounds that require separate attention. Refer to Table 2-2 through Table 2-3 for pin-out ground information for the Phantom 40.

Shielding

Shielding

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

Receiver Mounting

Receiver mounting

The Phantom 40 is a precision instrument. To ensure optimal operation, mount the receiver in a way to minimize vibration and shock.

When mounting the Phantom 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.

Chapter 4: Operating the Phantom 40 OEM Board

Overview

Introduction

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

Contents

Powering the Phantom 40 On/Off

Powering the Phantom 40

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

Communicating with the Phantom 40

Communicating with the Phantom 40

The Phantom 40 features three serial ports (Port A, Port B, Port C) that you can configure independently from one another.

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 Phantom 40

Configuring the Phantom 40

You can configure all aspects of Phantom 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 Phantom 40, connect to a terminal program or Hemisphere GNSS' software applications (SLXMon or PocketMax).

LED Indicators

LED Indicators

The Phantom 40 features the following surface-mounted diagnostic LEDs that indicate board status (see Figure 2-6). Table 2-4 lists the LED indicators by name, color and board status.

Table 2-4: LED indicators

LED Indicator	LED Name	Color	Board Status
PWR	Power	Red	Power is on.
GNSS-GNSS lock	GNSS lock indicator	Orange	The user has a position.
DIFF-Differential lock	Differential lock indicator	Blinking Solid	A blinking light indicates the user is receiving corrections, but the corrections aren't decoded and no frame synchronization. A solid light indicates the receiver has locked onto the differential source.
DGPS-DGPS position	DGPS position mode	Green Blinking	Indicates the user is receiving corrections. The LED blinks when the estimated accuracy of the position does not meet the required threshold configured in the **$JLIMIT** command.

Figure 2-6: Onboard LEDs

Configuring the Data Message Output

Configuring the data message output

The Phantom 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 Phantom 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

‘THIS’ Port and the ‘OTHER’ Port, Continued

‘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 Port C, 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 Phantom 40 Configuration

Saving the Phantom 40 configuration

Each time you change the Phantom 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 Phantom 40 using a terminal program or Hemisphere GNSS' applications (SLXMon or PocketMax).

The Phantom 40 takes approximately thirty seconds to save the configuration to non-volatile memory and indicates when the configuration has been saved. Below is the standard configuration for the Phantom 40. For more information on these commands refer to the HGNSS TRM.

$JOFF,PORTA
$JOFF,PORTB
$JOFF,PORTC
$JBAUD,19200,PORTA
$JBAUD,19200,PORTB
$JBAUD,19200,PORTC
$JAGE,2700
$JLIMIT,10.0
$JMASK,5
$JDIFF,WAAS
$JPOS,51.0,-114.0
$JSMOOTH,LONG900
$JAIR,AUTO
$JALT,NEVER

$JNP,7
$JWAASPRN,AUTO
$JTAU,COG,0.00
$JTAU,SPEED,0.00

$JASC,GPGGA,1,PORTA
$JASC,GPGGA,1,PORTB

$JFREQ,AUTO
$JSAVE

Using the Phantom 40 WebUI

Overview

The Phantom 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.

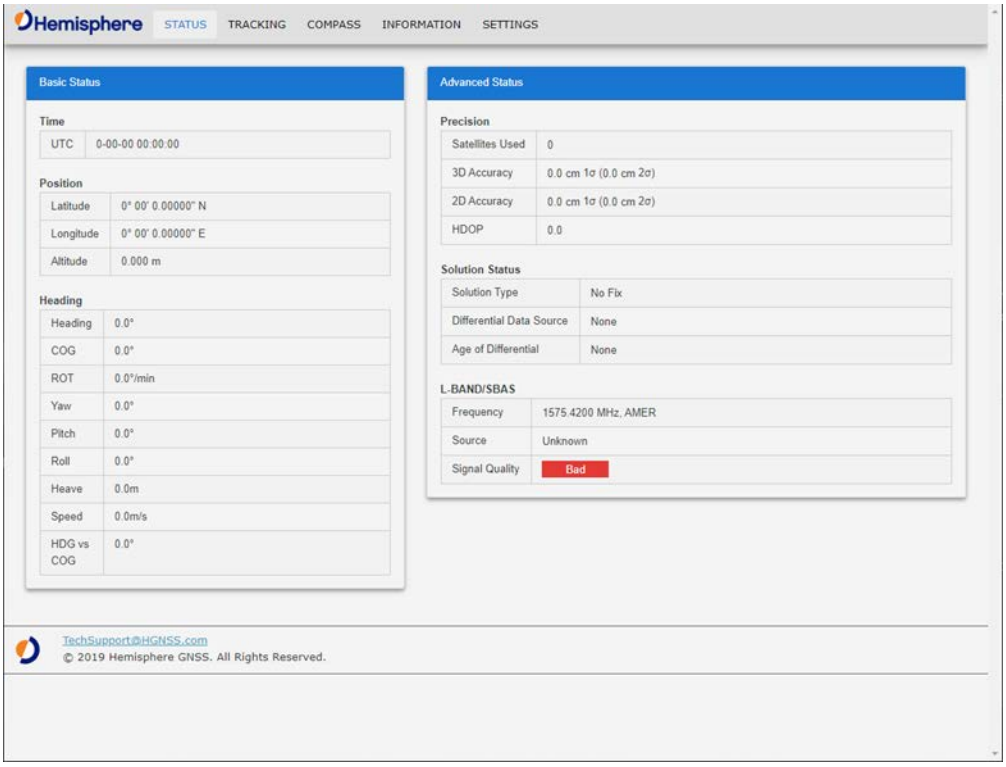
Open a web browser window and type the IP address reported in the **$JETHERNET** command.

Continued on next page

Using the Phantom 40 WebUI, Continued

Overview, continued

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



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Using the Phantom 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 [1]

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°

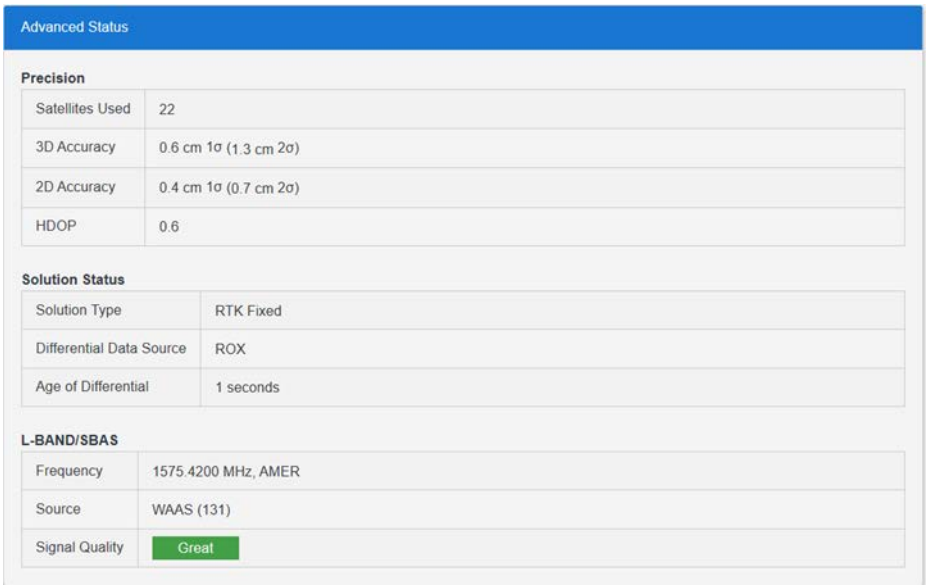
Continued on next page

[1] Heading does not apply to the Phantom 40 OEM board.

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, Bit Error Rate, Carrier Lock, Frame Sync, Frame Sync 2)



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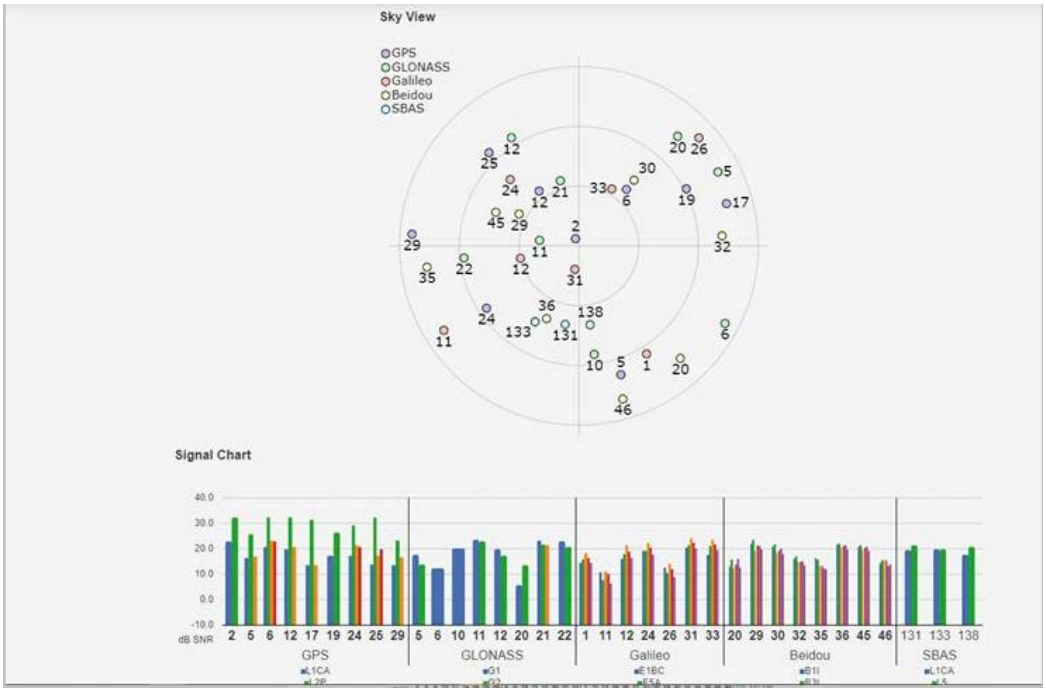
Tracking

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, and SBAS).

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



Compass[2]

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

Continued on next page

[2] The Compass screen does not apply to the Phantom 40.

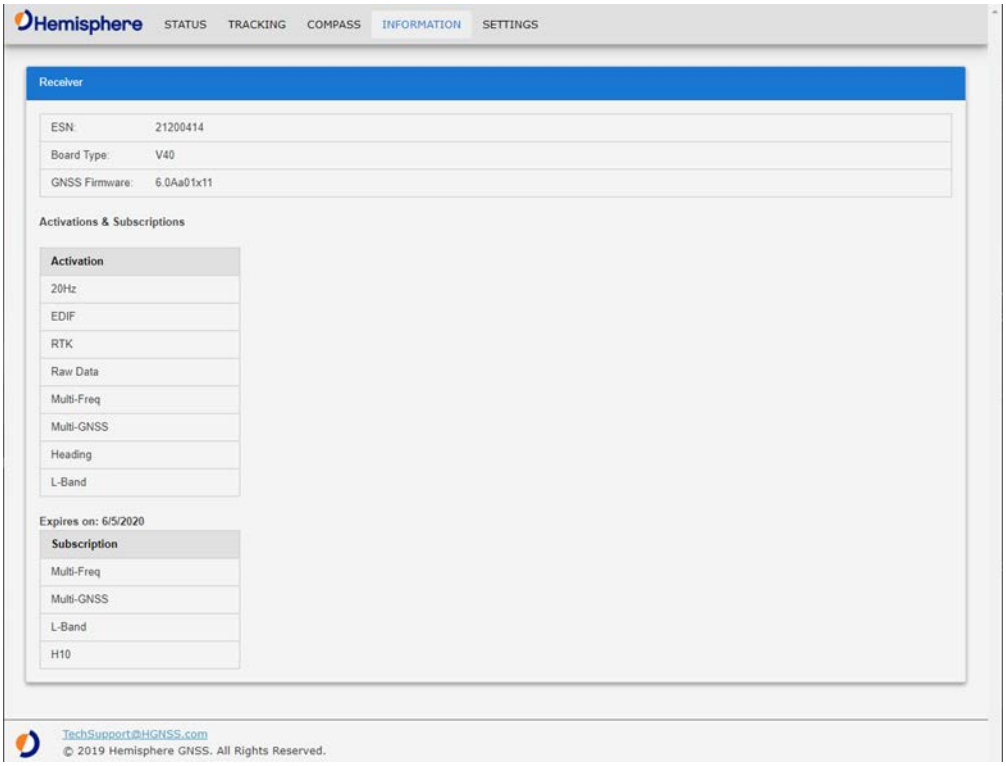
Using the Phantom 40 WebUI, Continued

Information

The **Information** window displays the Phantom 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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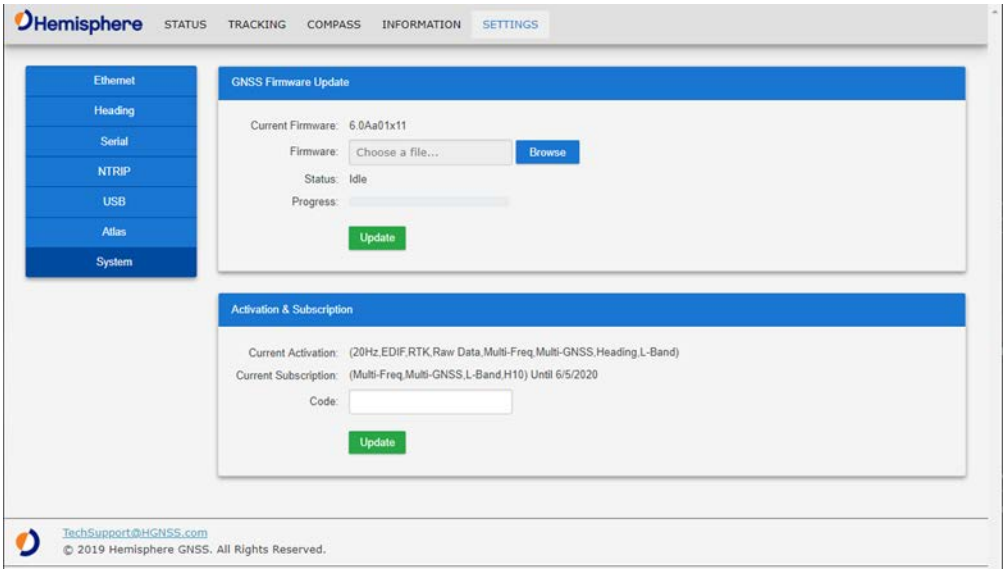
Settings

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



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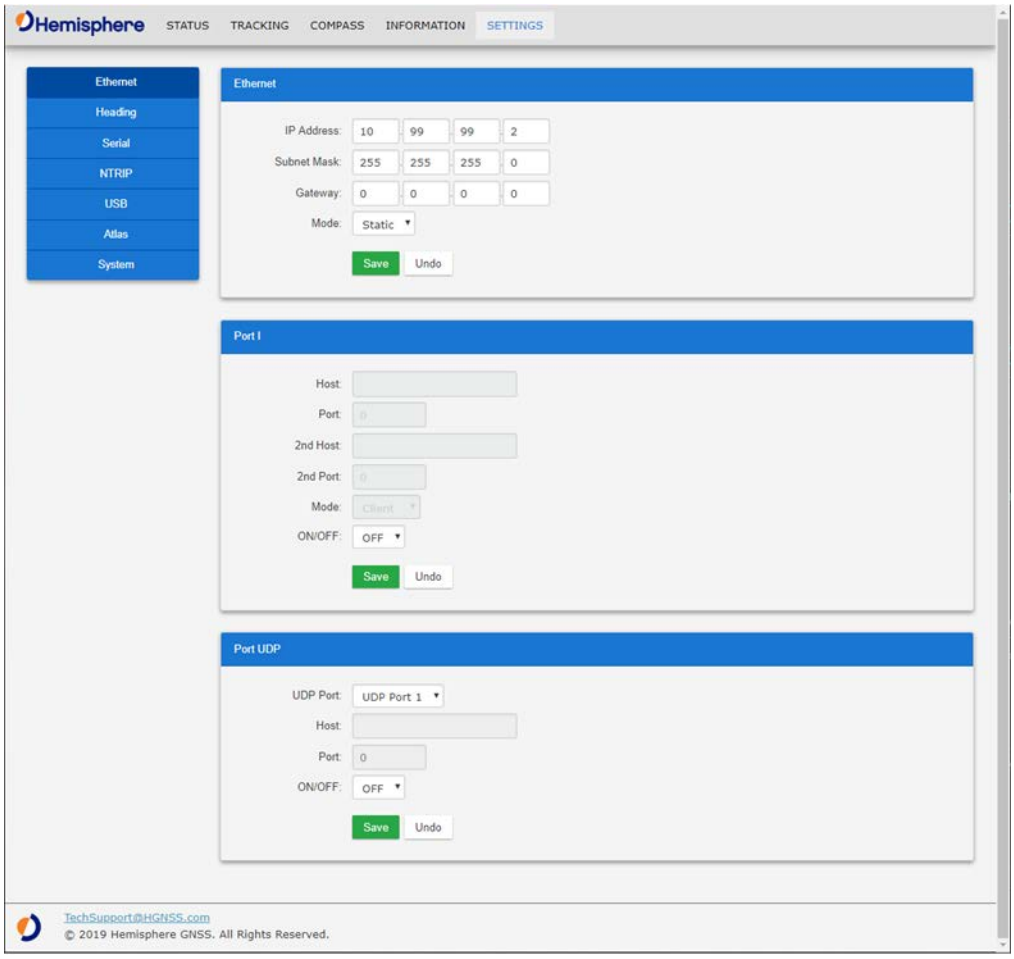
Settings-Ethernet

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.



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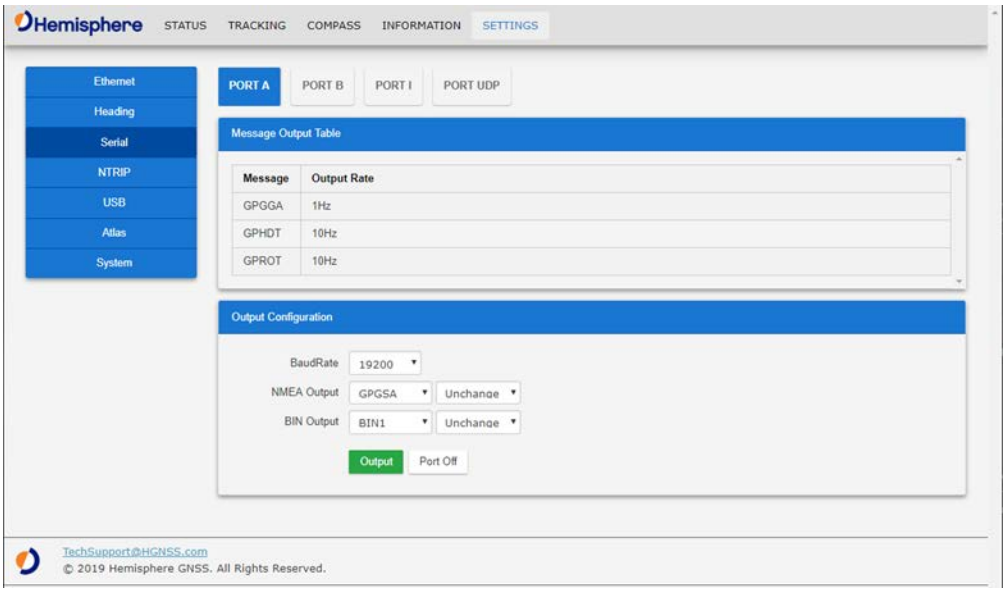
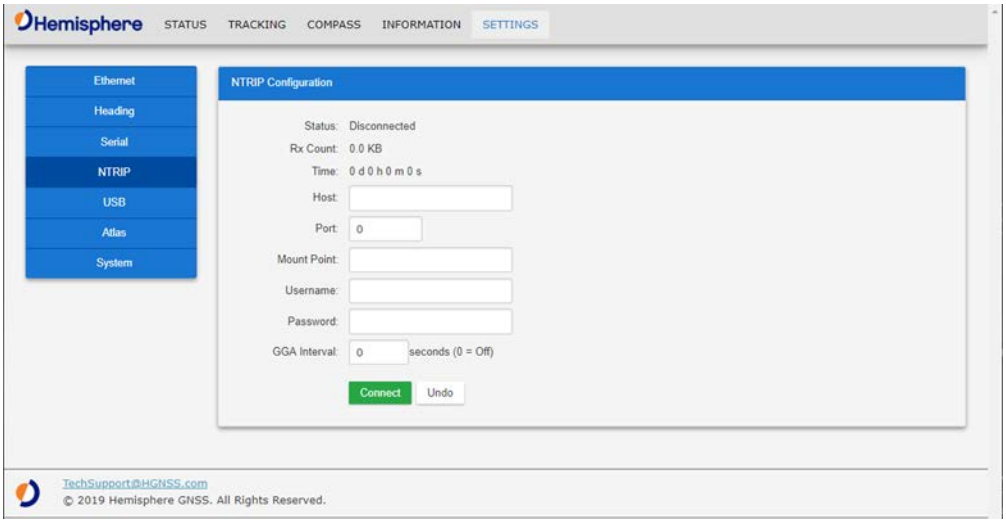
Settings, Serial

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



Settings, NTRIP

If your Phantom 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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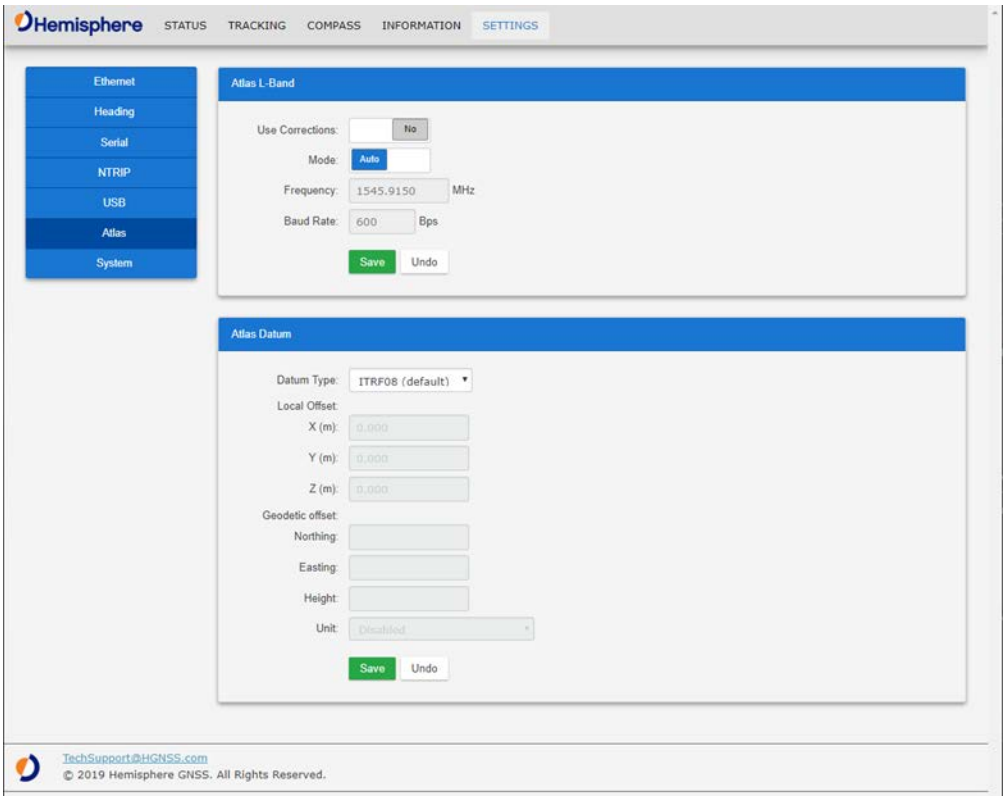
Settings, Atlas

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).

Note: This datum setting only applies to Atlas position solutions.



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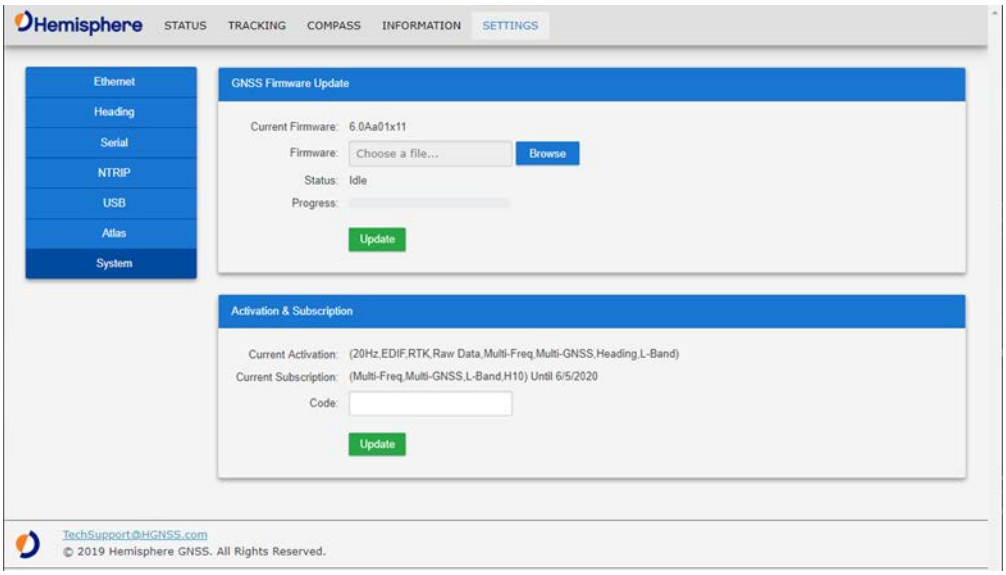
Settings, System

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 Phantom 40.

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

Contents

Troubleshooting

Phantom 40 troubleshooting

Table A-1: Phantom 40 Troubleshooting

Symptom	Possible Solution
What is the first thing I do if I have a problem with the operation of the Phantom 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 Phantom 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 Phantom 40 via Hemisphere query command **$JI, $JSHOW** • Verify that Phantom 40 is locked to GPS satellites (this can often be done on the receiving device). • Check the integrity and connectivity of power and data cable connections
Random data from Phantom 40	• Verify that the RCTM or Bin messages are not being accidentally output (send a **$JSHOW** command) • Verify that the baud rate settings of Phantom 40 and remote device match • Check the serial grounding
No GNSS lock	• Check the 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)

Continued on next page

Phantom 40 troubleshooting, continued

Table A-1: Phantom 40 Troubleshooting (continued)

Symptom	Possible Solution
No SBAS	• Check antenna cable integrity • Verify antenna's view of the sky, especially towards that 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)
No DGNSS or RTK	• Verify that the baud rate of the correction input port matches the baud rate of the external source. • Verify the pin-out between the correction source and the correction 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 correction input port). • Use the **$JDIFFX,INCLUDE** command to verify that RTCM2, RTCM3, CMR, or ROX (whichever one is applicable) is enabled.
Non-DGPS output	• Verify P40 SBAS and lock status (or external source is locked) • Confirm baud rates match the external source correctly • Issue a **$JDIFF** command and see if the expected differential mode is in fact the current mode

Continued on next page

Appendix B: Technical Specifications

Introduction

Appendix B contains the Phantom 40 OEM Board technical specifications.

Contents

Phantom 40 Technical Specifications

Phantom 40 specifications

Tables B1-B6 provide the technical specifications for the Phantom 40.

Phantom 40 sensor specifications

Table B-1: Phantom 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	800+
GPS Sensitivity	-142 dBm
SBAS Tracking	3-channel, parallel tracking
Update Rate	1 Hz standard, 10 Hz, 20 Hz, or 50 Hz optional (with activation)
Horizontal accuracy	

	RMS (67%)	2DMRS (95%)
RTK[1]	8 mm + 1 ppm	15 mm + 2 ppm
Atlas H10 [1,2]	0.04 m	0.08 m
Atlas H30 [1,2]	0.15 m	0.3 m
Atlas Basic [1,2]	0.50 m	1.0 m
SBAS[1]	0.3 m	0.6 m
Autonomous, no SA[1]	1.2 m	2.5 m

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

Continued on next page

Phantom 40 Technical Specifications, Continued

Phantom 40 sensor specifications, continued

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

Item	Specification
Timing (1 PPS) Precision	20 ns
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)
Antenna Input Impedance	50 Ω
Maximum Speed	1,850 kph (999 kts)
Maximum Altitude	18,288 m (60,000 ft)

Phantom 40 communication specifications

Table B-2: Phantom 40 Communication specifications

Item	Specification
Serial ports	1 x 3.3V CMOS (1 x RS-232/RS-422*) 2 x RS-232 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 [2]
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

*RS-422 requires a future firmware update.

Continued on next page

Phantom 40 Technical Specifications, Continued

Phantom 40 power specifications

Table B-3: Phantom 40 Power specifications

Item	Specification
Input voltage	3.3 VDC +/- 3% typical
Power consumption	1.8 W (All Signals + L-band) typical
Current consumption	545 mA nominal (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

Phantom 40 environmental specifications

Table B-4: Phantom 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 installed 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

Continued on next page

Phantom 40 Technical Specifications, Continued

Phantom 40 mechanical specifications

Table B-5: Phantom 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, GNSS lock, Differential lock, DGNSS position
Power/Data connector	24-pin male header 2 mm pitch 16-pin male header 2 mm pitch
Antenna connector	MMCX, female, straight

Phantom 40 L-band receiver specifications

Table B-6: Phantom 40 Atlas 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)

[1] Depends on multipath environment, number of satellites in view, satellite geometry, and ionospheric activity
[2] Hemisphere GNSS proprietary
[3] CMR and CMR+ do not cover proprietary messages outside of the typical standard

Appendix C: Frequently Asked Questions (FAQ)

Overview

Introduction

Appendix C contains some of the most frequently asked questions about the Phantom 40 OEM board.

Contents

FAQ

Integration

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

Question	Solution
Do I need to use the PPS and/or event marker?	No, these are not necessary for Phantom 40 operation.
What should I do with the 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 because this signal is active low with an internal pull-up.
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 Phantom 40?	Not necessarily, but you may need to if there are RF interference issues, such as if the Phantom 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 that you always conduct an RF pre- scan when integrating OEM boards.

Continued on next page

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
What type of assistance can I expect from Hemisphere GNSS when integrating Phantom 40?	Integration of a GNSS board has such benefits as: • Lower system cost • Improved branding (rather than relabeling an existing product) • Better control of system design among others • As an integrator, you are responsible for ensuring that the correct resources are in place to technically complete it. Hemisphere GNSS will provide reasonable assistance. • However, Hemisphere GNSS does not have dedicated engineering resources for in- depth integration support. Hemisphere GNSS will do its best to provide support as necessary, but you should expect to have reasonable expertise to use this Integrator's Guide.

Continued on next page

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

FAQ, Continued

Power, Communication, and Configuration

Question	Solution
Why isn't my Phantom 40 communicating?	This could be one of a few issues: • Examine the Phantom 40 cables and connectors for signs of damage or offset. • Ensure the Phantom 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 Phantom 40 is connected to the receive line of the other device. Also, ensure the signal grounds are connected. • If the Phantom 40 is connected to a custom or special device, ensure the serial connection to it does not have any incompatible signal lines present that prevent proper communication. • Make sure the baud rate of the Phantom 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 that 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

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

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 Phantom 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 Phantom 40 and configure it?	Hemisphere GNSS uses different software applications: • SLXMon - Available at 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 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

FAQ, Continued

GNSS Reception and Performance

Question	Solution
How do I know what the Phantom 40 is doing?	• The Phantom 40 supports standard NMEA data messages. The **$GPGSV** and Bin99 data messages contain satellite tracking and SNR information. If available, the computed position is contained in the **$GPGGA** message. • The Phantom 40 has surface-mounted status LEDs that indicate receiver status.
Do I have to be careful when using the Phantom 40 to ensure it tracks properly?	• For best performance, the Phantom 40's antenna must have a clear view of the sky for satellite tracking. • The Phantom 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 that are used, the greater the positioning accuracy.

Continued on next page

FAQ, Continued

SBAS Reception and Performance

Question	Solution
How do I know if the Phantom 40 has acquired an SBAS or Atlas signal?	• The Phantom 40 can output the **$RD1** message that contains the Bit Error Rate (BER). • The BER value describes the rate of errors received from SBAS. Ideally, this should be zero. However, the Phantom 40 performs well up to 150 BER for SBAS and up to 500 for Atlas. 150 for SBAS and 500 for Atlas implies that the receiver is not locked onto the relevant satellite. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.
How do I know if the Phantom 40 has a differentially corrected or RTK-corrected position?	• The Phantom 40 outputs the **$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, continued

Question	Solution
How do I select an SBAS satellite?	• By default, the Phantom 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.
How will the antenna selection and mounting affect Phantom 40 performance?	• For best results select a multipath-resistant antenna. Ensure the antenna tracks all the available signals for the receiver. It's possible other GNSS antennas are possible. • 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 of Hemisphere GNSS antennas, and the results may vary with if you are using an antenna from another manufacturer.

Index

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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.

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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