Hemisphere®

875-0364-0

A222™ Smart Antenna

User Guide
Revision: A3
October 29, 2019

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.

Copyright Notice

Trademarks

Hemisphere GNSS®, the Hemisphere GNSS logo, TRACER™, Crescent®, Eclipse™, e-Dif®, L-Dif™, PocketMax4™, S320™, SBX-4™, Vector™, XF1™, and XF2™ are proprietary trademarks of Hemisphere GNSS, Inc. Other trademarks are the properties of their respective owners.

Patents

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

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

Australia Patents	
2002244539	2002325645
2004320401	

Continued on next page

Device Compliance, License and Patents, Continued

Notice to Customers

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

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

Technical Support

If you need to contact Hemisphere GNSS Technical Support:

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

Documentation Feedback

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

Terms and Definitions

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

A222 terms & definitions

Term	Definition
Activation	Activation refers to a feature added through a one-time purchase.
Atlas	Atlas is a subscription-based service provided by Hemisphere that enables the A222 to achieve sub-decimeter accuracy without a base station or datalink.
BeiDou	BeiDou is the global satellite system deployed and maintained by China.
DGPS/DGNSS	Differential GPS/GNSS refers to a receiver using Differential Corrections.
Elevation Mask	Elevation Mask is the minimum angle between a satellite and the horizon for the receiver to use that satellite in the solution.
Firmware	Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.
GALILEO	Galileo is a global navigation satellite system implemented by the European Union and the European Space Agency.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System deployed and maintained by Russia.
GPS	Global Position System (GPS) is a global navigation satellite system implemented by the United States.
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 differential GPS method that provides better accuracy than differential corrections
SBAS	Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.

Continued on next page

Terms and Definitions, Continued

A222 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.
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 User Guide provides information to help you quickly set up your A222 Smart Antenna. You can download this manual from the Hemisphere GNSS website at WWW.HGNSS.COM.

Contents

Product Overview

Product overview

Hemisphere GNSS' all new scalable A222 was designed to excel in challenging environments, and is ideal for use with various applications, including precision agriculture, machine control, construction, mining, and marine.

The A222 is a multi-GNSS RTK, high accuracy GNSS receiver that allows you to work quickly and accurately. Built on Hemisphere GNSS' Eclipse™ platform, A222 boasts the latest GNSS patented technology and offers quick startup and reacquisition times.

The A222 can be updated by adding L1/L2 GLONASS activations and subscriptions for Athena RTK and/or Atlas L-band. Athena RTK is Hemisphere's most advanced RTK processing software that can be added to the A222 as a subscription service.

Note: Throughout the rest of this manual, A222 Smart Antenna is referred to simply as A222.

Figure 1-1: A222 Smart Antenna

Continued on next page

Product Overview, Continued

Product overview, continued

A222 is a versatile smart antenna with several first-class features:

- Utilizes Hemisphere's Athena GNSS engine
- Atlas support over L-band corrections
- Environment-proven enclosure for the most aggressive user scenarios

Athena RTK

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
- Performance under scintillation. Sustained accuracy under ionospheric scintillation activities, in high scintillation-affected areas
- Atlas L-band is Hemisphere's industry leading correction service, which can be added to the A222 as a subscription

Atlas L-band

Atlas L-band is Hemisphere's industry leading correction service, which can be added to the A222 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 to 100 cm range
- **Convergence time** – Industry leading convergence times of 10-40 minutes

Continued on next page

Product Overview, Continued

For more information

For more information about Athena RTK, see:
HTTP://HGNSS.COM/TECHNOLOGY

For more information about Atlas L-band, see:
HTTP://HGNSS.COM/ATLAS

Key Features

A222 Key features

Key features of the A222 include:

- Centimeter-level accuracy using Atlas* or Athena** technology in a rugged, all-in-one enclosure (*requires subscription **requires activation)
- Improved GNSS performance—particularly with RTK and/or L-band applications
- Very fast RTK fix and reacquisition times
- Supports, NMEA 0183, NMEA 2000*, for communication with external devices (*requires NMEA certification)
- Wide operating voltage range of 8-32 VDC, providing high transient protection for any power source

A222 supports a variety of protocols for communicating with navigation systems, CAN systems, and other devices.

What's Included in Your Kit

A222 kit

The following parts and accessory items are included with your A222 Smart Antenna.

A222 Parts list

Table 1-1 provides the part name and description, quantity, and part number for each part in your kit.

Table 1-1 A222 Parts list/accessory items

Part No.	Description	Qty
804-0153-0 804-0155-0	A222 GNSS Smart Antenna or A222 Unbranded GNSS Smart Antenna	1 1
710-0130-0	Mounting adapter, 1" to 5/8" Pole Mount	1
Note: Your kit will include one of the above mounting adapters, depending on your order.		
The following accessory items are available for purchase separately for your A222.		
051-0129-002	Power/data cable (single DB9), 3 m	1
051-0169-000	Power/data cable (unterminated), 4.6 m	1

Product support

If you have questions regarding the setup, configuration, or operation of A222, contact your local dealer. For additional support information see Technical Support.

Firmware Upgrades

Overview

Periodically, Hemisphere GNSS releases firmware upgrades to improve performance, fix bugs, or add new features to a product. To update the firmware on the A222:

1. Download the latest version of Hemisphere GNSS RightArm from the following link:
   HTTPS://HGNSS.COM/RESOURCES-SUPPORT/SOFTWARE.

RightArm updates

Connect the A222 to a computer over serial. Firmware can be loaded over either serial port. Set the baud rate of the serial port you are using to 19200.

Launch RightArm.

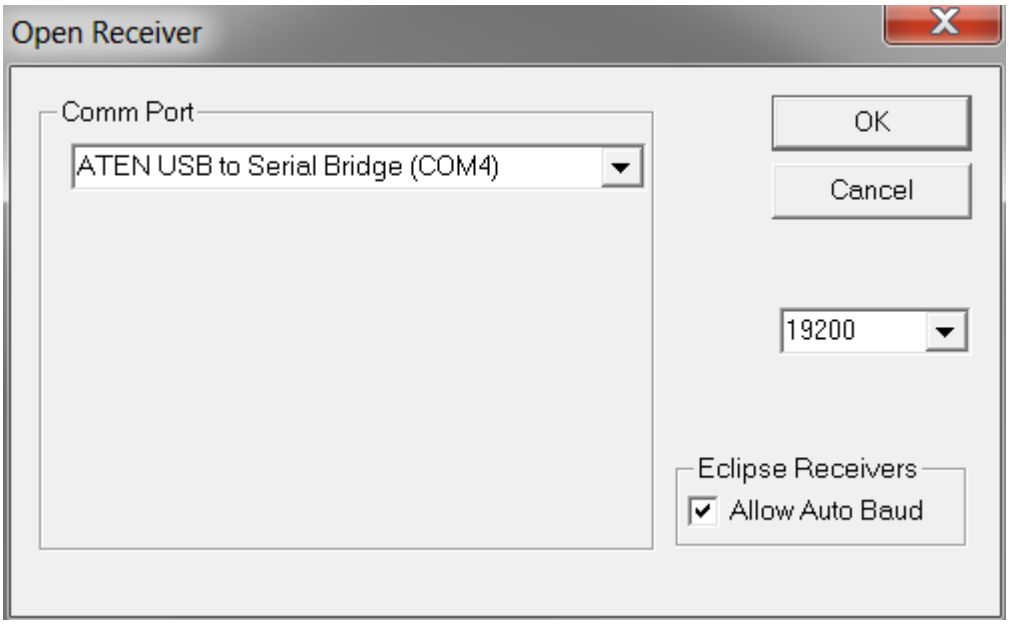
Click the **Connect** button or navigate to Receiver -> Connect.

Continued on next page

Firmware Upgrades, Continued

RightArm updates, continued

Choose the COM port connected to the A222and click **OK**.



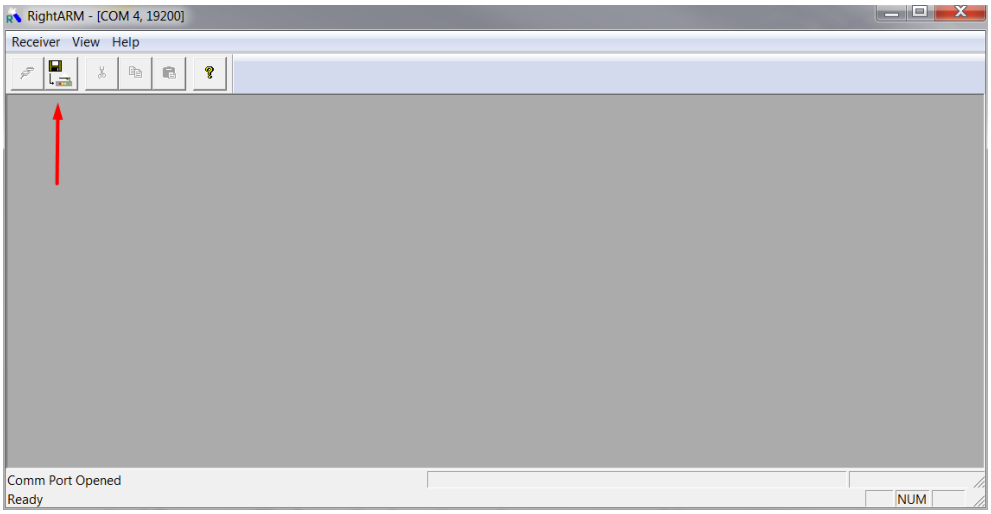
Note: The baud rate of the serial port should be set to 19200 bps. Select "Allow Auto Baud" to change the baud rate during the firmware upgrade for a faster update.

Continued on next page

Firmware Upgrades, Continued

RightArm updates, continued

Click the **Programming** button.



Select a **Program Type**.

The A222 has two firmware applications, allowing two different versions of GNSS firmware. Hemisphere GNSS suggests loading the new firmware onto both applications.

After the firmware update is completed, check the current GNSS firmware.

If the current firmware is not the same as the newly loaded firmware, the A222 could be using the other application. You can switch applications by sending the following command:

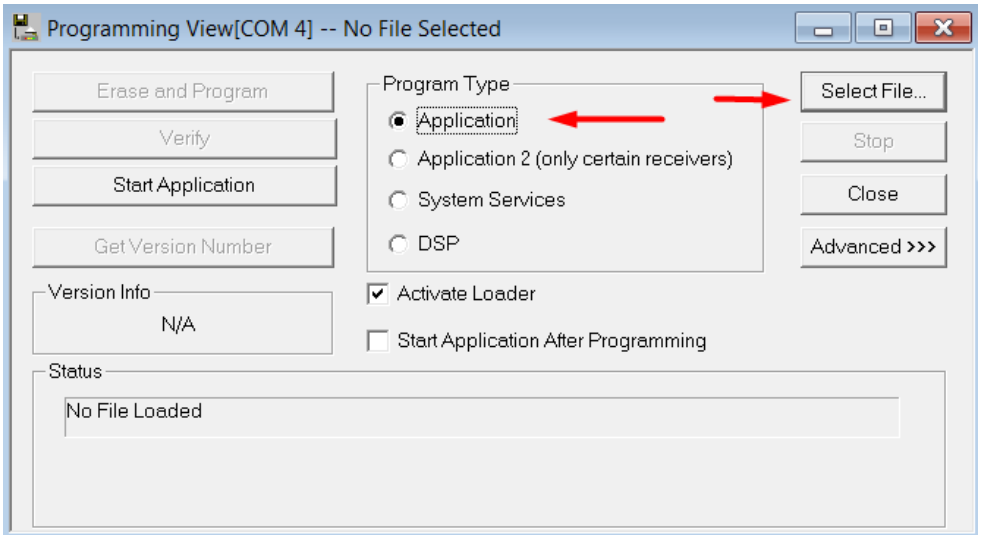
$JAPP,OTHER.

Choose the Application, and press **Select File** to select the firmware file.

Continued on next page

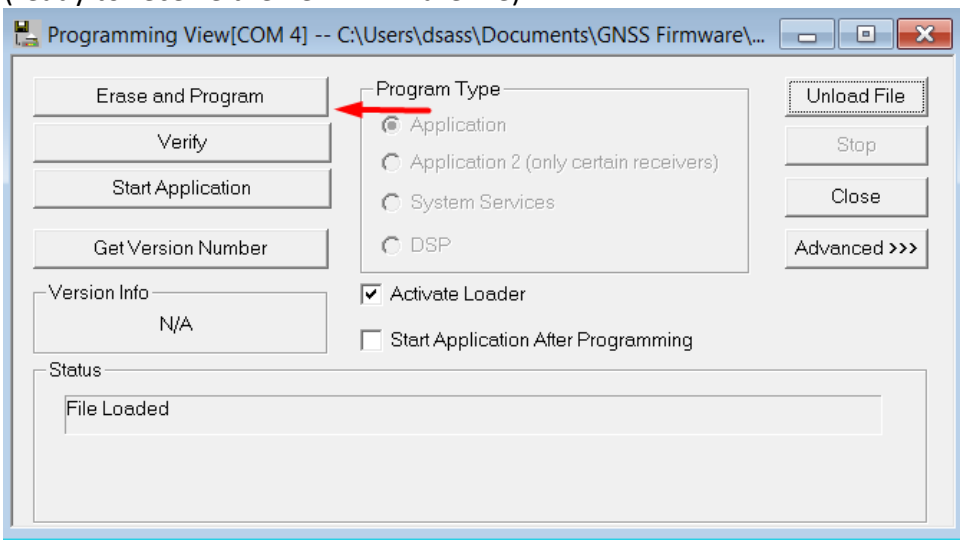
Firmware Upgrades, Continued

RightArm updates, continued



Choose the firmware, and click **Erase and Program**.

The **Activate Loader** checkbox in the Programming View window is selected. After pressing the Erase and Program button, this checkbox will de-select, and the **Status** field indicates the receiver is in loader mode (ready to receive the new firmware file).



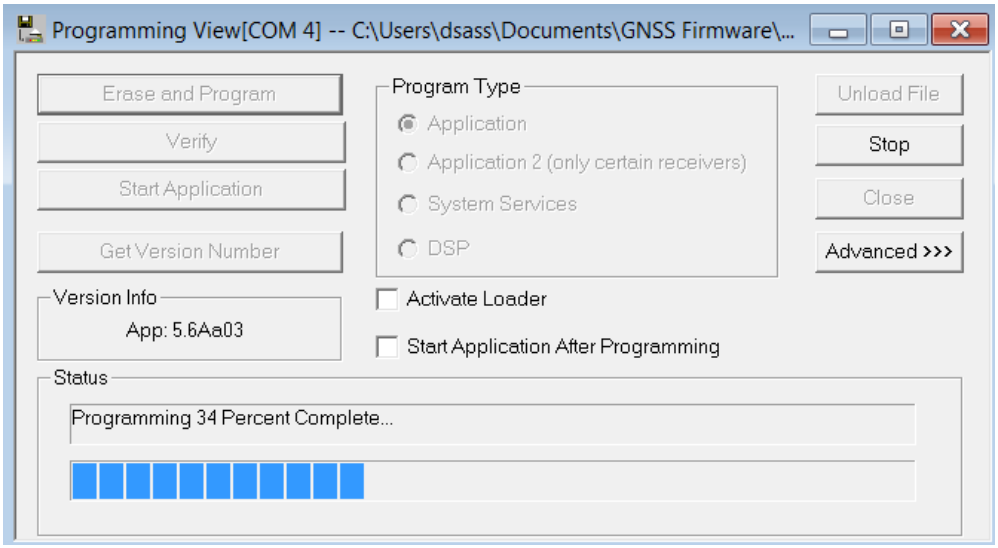
Continued on next page

Firmware Upgrades, Continued

RightArm updates, continued

Note: If the Activate Loader check box remains selected, power the receiver off and on. When the receiver powers back on, the Activate Loader box should be de-selected.

⚠WARNING:
Do not to interrupt the power supply to the receiver, and do not interrupt the communication link between the PC and the receiver until programming is complete. Failure to do so may cause the receiver to become inoperable and will require factory repair.



Note: After completing the firmware update, Hemisphere GNSS suggests repeating this process for the other application.

Chapter 2: Installing the A222

Overview

Introduction

This chapter provides instructions on how to mount and install your A222 Smart Antenna.

Contents

Installing the A222

Introduction

This section provides information on installing the A222 Smart Antenna.

Display, mounting and connectors

All connections and ports are located on the bottom of the unit, as shown in Figure 2-1. Table 2-1 provides additional information about each port/connection.

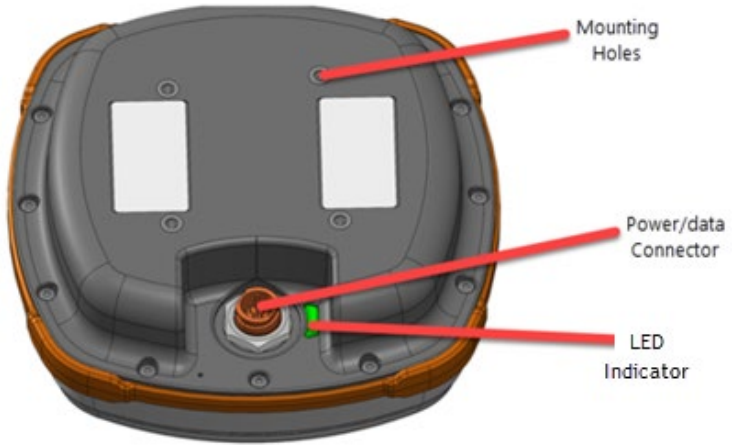


Figure 2-1: A222

Continued on next page

Installing the A222, Continued

Display, mounting and connectors, continued

Table 2-1: A222 Ports and Connections

Port/Connection	Description
Mounting holes	Four off-set mounting holes. Two adapters are available, the first includes a marine 1” standard, adaptable to 5/8”. The second allows for flush-mounting the unit.
Power, data port (12-pin)	External power/data cable; allows you to supply power to A222 as well as communicate with external devices via NMEA 0183 serial, and binary.

Power/data cable considerations

Before mounting the A222, consider the following regarding power/data cable routing:

Do	Do not
Ensure cable reaches appropriate power source	Run cables in areas of excessive heat
Keep cable away from corrosive chemicals	Run cables through a door or window jams
Connect to a data storage device, computer, or other device that accepts GNSS data	Crimp or excessively bend the cable
Keep cable away from rotating machinery	Place tension on the cable
Remove unwanted slack from the cable at the A222 end	
Secure along the cable route using plastic wrapping	

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

LED Indicator

LED Indicator

A222 uses a single LED (see Figure 2-1) that provides system information based on the color of the LED as follows:

- Blinking Red - Power on
- Blinking Amber - GNSS position available, including RTK float and Atlas
- Blinking Green - RTK-fixed or Atlas-converged position available
- Blinking any color - Receiver operational

⚠WARNING: If at any time the LED turns to a solid color for an extended period, the receiver has malfunctioned.

Mounting the A222

Overview

This section provides information on where to mount your antenna and the different mounting options available with the A222 Smart Antenna.

Selecting the proper antenna location

Proper antenna placement is critical to positioning accuracy.

To select the proper antenna location:

- Place the antenna with an unobstructed view of the sky. An obstructed view of the sky may impair system performance. The GNSS engine computes a position based on measurements from each satellite to the internal GNSS receiver.
- Mount the antenna on, or as close as possible to, the center of your point of measurement. For example, ideal antenna placement on a vehicle is the center of the cab roof, assuming there is a clear view of the sky.
- Position the antenna as high as possible.

Routing and securing the cables

Consider the following when routing cables:

- Power/data cable must reach an appropriate power source
- Power/data cable may connect to a data storage device, computer, or other device that accepts GNSS data
- Do not run cables in areas of excessive heat
- Do not expose cables to corrosive chemicals
- Do not crimp or excessively bend cables
- Do not place tension on cables
- Coil up excess cable in the cab of the vehicle or near the antenna
- Secure along the cable route using plastic tie wraps as necessary
- Do not run cables near high voltage or strong RF noise and transmitter sources

⚠WARNING: Improperly installed cables near machinery may cause injury or death.

Continued on next page

Mounting the A222, Continued

Mounting options

A222 allows for the following mounting options:

- Surface-mount
- Pole-mount

Surface-mount

You can surface-mount A222 with four machine screws (no. 8-32).

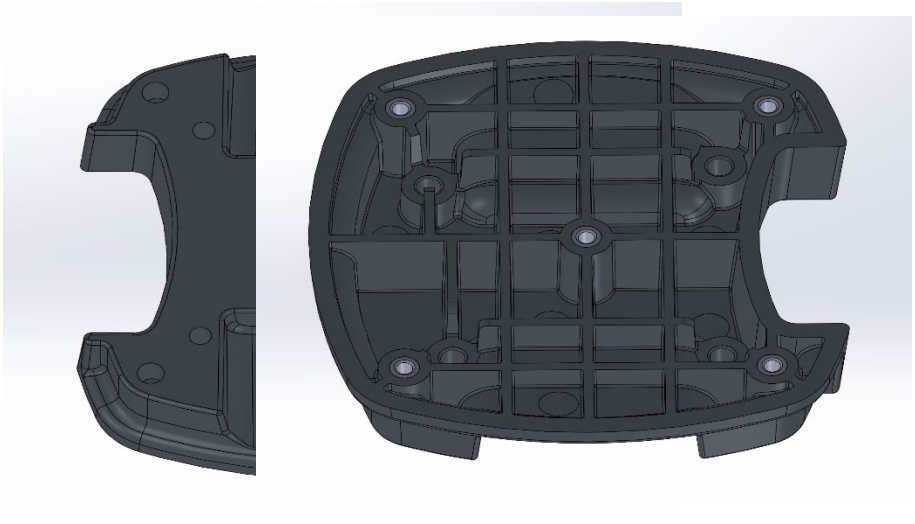


Figure 2-2: A222 top/bottom

Continued on next page

Mounting the A222, Continued

Surface-mount, continued

To surface-mount the A222 use the following steps:

Step	Action
1	Determine the desired location for A222 (see Selecting the Proper Antenna Location).
2	Refer to the template of the bottom portion of the A222 surface-mount (provided with A222 accessories). Use the outer four holes per your installation.
3	Mark the mounting hole centers on the mounting surface.
4	Place A222 surface mount over the marks to ensure the planned hole centers align with the true hole centers (adjusting as necessary).
5	Use a center punch to mark the hole centers.
6	Drill the mounting holes with a 5mm bit appropriate for the surface.
7	Use four machine screws (no. 8-32) to attach A222 to the surface mount adapter before securing the complete unit to the intended area.
8	Place A222 surface mount over the mounting holes and insert the mounting screws through the bottom of the mounting surface into A222 surface mount adapter.

Continued on next page

Mounting the A222, Continued

Surface-mount, continued

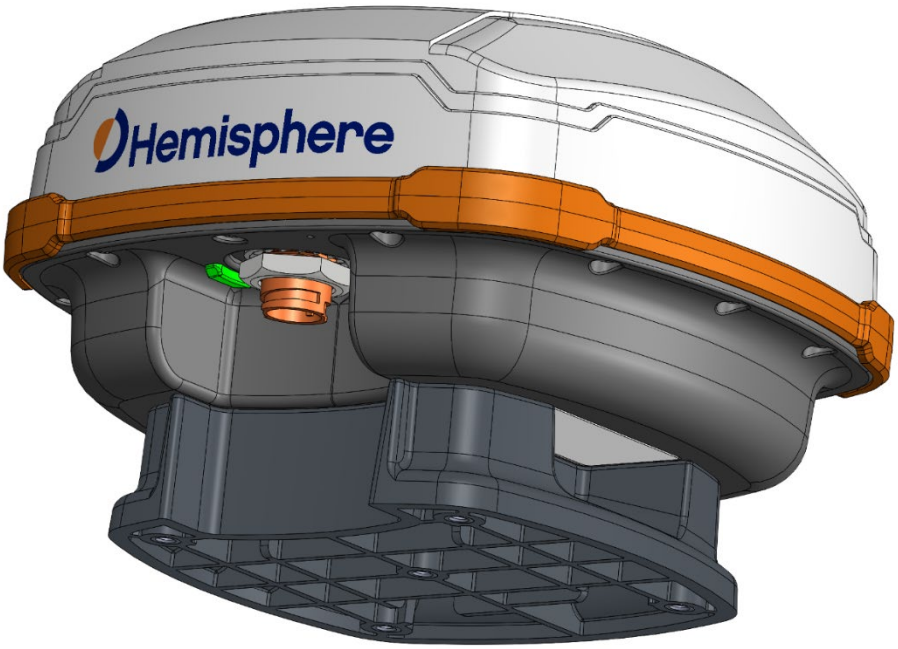


Figure 2-3: A222 Antenna with Surface Mount Accessory

WARNING: Hand-tighten only (10 to 12 in-lbs). Damage resulting from over-tightening is not covered by the warranty.

Continued on next page

Mounting the A222, Continued

Pole-mount

The center thread on the bottom of A222 is 1-14 UNS. The mounting assembly included with A222 includes a 5/8-11 UNC adapter. Simply thread the riser/pole into the antenna until snug.

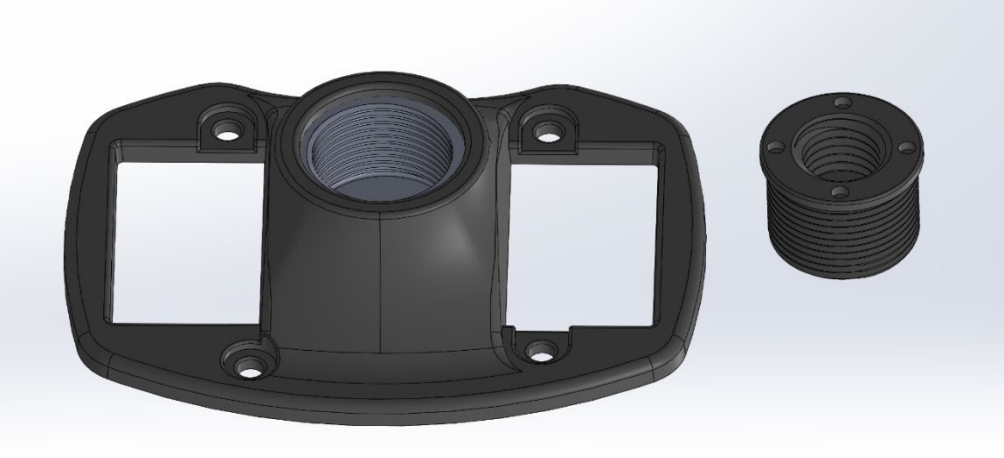


Figure 2-4: Pole-mount

⚠WARNING: Hand-tighten only (screws 10-12 in-lbs; pole 35-40 in-lbs.) . Damage resulting from over-tightening is not covered by the warranty.

Powering the A222

Power considerations

A222 accepts an input voltage of 8-32 VDC. For best performance use a clean and continuous power supply. When applying 12 VDC, A222 will draw approximately 3.2W.

Connecting to a power source

A222 uses a single cable for power and data input/output.

Note: A power/data cable is not supplied with A222, but is available as an accessory item. See Table 1-1 for a list of accessory items.

Note: The following information refers to using the accessory item cables available from Hemisphere GNSS.

The antenna end of the cable is terminated with an environmentally-sealed 12-pin connector and the opposite end is either DB9 or unterminated (requires field stripping and tinning).

To power A222 connect to a 12 VDC source.

Note: Selecting the right power connector will depend on your specific installation requirements.

⚠WARNING: Do not apply a voltage higher than 32 VDC. This will damage the receiver and void the warranty.

A222 features reverse polarity protection to prevent excessive damage if the power leads are accidentally reversed. With the application of power, A222 automatically proceeds through an internal startup sequence; however, it is ready to communicate immediately.

Continued on next page

Powering the A222, Continued

Power/data connector

Figure 2-5 shows the 12-pin power/data connector pinout assignments and Table 2-2 provides the pinout specifications.

Note: The Wire Color column in Table 2-2 refers to the color of the wires at the unterminated end of accessory item 051-0169-000 (4.6 m unterminated power/data cable).

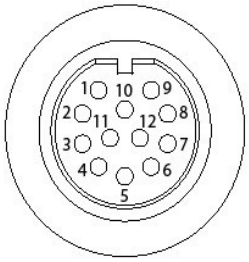


Figure 2-5: Pin-out assignments

Table 2-2: Pin-out specifications

Pin	Description	Wire Color
1	Manual mark in	White
2	Port B Tx	Brown
3	Port B Rx	Blue
4	CAN high	Orange
5	Signal ground	Yellow
6	Port A Tx	Violet
7	1 PPS	Gray
8	Port A Rx	Pink
9	CAN low	Tan
10	Power in (12 V)	Red
11	Power ground	Black
12	Speed out	Green

Note: For successful communication, the baud rate of the A222 serial ports (Port A and Port B) must be set to match that of the connected devices.

Chapter 3: Operating the A222

Overview

Introduction

This chapter explain the operations used in tracking with the A222 Smart Antenna.

Contents

Using A222

Overview

For your convenience, both the GNSS and differential correction of the A222 are preconfigured. The receiver will work out-of-the-box, and for most applications, little user setup is necessary.

When powered for the first time, the A222 will perform a “cold start,” which involves acquiring the available GNSS satellites in view and the SBAS differential service.

Differential and RTK Operation

Differential (DGNSS) and RTK operation

The purpose of differential GNSS (DGNSS) and RTK is to remove the effects of atmospheric errors, timing errors and satellite orbit errors, while enhancing system integrity.

Autonomous positioning capabilities of the A222 will result in positioning accuracies of 2.5m 95% of the time.

To improve positioning quality, the A222 can receive DGNSS corrections over SBAS, L-band corrections with Hemisphere GNSS' Atlas L-band technology, or RTK corrections over serial.

For more information on the differential services and the associated commands refer to the Hemisphere GNSS Technical Reference Manual.

SBAS Tracking

SBAS tracking

SBAS is a standard feature on the A222 and does not require an activation or subscription code.

The A222 automatically scans and tracks SBAS signals without the need to tune the receiver.

The A222 features two-channel tracking that provides an enhanced ability to maintain a lock on an SBAS satellite when more than one satellite is in view.

This redundant tracking approach results in more consistent tracking of an SBAS signal in areas where signal blockage of a satellite is possible.

Athena RTK

Athena RTK

Athena RTK requires the use of two separate receivers: a stationary base station (primary receiver) that broadcasts corrections over a wireless link to the rover (secondary receiver).

The A222 can use RTK through either serial. The receiver uses any RTK message coming in over a serial port if the RTK message type is included in the list of available differential sources.

If you do not know which RTK message type is being sent by the base station, you can include RTCM3, ROX, and CMR.

Including extra differential sources will not affect the receiver if those differential sources are not being received.

After setting the differential source configure the baud rate of the serial port receiving the RTK corrections. Ensure that the serial port configuration of the external device (such as radio or modem) is 8 bits/byte, 1 stop bit, no parity and no flow control.

Connect the external device to the serial port of the A222. Some cables may require the use of a gender changer and/or null modem adapter.

Supported Constellations

Supported constellations

A222 is available in its base form as L1 GPS, G1 GLONASS, E1 Galileo, and B1 BeiDou.

By adding multi-frequency GPS andGLONASS, the number of available signals increases – which improves RTK robustness.

Default Parameters

Default parameters

The following table lists the A222 default parameters:

Setting	Description
DGNSS	**Application**: Newest GNSS FW found at WWW.HGNSS.COM
Serial ports A and B	**Baud rate**: 4800, 9600, 19200, 57600, 115200 **Data bits:** 8 Parity: None Stop bit: 1 **Interface level:** RS-232
GNSS messages	**Type:** Hemisphere GNSS binary, NMEA 0183, NMEA 2000 **Update rate:** 1 Hz to 20 Hz***** **Max DGNSS age:** 259,200 sec **Elevation mask**: 5° *****With activation code

Configuring the A222

Overview

You can configure the A222 through the serial port using Hemisphere GNSS commands.

For example, you can select:

- Baud rate
- NMEA 2000 data message to output on the dual serial ports and the update rate of each message

Note: Use the $JSAVE command to save changes you make to the A222's configuration for the changes to be present in subsequent power cycles.

For information on Hemisphere GNSS commands refer to the Hemisphere GNSS Technical Reference.

Auto-seed

Auto-Seed allows the end user to shut down their device in a static position for any extended period of time. If the antenna remains stationary at shut down, the position status and Atlas convergence will remain in the device memory and resume upon start-up. This enables the Atlas solution to regain its accurate position within two minutes of start-up.

Auto-seed provides quick response positioning and enables the customer to get to work faster and with confidence in the GNSS solution.

Appendix A: Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for A222 common problems.

Contents

Troubleshooting

Appendix A troubleshooting

Symptom	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connectors • Check power input voltage (8 to 32 VDC) • Check current restrictions imposed by power source (maximum is 300 mA at 12 VDC)
No data from A222	• Check receiver power status • Check integrity and connectivity of power and data cable connections • Verify the baud rate settings match • Verify receiver responds to valid $J Command ($JI) • Verify it is locked to a valid DGNSS signal • Verify it is locked to 4 or more GNSS satellites
Random binary data from A222	• Verify the RTCM or the BIN messages are not being accidentally output • Verify the baud rate settings match • Potentially, the volume of data requested to be output could be higher than the current baud rate supports. Try either using a higher baud rate for communications or decreasing the number of messages and/or baud rates
No GNSS lock	• Check the integrity of the antenna's power/data cable • Verify the antenna is outdoors with a clear a view of the sky • Verify the lock status and signal-to-noise ratio (SNR) of GNSS satellites

Continued on next page

Troubleshooting, Continued

Appendix A troubleshooting, continued

Symptom	Possible Solution
No GNSS position	• Verify the antenna is outdoors with a clear view of the sky
A222 LED not blinking after connection to power	• Verify polarity of power leads • Check integrity of power cable connections • Check power input voltage (8 - 32 VDC)
A222 LED indicator solid color (not blinking)	• Power-cycle the receiver • Contact Technical Support

Appendix B: Technical Specifications

Technical Specifications

Introduction

Appendix B provides the A222 technical specifications for sensor, communication and power.

Contents

A222 Technical Specifications

Overview

Table B-1 through Table B-7 provides the GNSS sensor, horizontal accuracy, L-band sensor, communication, power, environmental, and mechanical specifications for the A222.

A222 technical specifications

Table B-1: A222 sensor

Item	Specification
Receiver type	GNSS L1, G1 (Standard) GNSS L2, L-band, RTK (optional)
Signals received	GNSS, GLONASS, and Atlas
Channels	114
GNSS sensitivity	-142 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, 20 Hz optional (with activation)
~~Pitch/roll accuracy~~	~~1º using tilt sensor~~
Timing (1PPS) accuracy	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)
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288 m (60,000 ft)

Continued on next page

A222 Technical Specifications, Continued

A222 technical specifications

Table B-2: Horizontal accuracy

Item	Specification	
	RMS (67%)	2RDMS (95%)
RTK[1,2]	8 mm+1 ppm	15 mm+2 ppm
L-band[1,3]	0.04 m	0.08 m
SBAS (WAAS)[1]	0.3 m	0.6 m
Autonomous	1.2 m	2.4 m

Table B-3: L-band sensor specifications

Item	Specification
Receiver type	Single channel
Channels	1530 to 1560 MHz
Sensitivity	-130 dBm
Channel spacing	5.0 kHz
Satellite selection	Manual and automatic
Reacquisition time	15 seconds (typical)

Table B-4: Communication specifications

Item	Specification
Serial	2 full-duplex RX-232
Baud rates	4800-115200
Data I/O protocol	NMEA 0183, NMEA 2000*, and Hemisphere GNSS binary. **requires NMEA certification*
Correction I/O protocol	Hemisphere GNSS proprietary, RTCM v2.3 (DGNSS), RTCM v3 (RTK), CMR (RTK), CMR+ (RTK)[4]
Timing output	1 PPS CMOS, active ~~high~~low, rising edge sync, 10 kΩ, 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 kΩ, 10 pF load

Continued on next page

A222 Technical Specifications, Continued

A222 technical specifications, continued

Table B-5: Power specifications

Item	Specification
Input voltage	8- 32 VDC with reverse polarity operation
Power consumption	< 3.2 W nominal GNSS (L1/L2), GLONASS (L1/L2) and L-band
Current consumption	0.26 A nominal GNSS (L1/L2), GLONASS (L1/L2) and L-band
Power isolation	No
Reverse polarity protection	Yes
Antenna voltage	Internal antenna

Table B-6: Environmental specifications

Item	Specification
Operating temperature	-40° C to +70° C (-40° F to +158° F)
Storage temperature	-40° C to +85° C (-40° F to +185° F)
Humidity	95% non-condensing
Shock and Vibration	Mechanical Shock: EP455 Section 5.14.1 Operational Vibration: EP455 Section 5.15.1 Random
EMC	CE (ISO 14982 Emissions and Immunity), FCC Part 15, Subpart B, CISPR 22
Enclosure	IP67

Continued on next page

A222 Technical Specifications, Continued

A222 technical specifications, continued

Table B-7: Mechanical specifications

Item	Specification
Dimensions	15.8 L x 15.8 W x 7.9 H (cm) 6.2 L x 6.2 W x 3.2 H (in)
Weight	<1.05 kg (<2.30 lbs)
Status indicators (LED)	• Blinking Red - Power on • Blinking Amber - GNSS position available, including RTK float and Atlas • Blinking Green - RTK-fixed or Atlas-converged position available • Blinking any color - Receiver operational
Power/data connector	12-pin male (metal)
Antenna mounting	1-14 UNS female, 5/8-11 UNC female adapter, and surface mount available

References:
[1] Depends on multipath environment, number of satellites in view, satellite geometry and ionospheric activity
[2] Depends also on baseline length
[3] Requires a subscription for Atlas
[4] Receive only, does not transmit this format

Index

End User License Agreement

End User license agreement

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

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

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

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

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

Continued on next page

End User License Agreement, Continued

End User license agreement, continued

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

Continued on next page

End User License Agreement, Continued

End User license agreement, continued

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

Continued on next page

End User license agreement, continued

(c) replace the Software, or the Product, with non-infringing software, or product, of equal or better performance and quality, or (d) if none of the foregoing can be done on a commercially reasonable basis, terminate this license and Licensee shall stop using the Product and Hemisphere shall refund the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.

19. The foregoing sets out the entire liability of Hemisphere and the sole obligations of Hemisphere to Licensee in respect of any claim that the Software or its use infringes any third party rights.
20. INDEMNIFICATION. Except in relation to an infringement action, Licensee shall indemnify and hold Hemisphere harmless from any and all claims, damages, losses, liabilities, costs and expenses (including reasonable fees of lawyers and other professionals) arising out of or in connection with Licensee's use of the Product, whether direct or indirect, including without limiting the foregoing, loss of data, loss of profit or business interruption. TERMINATION. Licensee may terminate this Agreement at any time without cause. Hemisphere may terminate this Agreement on 30 days notice to Licensee if Licensee fails to materially comply with each provision of this Agreement unless such default is cured within the 30 days. Any such termination by a party shall be in addition to and without prejudice to such rights and remedies as may be available, including injunction and other equitable remedies. Upon receipt by Licensee of written notice of termination from Hemisphere or termination by Licensee, Licensee shall at the end of any notice period (a) cease using the Software; and (b) return to Hemisphere (or destroy and provide a certificate of a Senior Officer attesting to such destruction) the Software and all related material and any magnetic or optical media provided to Licensee. The provisions of Sections 6), 7), 8), 9), 10), 15), 21), 26) and 27) herein shall survive the expiration or termination of this Agreement for any reason.
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.

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

Warranty Notice

Warranty notice

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

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

EXCLUSION OF ALL OTHER WARRANTIES. The LIMITED WARRANTY shall apply only if the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS relevant User’s Manual and Specifications, AND the Product is not modified or misused. The Product is provided “AS IS” and the implied warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and ALL OTHER WARRANTIES,
express, implied or arising by statute, by course of dealing or by trade usage, in connection with the design, sale, installation, service or use of any products or any component thereof, are EXCLUDED from this transaction and shall not apply to the Product. The LIMITED WARRANTY is IN LIEU OF any other warranty, express or implied, including but not limited to, any warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, title, and non-infringement.

LIMITATION OF REMEDIES. The purchaser’s EXCLUSIVE REMEDY against Hemisphere GNSS shall be, at Hemisphere GNSS's option, the repair or replacement of any defective Product or components thereof. The purchaser shall notify Hemisphere GNSS or a Hemisphere GNSS's approved service center immediately of any defect. Repairs shall be made through a Hemisphere GNSS approved service center only. Repair, modification or service of Hemisphere GNSS products by any party other than a Hemisphere GNSS approved service center shall render this warranty null and void. The remedy in this paragraph shall only be applied in the event that the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS's relevant User’s Manual and Specifications, AND the Product is not modified or misused. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE
TO PURCHASER, even if Hemisphere GNSS has been advised of the possibility of such damages. Without limiting the foregoing, Hemisphere GNSS shall not be liable for any damages of any kind resulting from installation, use, quality, performance or accuracy of any Product.

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

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

Continued on next page

Warranty Notice, Continued

Warranty notice, continued

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

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

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

Hemisphere GNSS
8515 E. Anderson Drive Scottsdale, AZ 85255, USA
Phone: +1-480-348-6380
Fax: +1-480-270-5070
TECHSUPPORT@HGNSS.COM
WWW.HGNSS.COM

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