Hemisphere®

875-0364-0

A222™ Smart Antenna

User Guide

Revision: A1

August 01, 2017

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™, miniEclipse™, PocketMax3 PC™, PocketMax3™, PocketMax3™, 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:

U.S. Patents					Australia Patents
6111549	6876920	7400956	8000381	8214111	2002244539
6397147	7142956	7429952	8018376	8217833	2002325645
6469663	7162348	7437230	8085196	8265826	2004320401
6501346	7277792	7460942	8102325	8271194	
6539303	7292185	7689354	8138970	8307535	
6549091	7292186	7808428	8140223	8311696	
6711501	7373231	7835832	8174437	8334804	
6744404	7388539	7885745	8184050	RE41358	
6865465	7400294	7948769	8190337		

Other U.S. and foreign patents pending.

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 85255USA
Phone: (480) 348-6380
Fax: (480) 270-5070
techsupport@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 writing to the following email address: techsupport@hgnss.com.

Table of Contents

Chapter 1: Introduction

Introduction

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

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 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 benefits include the following:

- **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

Key Features

Key features of 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
- Integrated 2D tilt sensor enables offset corrections

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

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 Name/Description	Qty	Part Number
A222 GNSS Smart Antenna	1	804-0153-0
Mounting adapter, 1" to 5/8" Pole Mount Mounting adapter, Flat Mount ***Note:*** *Your kit will include one of the above adapters, depending on your order.*	1 1	710-0130-0 710-0129-0
The following accessory items are available for purchase separately for your A222.		
Power/data cable (single DB9), 3 m	1	051-0129-002
Power/data cable (unterminated), 4.6 m	1	051-0169-000

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".

Chapter 2: Installation

Display, Mounting, and Connectors

LED Display

Mounting A222

Powering A222

Installation

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.

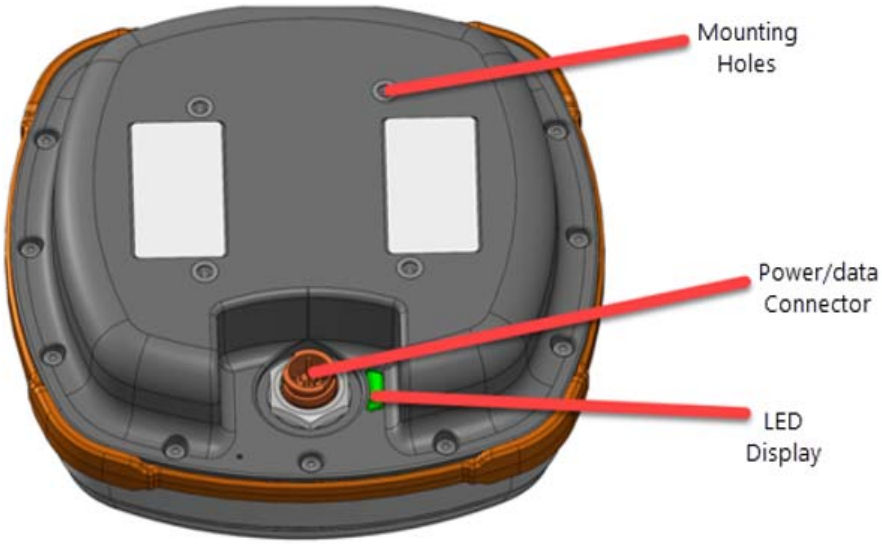

Figure 2-1: A222

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.

LED Display

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 A222

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

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.

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).

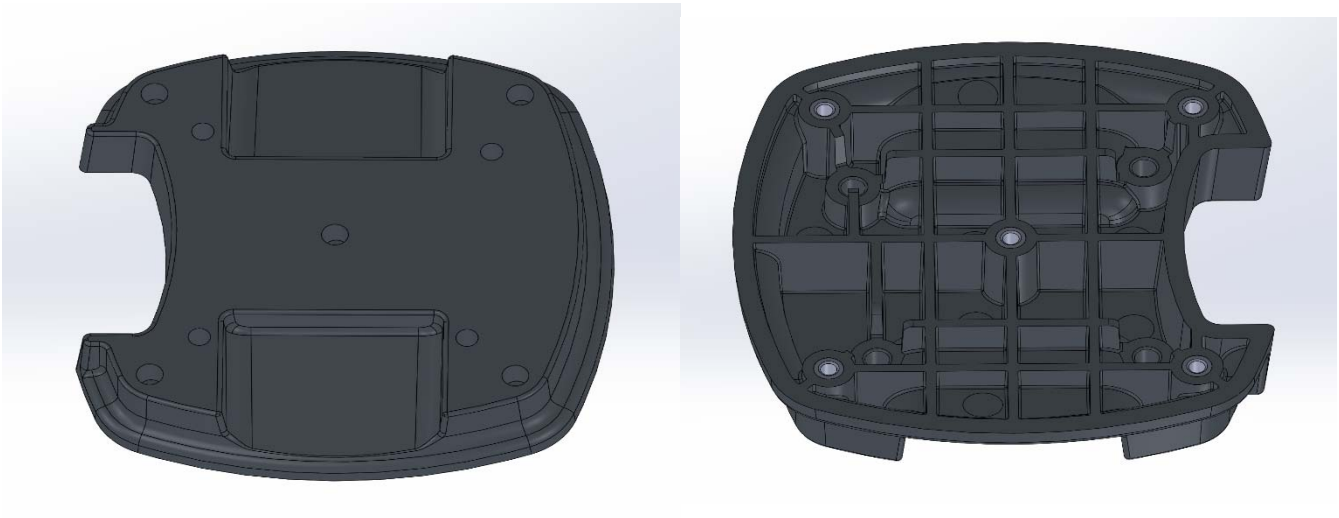

Figure 2-2: A222 Top/Bottom

To surface-mount A222:

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.

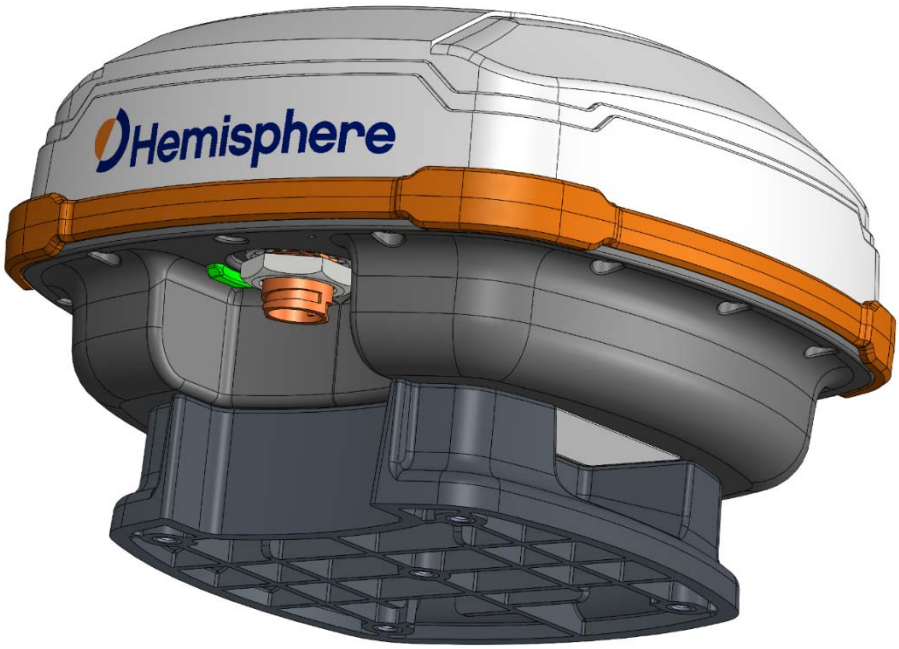

Figure 2-3: A222 Antenna with Surface Mount Accessory

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

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 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 A222 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.

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).

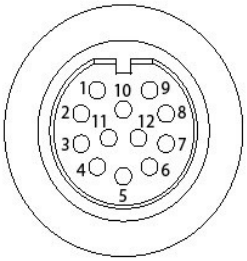

Figure 2-5: Power Assignments

Table 2-2: Pinout 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: Using A222

GNSS Operation

Differential Operation

Default Parameters

Configuring the A222

Using A222

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.

GNSS Operation

The GNSS receiver is always operating, regardless of the DGNSS mode of operation. The following sections describe the general operation of the A222’s internal GNSS receiver.

Automatic Tracking

The A222’s internal GNSS receiver automatically searches for GNSS satellites, acquires the signals, and manages the navigation information required for positioning and tracking.

Receiver Performance

The A222 works by finding four or more GNSS satellites in the visible sky and uses information from the satellites to compute a position within 2.4 m. Since there is some error in the GNSS data calculations, the A222 also tracks a differential correction. The A222 uses these corrections to improve its position accuracy to better than 0.6 m.

The two main aspects of GNSS receiver performance are 1) satellite acquisition, and 2) positioning and heading calculation.

When the A222 is properly positioned, the satellites transmit coded information to the antenna on a specific frequency. This allows the receiver to calculate a range to each satellite.

GNSS is essentially a timing system. The ranges are calculated by timing how long it takes for the signal to reach the GNSS antenna. The GNSS receiver uses a complex algorithm incorporating satellite locations and ranges to each satellite to calculate the geographic location and heading. Reception of any four or more GNSS signals allows the receiver to compute three-dimensional coordinates.

Differential Operation

The purpose of differential GNSS (DGNSS) 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 2.4 m 95% of the time. To improve positioning quality to better than 0.6 m 95%, the A222 can use differential corrections received through the internal SBAS demodulator or through externally supplied RTCM corrections.

Automatic SBAS Tracking

The A222 automatically scans and tracks SBAS signals without the need to tune the receiver. The A222 features three-channel tracking that provides an enhanced ability to maintain a lock on an SBAS satellite when more than one satellite is in view.

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

You can configure the A222 through the serial port using Hemisphere GNSS commands. For example, you can select the:

- 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

Appendix A: Troubleshooting

Table A-1 provides a list of issues with possible solutions to help you troubleshoot anomalous A222 operation.

Table A-1: Troubleshooting

Issue	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connections • Check power input voltage (8 - 32 VDC) • Check current restrictions imposed by power source (maximum is 300 mA at 12 VDC)
• No data from the A222 • No communication • No valid data	• 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
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 displays solid color (not blinking)	• Power-cycle the receiver • Contact Technical Support

Appendix B: Technical Specifications

Appendix B: Technical Specifications

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.

Table B-1: GNSS Sensor Specifications

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)

Table B-2: Horizontal Accuracy

Item	Specification	
	RMS (67%)	2DRMS (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 RS-232

Table B-4: Communication Specifications (continued)

Item	Specification
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, rising edge sync, 10 kΩ, 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 kΩ, 10 pF load

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

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)

Table B-7: Mechanical Specifications (continued)

Item	Specification
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

[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

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.
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 positioning and navigation accuracy obtainable with the Software as stated in the Product or Software documentation serves to provide only an estimate of achievable accuracy based on specifications provided by the US Department of Defense for GPS positioning and DGPS service provider performance specifications, where applicable.
10. **WARRANTY DISCLAIMER.** EXCEPT AS EXPRESSLY SET OUT IN THIS AGREEMENT, HEMISPHERE MAKES NO REPRESENTATION, WARRANTY OR CONDITION OF ANY KIND TO LICENSEE, WHETHER VERBAL OR WRITTEN AND HEREBY DISCLAIMS ALL REPRESENTATIONS, WARRANTIES AND CONDITIONS OF ANY KIND INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, ACCURACY, RELIABILITY OR THAT THE USE OF THE SOFTWARE WILL BE UNINTERRUPTED OR ERROR-FREE AND HEREBY DISCLAIMS ALL REPRESENTATIONS, WARRANTIES AND CONDITIONS ARISING AS A RESULT OF CUSTOM, USAGE OR TRADE AND THOSE ARISING UNDER STATUTE.
11. **LIMITS ON WARRANTY DISCLAIMER.** Some jurisdictions do not allow the exclusion of implied warranties or conditions, so some of the above exclusions may not apply to Licensee. In that case, any implied warranties or conditions which would then otherwise arise will be limited in duration to ninety (90) days from the date of the license of the Software or the purchase of the Product. The warranties given herein give Licensee specific legal rights and Licensee may have other rights which may vary from jurisdiction to jurisdiction.
12. **CHANGE TO WARRANTY.** No employee or agent of Hemisphere is authorized to change the warranty provided or the limitation or disclaimer of warranty provisions. All such changes will only be effective if pursuant to a separate agreement signed by senior officers of the respective parties.
13. **WARRANTY CLAIM.** In the event Licensee has a warranty claim Licensee must first check for and install all Updates that are made available. The warranty will not otherwise be honored. Proof of purchase may be required. Hemisphere does not honor claims asserted after the end of the Warranty Period.
14. **LICENSEE REMEDIES.** In all cases which involve a failure of the Software to conform in any material respect to the documentation during the Warranty Period or a breach of a warranty, Hemisphere's sole obligation and liability, and Licensee's sole and exclusive remedy, is for Hemisphere, at Hemisphere's option, to (a) repair the Software, (b) replace the Software with software conforming to the documentation, or (c) if Hemisphere is unable, on a reasonable commercial basis, to repair the Software or to replace the Software with conforming software within ninety (90) days, to terminate this Agreement and thereafter Licensee shall cease using the Software. Hemisphere will also issue a refund for the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.
15. LIMITATION OF LIABILITY. IN NO EVENT WILL HEMISPHERE BE LIABLE TO LICENSEE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES INCLUDING ARISING IN RELATION TO ANY LOSS OF DATA, INCOME, REVENUE, GOODWILL OR ANTICIPATED SAVINGS EVEN IF HEMISPHERE HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH LOSS OR DAMAGE. FURTHER, IN NO EVENT WILL HEMISPHERE'S TOTAL CUMULATIVE LIABILITY HEREUNDER, FROM ALL CAUSES OF ACTION OF ANY KIND, EXCEED THE TOTAL AMOUNT PAID BY LICENSEE TO HEMISPHERE TO PURCHASE THE PRODUCT. THIS LIMITATION AND EXCLUSION APPLIES IRRESPECTIVE OF THE CAUSE OF ACTION, INCLUDING BUT NOT LIMITED TO BREACH OF CONTRACT, NEGLIGENCE, STRICT LIABILITY, TORT, BREACH OF WARRANTY, MISREPRESENTATION OR ANY OTHER LEGAL THEORY AND WILL SURVIVE A FUNDAMENTAL BREACH.
16. LIMITS ON LIMITATION OF LIABILITY. Some jurisdictions do not allow for the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or

exclusion may not apply to Licensee and Licensee may also have other legal rights which may vary from jurisdiction to jurisdiction.

17. BASIS OF BARGAIN. Licensee agrees and acknowledges that Hemisphere has set its prices and the parties have entered into this Agreement in reliance on the limited warranties, warranty disclaimers and limitations of liability set forth herein, that the same reflect an agreed-to allocation of risk between the parties (including the risk that a remedy may fail of its essential purpose and cause consequential loss), and that the same forms an essential basis of the bargain between the parties. Licensee agrees and acknowledges that Hemisphere would not have been able to sell the Product at the amount charged on an economic basis without such limitations.

18. PROPRIETARY RIGHTS INDEMNITY. Hemisphere shall indemnify, defend and hold harmless Licensee from and against any and all actions, claims, demands, proceedings, liabilities, direct damages, judgments, settlements, fines, penalties, costs and expenses, including royalties and attorneys' fees and related costs, in connection with or arising out of any actual infringement of any third party patent, copyright or other intellectual property right by the Software or by its use, in accordance with this Agreement and documentation, PROVIDED THAT: (a) Hemisphere has the right to assume full control over any action, claim, demand or proceeding, (b) Licensee shall promptly notify Hemisphere of any such action, claim, demand, or proceeding, and (c) Licensee shall give Hemisphere such reasonable assistance and tangible material as is reasonably available to Licensee for the defense of the action, claim, demand or proceeding. Licensee shall not settle or compromise any of same for which Hemisphere has agreed to assume responsibility without Hemisphere's prior written consent. Licensee may, at its sole cost and expense, retain separate counsel from the counsel utilized or retained by Hemisphere.

19. INFRINGEMENT. If use of the Software may be enjoined due to a claim of infringement by a third party then, at its sole discretion and expense, Hemisphere may do one of the following: (a) negotiate a license or other agreement so that the Product is no longer subject to such a potential claim, (b) modify the Product so that it becomes non- infringing, provided such modification can be accomplished without materially affecting the performance and functionality of the Product, (c) replace the Software, or the Product, with non-infringing software, or product, of equal or better performance and quality, or (d) if none of the foregoing can be done on a commercially reasonable basis, terminate this license and Licensee shall stop using the Product and Hemisphere shall refund the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.

    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.

27. **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

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

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

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

Hemisphere GNSS
8515 E. Anderson Drive
Scottsdale, AZ 85255, USA
Phone: +1-480-348-6380
Fax: +1-480-270-5070
techsupport@hregnss.com www.hgnss.com

Hemisphere GNSS Inc.
8515 East Anderson Drive, Suite A
Scottsdale, Arizona, US 85255
Phone: 480-348-6380
Fax: 480-270-5070
precision@hgnss.com
www.hgnss.com