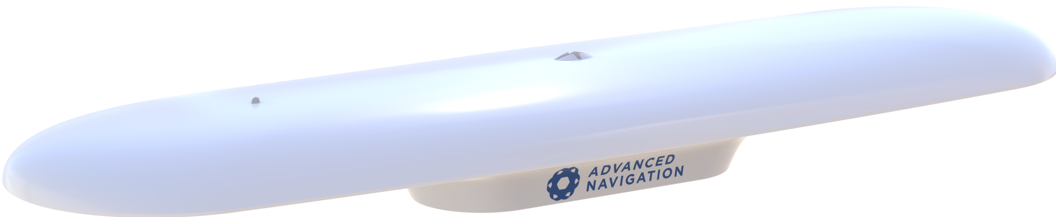

GNSS Compass Reference Manual

v2.6 07 May 2024

Contents

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Document Version: 2.6 Publication Date: 07 May 2024

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1 Revision History

Version	Date	Changes
2.6	7 May 2024	Updated firmware changelog, see 2.1 Firmware Changelog
2.5	14 November 2023	Updated 11.5.6 Port Function Configuration Packet Updated software changelog, see 9.2.1 GNSS Compass Manager Software Changelog Updated firmware changelog, see 2.1 Firmware Changelog Updated 11.5.9 Port Output Configuration Packet
2.4	17 February 2023	Updated software changelog, see 9.2.1 GNSS Compass Manager Software Changelog Updated software installation information to include Java 11 requirement, see 9.2.3 Installation and Starting and 7.1 Installation Checklist Updated instructions for running GNSS Compass Manager on MacOS, see 9.2.3 Installation and Starting
2.3	13 October 2022	Updated firmware changelog, see 2.1 Firmware Changelog Updated hardware changelog, see 2.2 Hardware Changelog Updated software changelog, see 9.2 Using GNSS Compass Manager Updated Logging information as per Manager v6.2, see 9.2.8.4 Log Converter Added disclaimer that ANPP packet 181 is only applicable to State packets, see 11.5.1 Packets Period Packet Corrected error in Filter Options Packet definition, see 11.5.5 Filter Options Packet
2.2	22 July 2022	Updated firmware changelog, see 2.1 Firmware Changelog Updated firmware upgrade section, see 8.12 Upgrading the Firmware Added section outlining how to upgrade GNSS Receiver firmware, see 9.2 Using GNSS Compass Manager Corrected System State Packet definition error, see 11.4.1 System State Packet Updated Standard certification, see 6.8 Certification Updated External Time Packet to show it is Read only, see 11.4.32 External Time Packet Added disclaimer that GNSS Compass manager is only available for systems with x64 architecture, see 7.1 Installation Checklist and 9.2 Using GNSS Compass Manager
2.1	25 March 2022	Updated 2.1 Firmware Changelog Updated 2.2 Hardware Changelog Updated Device ID table, see 11.3.4 Device Information Packet Clarified geoid, ellipsoid and orthometric heights, see 12.5 Geodetic Co-ordinate System Added IP Dataports Configuration Packet, see 11.5.11 IP Dataports Configuration Packet Clarified that 11.4.36 Raw Satellite Data Packet is only valid for v1.x hardware Added connections to Specifications, see 6.5 NMEA 2000 Drop Cable, 6.6 Ethernet Connection & 6.7 Serial Connection

Version	Date	Changes
2.0	4 November 2021	Major update for v2 hardware Updated **2.1 Firmware Changelog** Updated POE injector from AC to DC
1.1	13 January 2021	Updated **2.1 Firmware Changelog** Updated **5 Part Numbers and Ordering** Revised wording on **6.8 Certification** Updated NMEA 0183 Added precise time protocol (PTP)
1.0	23 January 2018	Initial Release

Table 1: Revision History

2 Introduction

GNSS Compass is a low cost all in one GNSS/INS navigation and heading solution. It provides accurate dual antenna GPS based heading that is not subject to magnetic interference and can maintain accurate heading during GNSS outages of up to 20 minutes. It features high accuracy RTK positioning and is plug and play with NMEA 0183, NMEA 2000 and Ethernet interfaces.

The GNSS Compass can provide amazing results but it does need to be set up properly and operated with an awareness of its limitations. Please read through this manual carefully to ensure success within your application.

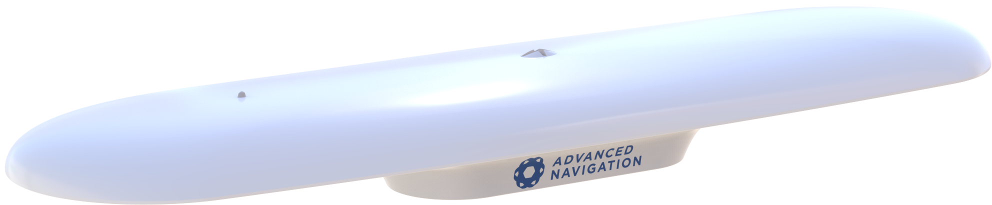

Figure 1: GNSS Compass

Note: For information about Global Navigation Satellite Systems (GNSS) and related concepts explained in simple terms, see **12 Reference Information**.

Use the links below for detailed information about GNSS Compass.

- **5 Part Numbers and Ordering**
- **6 Specifications**
- **7 Installing GNSS Compass**
- **8 Using GNSS Compass**
- **9 Configuring and Monitoring GNSS Compass**
- **10 Interfacing**
- **11 Advanced Navigation Packet Protocol**
- **12 Reference Information**

2.1 Firmware Changelog

Version	Date	Changes
2.47	5 April 2024	Added support for GNSS receiver firmware version 20230830 Improved tolerance to heading drift due to high ionospheric activity
2.30	10 November 2023	GNSS receiver configuration is also reset to default upon a factory restore. More reliable RTCM input buffering in edge cases Populate GGA number of satellites field correctly when NTRIP client sends position to NTRIP server Improved web UI map fitment in the browser Fixed NMEA2000 Rate-of-Turn message (PGN 127251) scaling factor Improve position standard deviation under RTK Float on v2 HW Correct time accuracy when using external time source Improved NMEA2000 reliability. Max 17 satellites reported in PGN129029 NMEA0183 GGA message now reports GNSS Quality = 2 when there is an SBAS Fix. Previously it reported 1 Support more NMEA 0183 output messages in ANPP195 GPIO Output Config Packet NTRIP client GGA message now has DOP field populated and doesn't include any extra preamble bytes Reset time upon cold reset For POE variant, NTRIP client now sends position to NTRIP server regularly to better support VRS Fixed memory leak that could cause crash after 100's of network dataport connect/disconnect cycles Fixed memory leak in NTRIP client In the NTRIP client, don't prepend HTTP preamble when sending GGA message Correctly populate the NTRIP client GGA message DOP field Increased magnetometer sample rate for improved navigation Change NMEA2000 to report DGNSS instead of 3D under SBAS fix Fix potential out of order NMEA2000 Fast Packets incompatibility with some receivers Improved reliability when there are a lot of satellites on HW v2 Improved reliability NTRIP client on HW v2 POE variant Fixed issue with NTRIP client not streaming from some servers Fixed NMEA2000 Position rounding Fixed NMEA2000 output data was noisier than the equivalent ANPP data Changed GNSS firmware version reporting in ANPP69 to prefix version number with a 9 when receiver chipset versions are different Fixed WebUI map and pin show different location to numerical position Fix Factory Restore and Cold Start Reset not clearing position
2.24	28 Septem-	Fixed failure to set NMEA packet rates

Version	Date	Changes
	ber 2022	Fixed ANPP packet periods packet not rejecting packets other than state packets
2.23	05 September 2022	Added support for hardware v2.3 Improved SBAS performance
2.22	12 July 2022	Added support for Aries GC2 GNSS Receiver firmware v220622 - improved RTK performance and fix time, improved SBAS support, added support for QZSS Improved navigation filter performance during RTK Float Improved reliability of RTCM corrections Improved RTCM3.x support Added support to Web UI NTRIP client for connecting to servers with NTRIP V2.0 Improved NTRIP server reconnection Added choice of auto or manual DNS config for DHCP mode in network configuration Web UI Fixed bug where DNS server field was ignored for Static IP mode Fixed current DNS server address not populating in the ANPP IP configuration packet Added GNSS Fail flag if GNSS receiver cannot boot properly or has unsupported firmware version Added hardware version check on startup, sending the unit to bootloader if the firmware is incompatible with the hardware Improved recovery from failed GNSS Receiver firmware updates Fixed issue when setting GPIO Output NMEA message rate to 25Hz disabled the message Various bug fixes
2.2	11 February 2022	Added support for HW v2.2 - **minimum FW version for HW v2.2** Improved vehicle type configuration on HW v2.x Fixed map not showing in Web UI Removed unsupported NMEA Packet rate from Web UI Fixed support for SBAS on HW v2.x devices Fixed timestamps on NMEA0183 packets that sometimes jumped backwards Fixed user config not saving on HW v2.x devices Fixed Zero Current Orientation values not updating in Web UI Fixed magnetometer measurement on HW v2.x Other general reliability improvements
2.1	6 October 2021	Updated to support v2 hardware
1.24	12 January 2020	Improved heading reliability Fixed intermittent issue with heading status indicator in Web UI
1.23	18 December 2020	Fixed NMEA 2000 time/date stamps that was outputting random times – Serial variants Fixed ANPP GNSS Receiver Info packet length
1.2	1 November 2018	Stability and accuracy improvements Bug fix for false magnetometer failure

Version	Date	Changes
		Bug fix for Raw Satellite Data packet always on/always off Default vehicle profile changed to small boat Bug fix for cold start reset not working Heave fix
0.96	5 December 2017	Initial release firmware

Table 2: Firmware Changelog

Note: To upgrade the firmware to the latest version, see **8.12 Upgrading the Firmware**.

2.2 Hardware Changelog

Version	Date	Changes
2.3	03 August 2022	PCB layout changes to accommodate alternate parts
2.2	15 January 2022	Manufacturing updates
2.1	6 December 2021	Manufacturing updates
2.0	23 September 2021	Combined LC and HA variants Updated GNSS receiver to Aries GC2 Updated sensors
1.0	10 May 2017	Initial release

Table 3: Hardware Changelog

3 Getting Started

To get started with GNSS Compass for the first time, it is recommended that you begin by establishing communications to the device, either before or after the unit is installed in its final location. These instructions assume the use of components provided in the **4 Evaluation Kit**, or purchased as Advanced Navigation supplied optional **5.3 Accessories**.

1. Install the GNSS Compass in an area where it has a full clear view of the sky and away from strong radio transmission sources as shown in **Figure 2: GNSS Compass ideal mounting location**

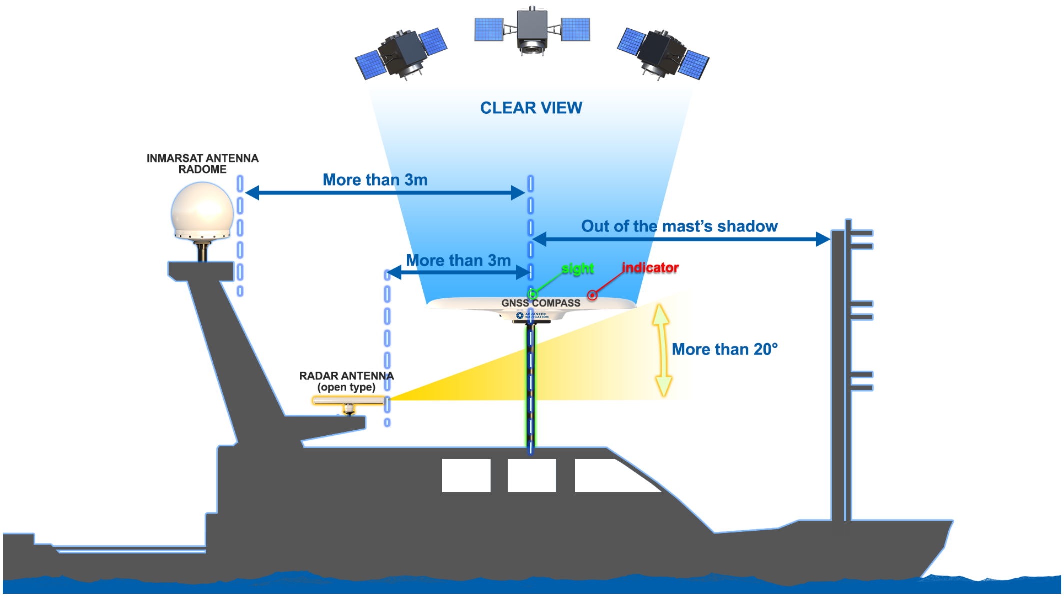

Figure 2: GNSS Compass ideal mounting location

2. Ensure that the GNSS Compass is aligned with the vessel such that the indicator on top is aligned pointing forwards on the vessel. The sight can be used to assist alignment by eye. See Figure 3: GNSS Compass alignment.

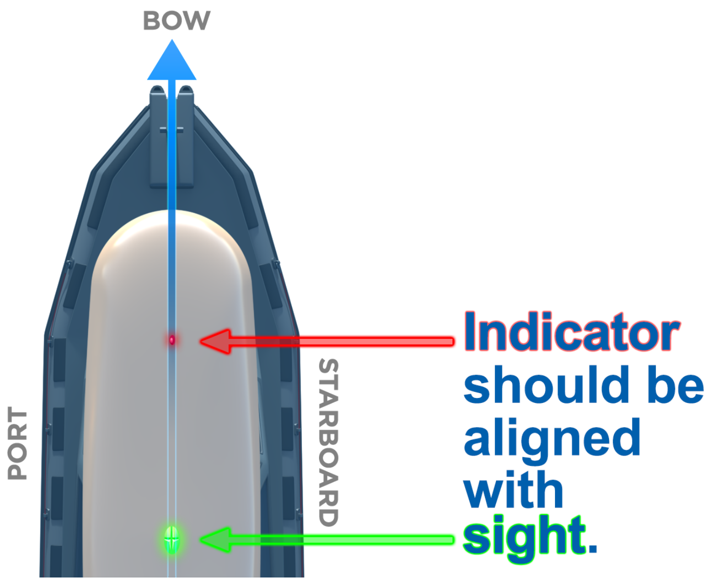

Figure 3: GNSS Compass alignment

3. Plug the cable into the GNSS Compass and rotate the nut clockwise to lock it in place. See GNSS Compass connector locking

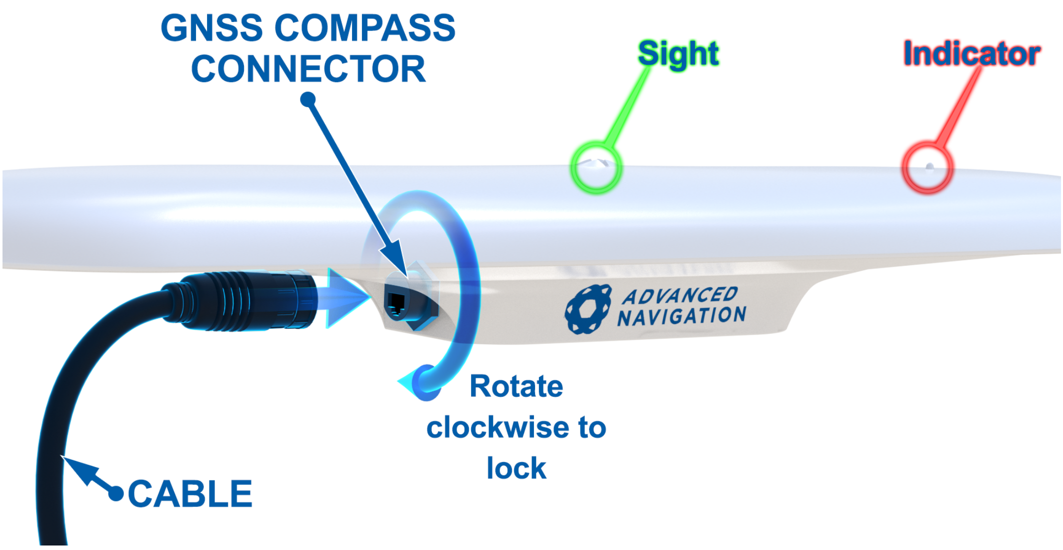

Figure 4: GNSS Compass connector locking

3.1 NMEA 2000 Connection

Plug the NMEA 2000 drop cable into a T connector on the NMEA 2000 backbone. The unit will power on and output the required NMEA 2000 messages without any configuration required. See 6.5 NMEA 2000 Drop Cable for more information.

3.2 NMEA 0183 Connection

Plug a 9 to 36 volt power source into the DC jack and connect the auxiliary RS422 port to the receiving NMEA0183 device. See **6.7 Serial Connection** for further details on the pin-out of the serial breakout cable recommended for NMEA 0183 installations. See **8.6 NMEA 0183** for further details on message configuration.

3.3 Power over Ethernet Connection

1. Plug the Ethernet cable from the GNSS Compass into the “Data+Power” port on the PoE injector. Plug an Ethernet cable into the Data port and connect the other end to a DHCP router.
2. Install zeroconf (Apple Bonjour) from one of the links below:

   https://www.advancednavigation.com.au/Bonjour.msi (32-bit installer)

   https://www.advancednavigation.com.au/Bonjour64.msi (64-bit installer)
3. Open a web browser and type in the address **http://gnss-compass.local/** to access the web interface.
4. The default username is admin and the default password is password.

4 Evaluation Kit

The Evaluation Kits provides the necessary parts and accessories to set up and connect a GNSS Compass unit. They are available in both an Ethernet (POE) and Serial version.

4.1 Evaluation Kit Contents

The GNSS Compass Evaluation Kit Contents are detailed below for both the Ethernet and Serial variants.

Part Number	Quantity		Description	Notes
	Ethernet	Serial		
GC2-EK-POE	1		GNSS Compass Ethernet Variant	GNSS Compass Ethernet variant Power over Ethernet interface Supports GPS, GLONASS, Galileo & BeiDou constellation L1/L2 10mm RTK Supports DGPS and SBAS Does not support L band
GC2-EK-SER		1	GNSS Compass Serial Variant	GNSS Compass Serial variant RS422/RS232 and CAN interfaces Supports GPS, GLONASS, Galileo & BeiDou constellation L1/L2 10mm RTK Supports DGPS and SBAS Does not support L band
CABLE-FTDI		1	RS232/422 Adaptor to USB	FTDI USB to RS232 / RS422 (selectable) 1 metre cable
SUPPLY-24V	1	1	24 V DC power supply	100-240 V AC Mains to 24 V DC Power Supply (DC jack) Includes 2-pin plug types A/C/G/I
GC-POE-CABLE-20M	1		20m Ethernet cable for GNSS Compass	20m CAT5e Ethernet cable with RJ45 Compatible with Ethernet units only (GC2-POE) IP67 environmentally sealed connector See **6.6 Ethernet Connection** for full details

Part Number	Quantity		Description	Notes
	Ethernet	Serial		
GC-SER-BREAK-20M		1	20m serial break-out cable for GNSS Compass	20m cable to DB9 connectors Compatible with serial units only (GC2-SER) IP67 environmentally sealed connector See **6.7 Serial Connection** for full details
POE-INJECTOR-DC	1		DC POE Injector	24V DC PoE Injector 25W 802.3at Type 2 "PoE+"

Table 4: Evaluation Kit Contents

5 Part Numbers and Ordering

This topic covers information about:

5.1 Evaluation Kits

Part Number	Description	Notes
GC2-EK-POE	GNSS Compass Ethernet Evaluation Kit	See **4 Evaluation Kit** for kit contents
GC2-EK-SER	GNSS Compass Serial Evaluation Kit	See **4 Evaluation Kit** for kit contents

Table 5: Evaluation Kit Part Numbers

5.2 Standalone Units

Part Number	Description	Notes
GC2-POE	GNSS Compass Ethernet Variant	GNSS Compass Ethernet variant Power over Ethernet interface Supports GPS, GLONASS, Galileo & BeiDou constellation L1/L2 10mm RTK Supports DGPS and SBAS Does not support L band No cables included
GC2-SER	GNSS Compass Serial Variant	GNSS Compass Serial variant RS422/RS232 and CAN interfaces Supports GPS, GLONASS, Galileo & BeiDou constellation L1/L2 10mm RTK Supports DGPS and SBAS Does not support L band No cables included

Table 6: Standalone Unit Part Numbers

5.3 Accessories

Part Number	Description	Notes
GC-POE-CABLE-20M	20m Ethernet cable for GNSS Compass	20m CAT5e Ethernet cable with RJ45 Compatible with Ethernet units only (GC2-POE) IP67 environmentally sealed connector See **6.6 Ethernet Connection** for full details
GC-NMEA2000-CABLE	6m NMEA 2000 drop cable for GNSS Compass	6m NMEA 2000 drop cable Compatible with serial units only (GC2-SER) IP67 environmentally sealed connector See **6.5 NMEA 2000 Drop Cable** for full details
GC-SER-BREAK-20M	20m serial breakout cable for GNSS Compass	20m cable to DB9 connectors Compatible with serial units only (GC2-SER) IP67 environmentally sealed connector See **6.7 Serial Connection** for full details
GC-SER-CABLE-20M	20m unterminated serial cable for GNSS Compass	20m unterminated cable Compatible with serial units only (GC2-SER) IP67 environmentally sealed connector See **6.7 Serial Connection** for full details
POE-INJECTOR-DC	DC POE Injector	24V DC PoE Injector 25W 802.3at Type 2 "PoE+" Requires 12/24V DC power supply (SUPPLY-24V, CAR12VPWR or similar)
SUPPLY-24V	24 V DC Power Supply	100-240 V AC Mains to 24 V DC Power Supply (DC jack) Includes 2-pin plug types A/C/G/I
CAR12VPWR	Car auxiliary power outlet supply	Car auxiliary power supply to 2.1 x 5.5mm DC jack power supply
CABLE-FTDI	USB to RS232 / RS422 cable 1 m	1 m FTDI USB to RS232 / RS422 (selectable) cable
MOUNT-SUCT	Suction Cup Antenna Mount	Suction cup 5/8” GNSS antenna survey mount for easy installation of GNSS antenna on vehicles. Requires 5/8" to 1-14 UNS-2A thread adapter, not supplied
GC-CASE	Rugged Transport Case	Rugged Transport Case

Table 7: Ordering Part Numbers for Accessories

6 Specifications

Review the following specifications for GNSS Compass Ethernet:

6.1 Navigation Specifications

Specification	Value
Horizontal Position Accuracy	1.5 m
Vertical Position Accuracy	2.0 m
Horizontal Position Accuracy (with RTK)	0.01 m
Vertical Position Accuracy (with RTK)	0.015 m
Velocity Accuracy	0.05 m/s
Roll & Pitch Accuracy	0.4 °
Heading Accuracy with Dual GNSS	0.2 °
Heave Accuracy (whichever is greater)	5 % or 0.05 m
Rotation Range	Unlimited
Hot Start Time (orientation)	1 s
Internal Filter Rate	200 Hz
Output Data Rate	200 Hz

Table 8: GNSS Compass Navigation Specifications

6.1.1 GNSS Specifications

Specification	Value
Model	Advanced Navigation Aries GC2
Supported Navigation Systems	GPS L1, L2 GLONASS L1, L2 Galileo E1, E5b BeiDou B1, B2
Supported SBAS Systems	WAAS

Specification	Value
	EGNOS MSAS GAGAN QZSS
Update Rate	8 Hz
Hot Start First Fix	6 s
Cold Start First Fix	30 s
Heading Fix (after valid position)	10 s
Acceleration Limit	4 g

Table 9: GNSS Specifications

6.2 Hardware Specifications

6.2.1 Ethernet Variant

Specification	Value
Power Input	Power over Ethernet (PoE) 802.3af or 802.3at
Power Consumption	1.3 W
Operating Temperature	-40 °C to 85 °C
Environmental Protection	IP67
Shock Limit	75 g 11 ms
Dimensions (length x width x height)	672 mm x 190 mm x 73.9 mm
Weight	1450 grams

Table 10: Hardware Specifications for GNSS Compass Ethernet

6.2.2 Serial Variant

Specification	Value
Power Input	9 to 36 V
Input Protection	-40 to 60 V
Power Consumption	1.4 W
Operating Temperature	-40 °C to 85 °C
Environmental Protection	IP67
Shock Limit	75 g 11 ms
Dimensions (length x width x height)	672 mm x 190 mm x 73.9 mm
Weight	1450 grams

Table 11: Hardware Specifications for GNSS Compass Serial

6.2.3 Mechanical Drawings

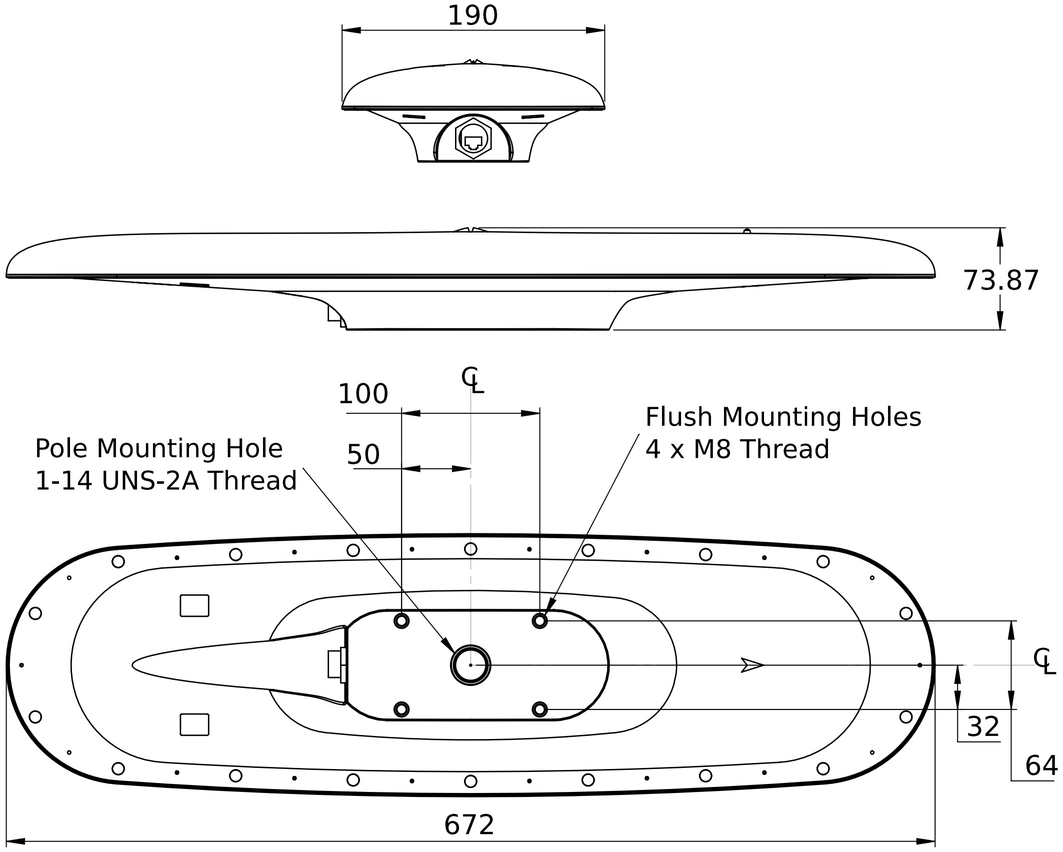

Figure 5: Mechanical Drawings of GNSS Compass

6.2.4 Axes

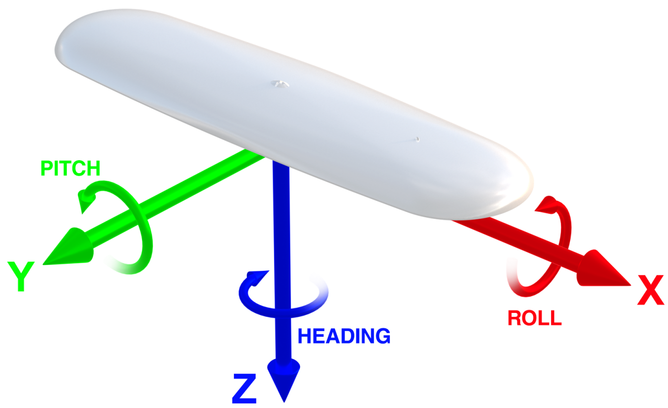

Figure 6: GNSS Compass axes with arrows showing positive direction

6.2.5 Serial Number

Units can be identified and tracked using the device serial number. This can be observed in a numbers of ways:

- Through the Device Information page in the web UI (**9.1.2 View Menu**)
- Through the Device Information page in the **9.2 Using GNSS Compass Manager** application.
- Via the 2D data matrix bar code on the underside of the enclosure near the IO connector. Applications are available for most smart-phones that can scan the 2D data matrix bar code to display the serial number. The label also contains the hardware version and build date.

Figure 7: GNSS Compass External Serial Number Sticker

6.3 Communication Specifications

6.3.1 Ethernet Variant

Interfaces	Ethernet
Speed	10/100 Mbps
Protocols	NMEA 0183 Advanced Navigation Packet Protocol TSS1 Simrad
Ports	Up to 4 TCP or UDP ports
Timing	PTP Server NTP Server
Timing Accuracy	50 ns (PTP) 1 ms (NTP)

Table 12: Ethernet Communication Specifications

6.3.2 Serial Variant

Interfaces	RS422 or RS232 CAN
Speed	2400 to 1 M baud
Protocols	NMEA 0183 NMEA 2000 Advanced Navigation Packet Protocol TSS1 Simrad
Timing	1PPS Output
Timing Accuracy	20 ns
Additional Interfaces	Auxiliary RS422/RS232 1PPS Output Alarm Output

Table 13: Serial Communication Specifications

6.4 Electrical Specifications

Parameter	Minimum	Typical	Maximum
RS232			
Tx Voltage Low		-5.4 V	-5 V
Tx Voltage High	5 V	5.4 V	
Tx Short Circuit Current			±60 mA
Rx Threshold Low	0.6 V	1.2 V	

Parameter	Minimum	Typical	Maximum
Rx Threshold High		1.5 V	2.0 V
RS422			
Tx Differential Output	1.5 V		
Tx Short Circuit Current			±250 mA
Rx Differential Threshold	-0.2 V		-0.05 V
1PPS			
Output Voltage Low	0 V		0.1 V
Output Voltage High	3 V		3.3 V
Output Current			50 mA

Table 14: Electrical Specifications

6.5 NMEA 2000 Drop Cable

The NMEA 2000 cable is only compatible with GNSS Compass part number GC2-SER. It has part number GC-NMEA2000-CABLE.

The NMEA 2000 cable is used to connect the serial variant GNSS Compass to an NMEA 2000 network and sends messages via the CAN protocol. See **8.5 NMEA 2000** messages for further details.

Connection to the GNSS Compass is made through a Holin C-Size 18 pin connector. The Holin part number is CCN-L218SM. The connector has a bayonet lock and provides a reliable and rugged connection to the GNSS Compass under demanding conditions. It is rated to IP67 in the mated condition. The opposite end of the cable is a 5 pin male Micro-C connector as per the NMEA 2000 standard. The cable is 6 metres long, dual shielded and UV stable.

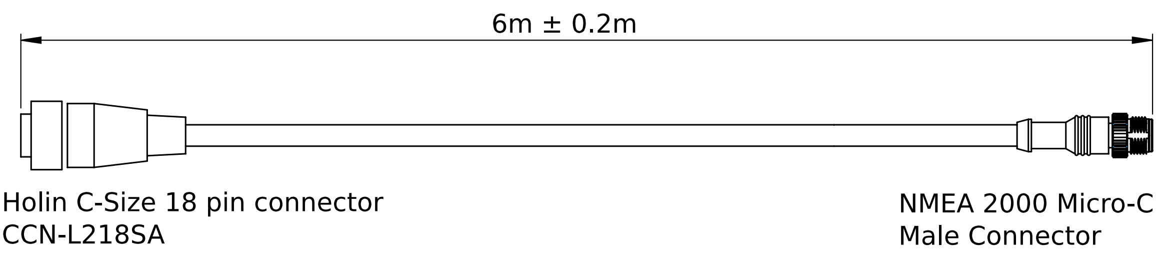

Figure 8: NMEA 2000 Drop Cable

Pin	Colour	Function
1	Bare	Drain/Shield
2	Red	Power Supply
3	Black	Power Ground
4	White	CAN Hi
5	Blue	CAN Lo

Table 15: NMEA 2000 drop cable pin allocation table

The NMEA 2000 drop cable should be used to connect to a T piece along the NMEA 2000 backbone in the vessel, see **Figure 9: GNSS Compass NMEA 2000 Connection**.

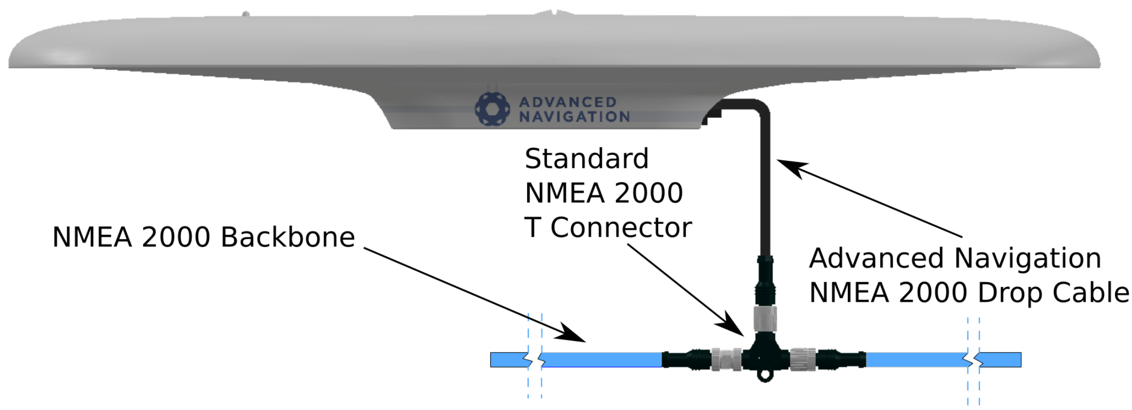

Figure 9: GNSS Compass NMEA 2000 Connection

6.6 Ethernet Connection

The Ethernet cable, part number GC-POE-CABLE-20M, is only compatible with GNSS Compass part number GC2-POE.

Connection to the Ethernet variant of the GNSS Compass is made through a Holin RJ45C- L4SAS environmentally sealed RJ45 connector. The connector has a bayonet lock and provides a reliable and rugged connection to the GNSS Compass under demanding conditions. It is rated to IP67 in the mated state. The opposite end of the cable is a shielded RJ45 plug that can connect to standard Ethernet equipment. The cable is 20 metres long shielded CAT5e with a UV stable jacket.

A standard CAT5, CAT5e or CAT6 Ethernet cable can be plugged into the connector on the GNSS Compass model GC2-POE, however it will not be environmentally sealed so is not recommended for outdoor use. Additionally most standard Ethernet cable are not UV stable and will break down in sunlight.

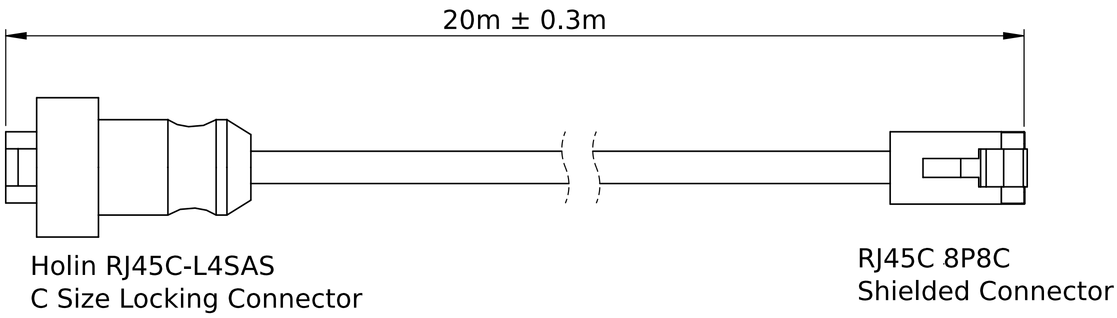

Figure 10: Ethernet Cable

6.7 Serial Connection

Note: The serial cable connections described in this section are only compatible with the Serial version of GNSS Compass, part number GC2-SER.

The Serial connection is used to provide the power supply and access to a range of interface connections. It can be achieved with a **6.7.2 Serial Unterminated Cable**, a **6.7.1 Serial Breakout Cable** or by building your own cable (see **6.7.3 Custom Serial Termination**). Connection is made through a Holin C-Size 18 pin connector.

6.7.1 Serial Breakout Cable

The serial breakout cable part number is GC-SER-BREAK-20M. The cable contains 4 female DB9 connectors and a 2.1 x 5.5mm DC connector. The cable assembly is supplied with 20 metres of UV stable shielded cable. Each individual wire is colour coded 26AWG wire. These connectors are not environmentally sealed.

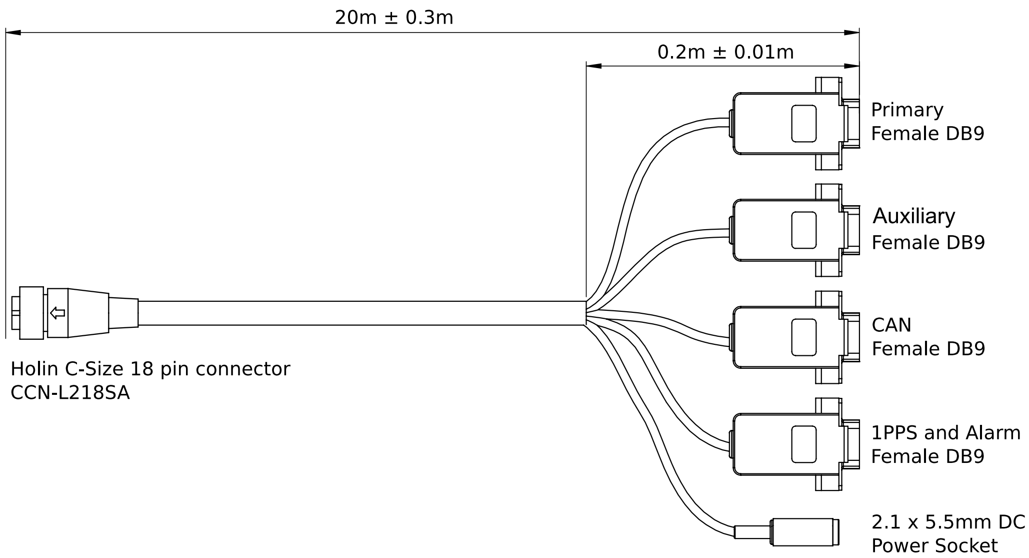

Figure 11: Serial Breakout Cable

Given below are details of the Serial breakout cable connections.

Function	Primary	Auxiliary	CAN	1PPS	Power
Power Supply					Tip
Power Ground					Ring
Primary RS422 Tx(+) / RS232 Tx	2				
Primary RS422 Tx(-)	8				
Primary RS422 Rx(+) / RS232 Rx	3				
Primary RS422 Rx(-)	7				
Auxiliary RS422 Tx(+) / RS232 Tx		2			
Auxiliary RS422 Tx(-)		8			
Auxiliary RS422 Rx(+) / RS232 Rx		3			
Auxiliary RS422 Rx(-)		7			
Signal Ground	5	5			
CAN Hi			7		
CAN Lo			2		
Alarm Hi				9	
Alarm Lo				1	
1PPS Out				2	
Signal Ground			6	5	

Function	Primary	Auxiliary	CAN	1PPS	Power
Drain Wire					Ring

Table 16: Serial Breakout Cable Connector Pin-out

6.7.2 Serial Unterminated Cable

The unterminated serial cable part number is GC-SER-CABLE-20M. The cable assembly is supplied with 20 metres of unterminated UV stable shielded cable. Each individual wire is colour coded 26AWG wire.

This cable is intended only for customers with experience in terminating shielded cable.

See **6.7.2.1 Pin Allocation** for details on pin out functions.

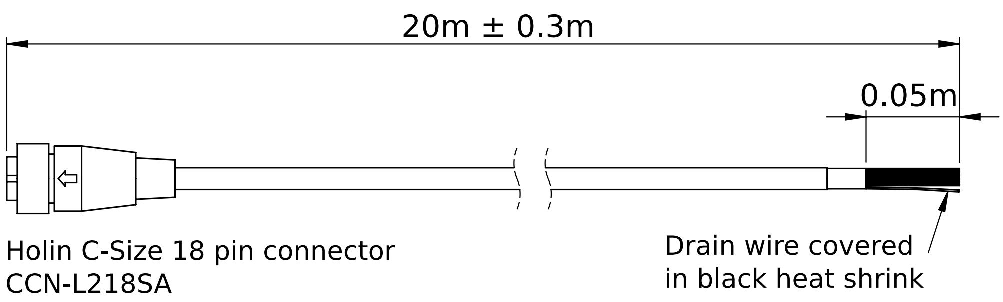

Figure 12: Serial Unterminated Cable

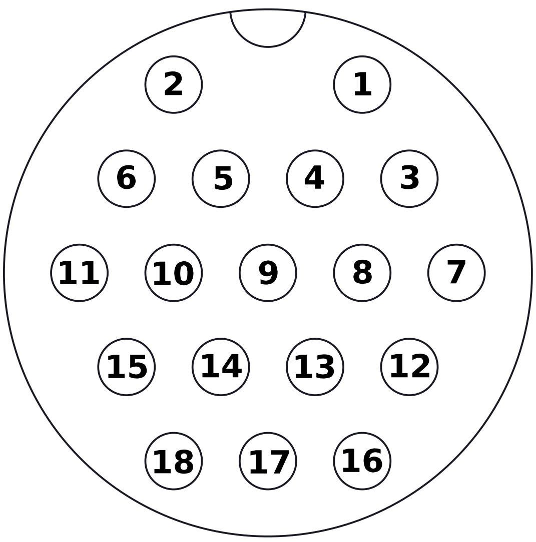

Figure 13: Connector pin assignment viewed from the front

6.7.2.1 Pin Allocation

Pin	Colour	Function
1	Red	Power Supply
2	Black	Power Ground
3	Green	Primary RS422 Tx(+) / RS232 Tx

Pin	Colour	Function
4	Green/White	Primary RS422 Tx(-)
5	Purple	Primary RS422 Rx(+) / RS232 Rx
6	Purple/White	Primary RS422 Rx(-)
7	Brown	Auxiliary RS422 Tx(+) / RS232 Tx
8	Brown/White	Auxiliary RS422 Tx(-)
9	Pink	Auxiliary RS422 Rx(+) / RS232 Rx
10	Pink/White	Auxiliary RS422 Rx(-)
11	Grey	Signal Ground
12	White	CAN Hi
13	Blue	CAN Lo
14	Orange	Alarm Hi
15	Orange/White	Alarm Lo
16	Yellow	1PPS Out
17	Grey/White	Signal Ground
18	Bare	Drain Wire

Table 17: Pin Allocation Table

6.7.3 Custom Serial Termination

Whilst it is recommended to use either a breakout cable or an unterminated cable from Advanced Navigation, you can also source and build your own custom Serial cable.

Connection to the GNSS Compass is made through a Holin C-Size 18 pin connector. The Holin part number is CCN-L218SM. The connector has a bayonet lock and provides a reliable and rugged connection to GNSS Compass under demanding conditions. It is rated to IP67 in the mated state.

See **6.7.2.1 Pin Allocation** for details on pin out functions.

6.8 Certification

The GNSS Compass is designed to meet IMO wheelmark for MED/4.7 Speed and Distance Measuring Equipment (SDME) and MED/4.41 Transmitting Heading Device (THD, GNSS method) based on the Directive 2014/90/EU.

The Serial model GC2-SER is pending certification to the following standards.

IMO Standards	ISO/IEC Standards
IMO Res.MSC 116(73)	ISO 22090-3:2014
IMO Res.MSC 191(79)	IEC 60945 (2002) incl. IEC 60945 Corr. 1 (2008)
IMO Res.A.694(17)	IEC 61162-1 ed4.0 (2010-11)
	IEC 61162-2 ed1.0 (1998-09)
	IEC 62288 Ed. 2.0 (2014-07)

Table 18: Standards for GC2-SER

The Ethernet model GC2-POE is pending certification to the following standards.

IMO Standards	ISO/IEC Standards
IMO Res.MSC 116(73)	ISO 22090-3:2014
IMO Res.MSC 191(79)	IEC 60945 (2002) incl. IEC 60945 Corr. 1 (2008)
IMO Res.A.694(17)	IEC 61162-450 Ed. 1.1 (2016-03)
	IEC 62288 Ed. 2.0 (2014-07)

Table 19: Standards for GC2-POE

7 Installing GNSS Compass

To install and quickly get started with GNSS Compass, follow the instructions provided in the **7.1 Installation Checklist**

Additional information related to installing GNSS Compass is provided in the following sections:

See	For
7.2 Mounting GNSS Compass	Guidelines on selecting the mounting location for the unit.
7.3 Mounting Alignment	Guidelines on setting the alignment with respect to the vehicle and antennas.
7.4 Networking	Information about changing GNSS Compass to a fixed IP address system after establishing a connection.
7.5 Vibration	Steps to mitigate the adverse effects of vibration on the performance.

Table 20: Additional Information

Note: For ordering an evaluation kit, a standalone kit or accessories for GNSS Compass, see **5 Part Numbers and Ordering**.

7.1 Installation Checklist

The GNSS Compass is designed to be plug and play such that it does not normally require any customer configuration. Typical installations utilising NMEA 0183 or NMEA 2000 will work out of the box.

7.1.1 Connection Options

The cables available from Advanced Navigation feature a connector with a locking nut and o-ring that are waterproof and dirtproof to the IP67 standard as well as resistant to shock and vibration. The environmental protection only applies when the connector is locked by pushing in and rotating the nut clockwise until it clicks, see **Figure 14: Connector locking**.

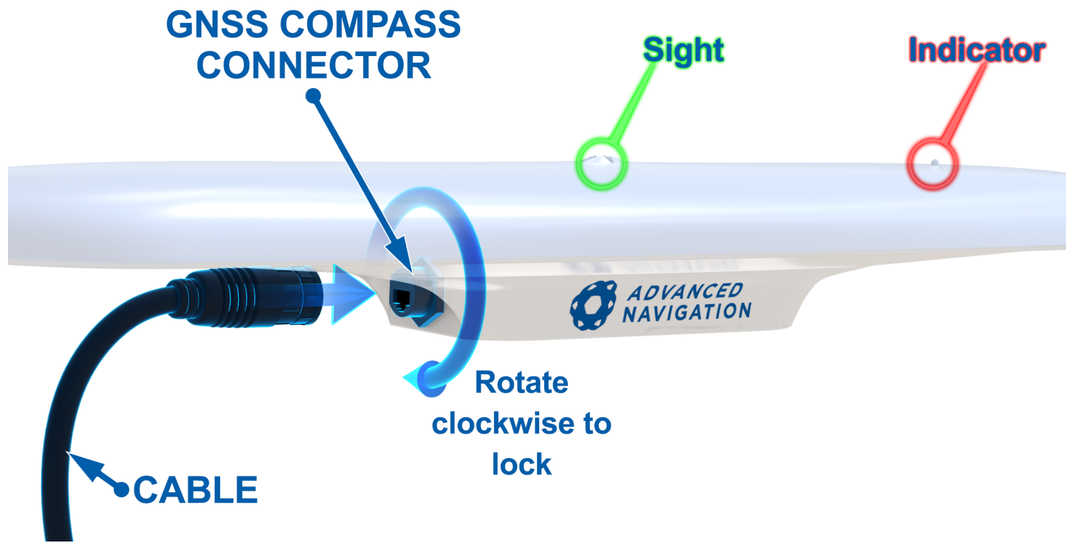

Figure 14: Connector locking

7.1.1.1 NMEA 2000

For connection to an NMEA 2000 network the **6.5 NMEA 2000 Drop Cable** is required (part number GC-NMEA2000-CABLE). One end of the cable should be connected to the GNSS Compass and the other end to a T-connector on the NMEA 2000 backbone of the vessel.

7.1.1.2 NMEA 0183

For connection to an NMEA 0183 network the Advanced Navigation **6.7.1 Serial Breakout Cable** is required (part number GC-SER-BREAK-20M). The auxiliary serial port connector should be connected to the receiving device. Power supply of between 9 to 36 volts should be applied to the DC jack with a 5 amp fuse.

7.1.1.3 Ethernet

For connection to an Ethernet network the Advanced Navigation **6.6 Ethernet Connection** is required (part number GC-POE-CABLE-20M). One end of the cable should be connected to the GNSS Compass and the other to either a PoE injector (part number POE-INJECTOR-DC) or 802.3af or 802.3at compliant PoE switch. The PoE injector or switch is then connected to a router.

7.1.1.4 ANPP

For connection to an ANPP receiving device the Advanced Navigation Serial Breakout Cable is required (part number GC-SER-BREAK-20M). The primary serial port connector should be connected to the receiving device. Power supply of between 9 to 36 volts should be applied to the DC jack with a 5 amp fuse.

For advanced applications requiring configuration changes please follow the steps below.

7.1.2 Configuration

7.1.2.1 Serial Variants

1. Mount the unit in the standard alignment of X+ pointing forward and Z+ pointing down. For more information, see **7.2 Mounting GNSS Compass**.
2. Connect a USB to serial adaptor to the primary port of the GNSS Compass Serial Breakout Cable.
3. **Java 11 is required** to run GNSS Compass Manager.
   Adoptium JRE 11 is the recommended Java installer to be used on all platforms. Install the latest version of Java 11 from **Adoptium**, selecting the correct operating system and architecture for your computer.
4. Download GNSS Compass Manager from the **GNSS Compass** product page of the Advanced Navigation website.

   Note: GNSS Compass Manager is only available for systems with x64 architecture.

5. Double click GNSS Compass Manager to start the application. See **9.2 Using GNSS Compass Manager** for specific notes for different platforms
6. Run GNSS Compass Manager by double clicking on the file.
7. Select the port, set the baud rate to 115,200 and click Connect.
8. Using the Configuration menu, options can be changed as required. Changes to configuration are saved between power cycles and only need to be applied once.

7.1.2.2 Ethernet Variants

1. Mount the unit in the standard alignment of X+ pointing forward and Z+ pointing down. For more information, see **7.2 Mounting GNSS Compass**.
2. Plug the Ethernet cable from the GNSS Compass into the “Data+Power” port on the PoE injector. Plug an Ethernet cable into the Data port and connect the other end to a DHCP router.
3. Download and install the Bonjour ZeroConf networking utility from the link **https://www.advancednavigation.com/Bonjour64.msi**.
4. Open a web browser and type in the address http://gnss-compass.local/ to access the web interface.
5. Using the Configuration menu, options can be changed as required. Changes to configuration are saved between power cycles and only need to be applied once. The default username is admin and default password is password.

7.2 Mounting GNSS Compass

7.2.1 Mounting Location

When installing GNSS Compass into a vehicle, the mounting position and **alignment** of the unit are essential for achieving optimal performance. Position refers to the physical location within the vehicle where the unit is installed while alignment refers to the orientation of the unit with respect to the orientation of the vehicle.

When planning a mounting location for GNSS Compass, refer to **Figure 15: Mounting Location example**, and be mindful of the following recommendations.

- Mount the unit in clear view of the sky
- Mounting the unit at least 3m from transmitting devices, otherwise they may degrade heading performance due to interference.
- Mount the unit in an area that will not exceed the rated temperature range, and with minimal temperature fluctuations.
- Mount the unit away from high levels of vibration where possible.
- Mount the unit at least 10 cm away (and preferably as far as possible) from sources of dynamic magnetic interference such as high current wiring or large motors for best performance.

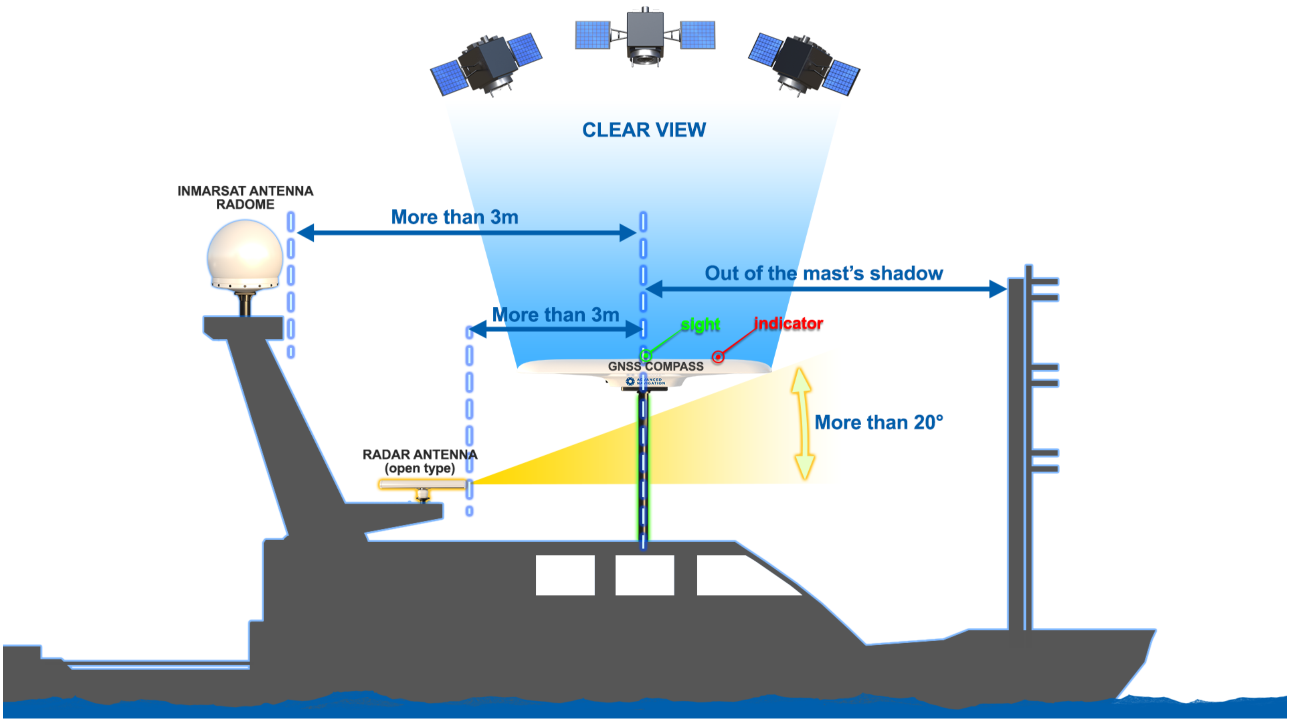

Figure 15: Mounting Location example

7.2.2 Mounting Options

The GNSS Compass can either be pole mounted, or surface mounted. See **6.2.3 Mechanical Drawings** for details

7.2.2.1 Pole mounting

If pole mounting the unit, connection is via a single 1-14 UNS-2A thread. The provided 1" nylon and 1" locking nut should be used to mount to a suitable mounting pole as illustrated in **Figure 16: Pole mounting assembly (pole mount not included)**.

Figure 16: Pole mounting assembly (pole mount not included)

7.2.2.2 Surface mounting

If mounting on a surface, use the 4 x M8 fixing holes as indicated in the **6.2.3 Mechanical Drawings**. It is strongly recommended to use the included shoulder washers to provide a small gap between the GNSS Compass and the mounting surface. This will help protect against warping or cracking of the unit on slightly uneven surfaces. Note the shoulder washers will require a nominal 10mm hole in the mounting surface as shown in **Figure 17: Surface mounting shoulder washer**.

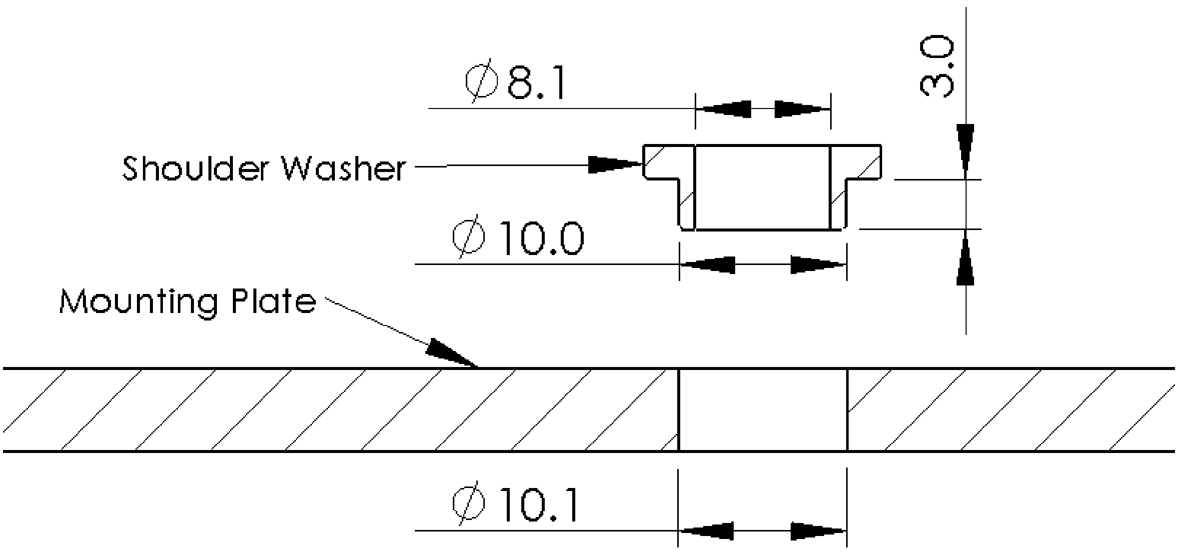

Figure 17: Surface mounting shoulder washer

For instructions on alignment of the unit within a vehicle, see **7.3 Mounting Alignment**.

7.3 Mounting Alignment

The GNSS Compass should be aligned such that it is level with the vehicle and the indicator on the lid is directly forward of the sight, see **Figure 18: GNSS Compass alignment**. The sight can be used to visually align the indicator for best results. See **Figure 19: Alignment on a boat** for example mounting on a boat and **Figure 20: Alignment on a car** for example mounting on a car.

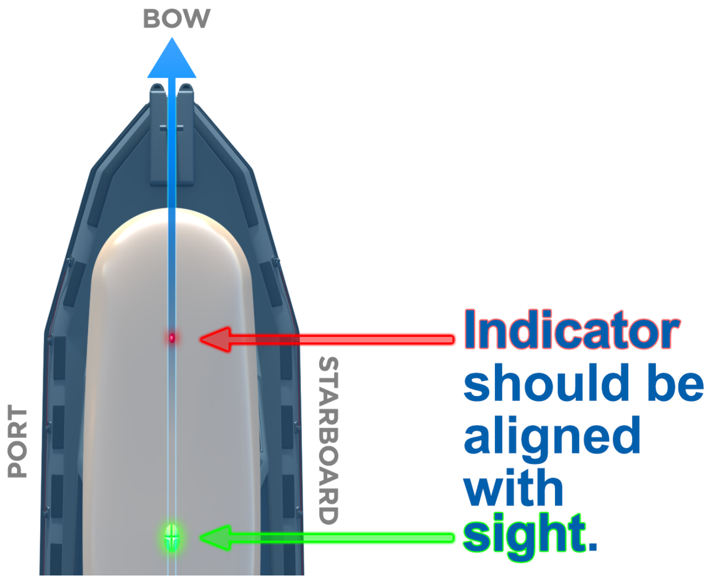

Figure 18: GNSS Compass alignment

Install the unit such that the X+ axis points forward towards the front of the vehicle and the Z+ axis points straight down towards the ground as shown below.

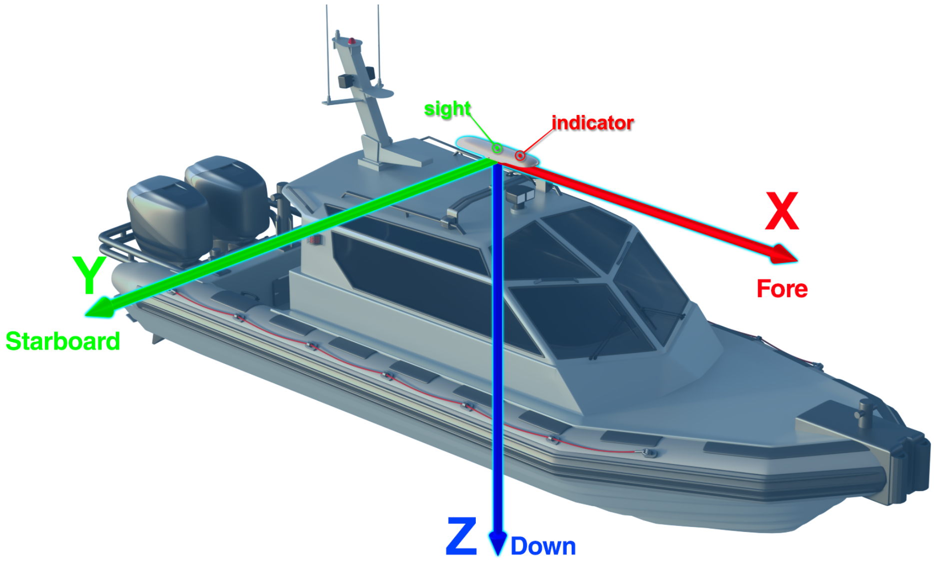

Figure 19: Alignment on a boat

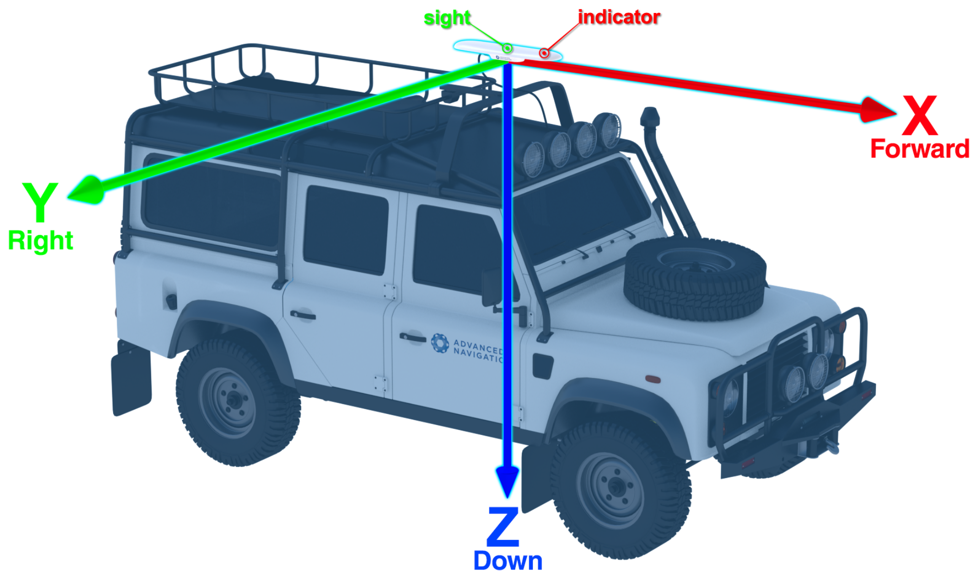

Figure 20: Alignment on a car

If aligning GNSS Compass with the vehicle axes is not possible within vehicle size or shape constraints, it may be mounted in a different alignment and the alignment offset can be configured **9.1 Using the Web User Interface** or **9.2 Using GNSS Compass Manager**.

7.4 Networking

The default configuration for GNSS Compass is for the DHCP Client to be Enabled. This makes it a plug-and-play solution for most users. It is possible to change GNSS Compass to a fixed IP address system once a connection has been established.

GNSS Compass supports the Zero Configuration (Zeroconf) networking feature. On Linux and MacOS systems no additional software is required. If you are using Microsoft Windows, install the Apple Bonjour software from **https://www.advancednavigation.com/Bonjour64.msi** if it's not already installed. Open a web browser and type in the address **http://gnss-compass.local/** to discover the device and access the web interface.

If you cannot establish a connection using a DHCP-capable network, you can connect to and configure the GNSS Compass using the Primary port RS232 serial interface and the GNSS Compass Manager application.

Note: A factory reset will re-enable the DHCP Client and lose any static IP address settings.

7.5 Vibration

GNSS Compass is able to tolerate a high level of vibration compared to other inertial systems. This is due to a unique gyroscope design and a special filtering algorithm among other things. There is, however, a limit to the amount of vibration that a unit can tolerate — temporary degradation in accuracy may occur while operating under high vibration.

When mounting GNSS Compass to a platform with vibration present, there are several options to mitigate the negative performance effects. It is recommended to conduct a brief operating check to confirm performance is within specification before conducting longer runs. The Raw Sensor view in the web UI or GNSS Compass Manager can give you a good idea of how bad the vibrations are. If the vibrations or shocks in operation are causing the sensors to go over range, you will need to increase the sensor range because this will significantly degrade position and orientation estimates. See **8.7 Sensor Ranges** for details.

If there are persistent issues:

- Try to find a mounting point with less vibration.
- Mount GNSS Compass to a plate which is then mounted to the platform through vibration isolation mounts. Be mindful that a plate with very soft mounts may also cause problems with shifts in orientation over time.

8 Using GNSS Compass

This section covers the following topics:

8.1 Filter Initialisation

There are four different levels of filter initialisation on GNSS Compass. These are orientation, navigation, heading and time.

The initialisation of each can be monitored by inspecting the 9.1.2.3 Status view in the web UI or 9.2.6 View Menu in the GNSS Compass Manager.

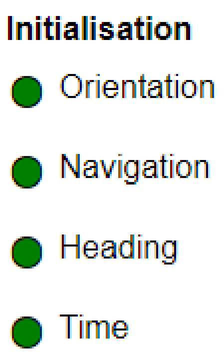

Figure 21: Initialisation Levels

After all four levels of initialisation, the GNSS Compass INS filter takes several minutes to achieve its full accuracy. It is recommended to wait two minutes after initialisation for applications requiring high accuracy.

8.1.1 Orientation Initialisation

Orientation initialisation occurs automatically upon power on and typically completes within seconds. To determine its orientation it uses the accelerometers to measure the gravity vector. Random accelerations from environmental sources can disturb this process, which can introduce minor orientation errors that will be corrected within several seconds. To prevent this, GNSS Compass monitors the accelerometers and gyroscopes and restarts the orientation detection if there are sudden movements. It is however still possible under some circumstances for it to miss minor movements and start with a small orientation error. GNSS Compass will progressively correct the orientation error over a period of several seconds.

Once orientation initialisation is complete, the roll, pitch and angular velocity values will be valid.

8.1.2 Navigation Initialisation

Once navigation initialisation is complete, the position, velocity and acceleration values will be valid.

8.1.3 Heading Initialisation

Heading initialisation completes once the system has determined a heading using one of its several methods. The conditions required to determine a heading depend upon the heading source being used, see **8.4 Heading Sources**. If velocity heading is enabled and the vehicle is moving, this will be very fast. If the system hot-starts, the last known heading value will be used. However, in order for the Heading Filter to initialise, the system must have a valid heading source.

Until the heading has been initialised, the system will not be able to navigate without a GNSS fix, and the roll and pitch values will not reach full accuracy.

8.1.4 Time Initialisation

Time initialisation completes once the system has determined time accurately. For this to occur the system must receive rough time.

Until the time has initialised, the Unix or formatted time that GNSS Compass outputs will be flagged as invalid.

8.2 Hot Start

Advanced Navigation devices were the first on the market with hot-start functionality. This hot-start functionality allows GNSS Compass to start inertial navigation within 500 ms to 2s The hot-start functionality is always on and fully automatic. See **6.1 Navigation Specifications** for details.

A next generation backup battery system within GNSS Compass provides the hot-start ability for more than 48 hours without power. When GNSS Compass hot-starts, it assumes that it is in the same state it was when it lost power and begins navigating from that position.

Whenever GNSS Compass is without power it continues to accurately keep time so that it is immediately valid for a hot-start.

The hot-start functionality is of particular benefit to vehicle tracking and robotics applications. The primary benefits are immunity and fast recovery from power failure as well as fast start up time.

8.3 Time

The time can be accessed via the following means:

- For Serial variants, part number GC2-SER. A dedicated **10.3 1PPS Signal**. This is the preferred means to obtaining the most accurate timing output.
- For Ethernet variants, part number GC2-POE. A built-in Precision Time Protocol (PTP) version 2 server for synchronisation with network-connected devices which require high accuracy time. The PTP server broadcasts PTP messages (Sync, Follow Up, Announce) to multicast IP address 224.0.1.129. The PTP broadcasts are sent whenever an Ethernet connection is established and cannot be disabled.

  - PTP version: 2, generic profile
  - Master output: UDP multicast
  - Clock sync: 2-step (1-step used as fallback if necessary)
  - 1PPS output: Internal clock / GNSS
  - Protocol: IEEE 1588
  - Delay mechanism: E2E (delay request-response)
- For Ethernet variants, part number GC2-POE. A built-in Network Time Protocol (NTP) server.

8.4 Heading Sources

There are several different heading sources available for GNSS Compass. The heading sources can be configured using the **Filter Options** page in the web UI (see **9.1 Using the Web User Interface**) or in the Manager application (see **9.2 Using GNSS Compass Manager**). It is possible to use multiple heading sources.

8.4.1 Dual Antenna Heading

This is the default heading source and provides the most accurate heading while GNSS is available. Dual antenna heading only works when a good GNSS fix is available to both antennas. It requires a clear view of the sky with minimal nearby sources of interference or multipath.

8.4.2 External Heading

This can be used if there is some other way to derive heading that is external to GNSS Compass. The heading must be supplied to GNSS Compass using the **11.4.29 External Heading Packet** or an NMEA message, see **NMEA Input**.

8.4.3 External Magnetometers Packet

Heading can derived using the magnetometers of an additional external Advanced Navigation product to input external magnetometer values. See **11.4.40 External Magnetometers Packet** for details.

8.5 NMEA 2000

The GNSS Compass serial variant (GC2-SER) permanently outputs the NMEA 2000 messages. These are available on the CAN port using an **6.5 NMEA 2000 Drop Cable**. It is not possible to modify this configuration:

PGN	Description	Output Period (milliseconds)	Rate (Hz)
126992	System Time UTC time and date	1000	1
126993	Heartbeat Transmitted by all NMEA devices to indicate the device is still present on the network. Reception of this PGN may also be used to maintain an address to NAME association table within the receiving device.	60000	
127250	Vessel Heading True and magnetic heading	100	10
127251	Rate of Turn Rate of change of the heading	100	10
127252	Heave Vertical distance relative to the average sea level	100	10
127257	Attitude Orientation of the vessel	1000	1
129025	Position, Rapid Update Rapid update of latitude and longitude	100	10
129026	COG & SOG, Rapid Update Rapid update of Course Over Ground (COG) and Speed Over Ground (SOG)	250	4
129029	GNSS Position Data Position and GNSS fix status	1000	1
129540	GNSS Satellites in View	1000	1
130578	Vessel Speed Components Longitudinal and transverse speed	250	4

Table 21: NMEA 2000 transmitted messages

8.6 NMEA 0183

The GNSS Compass supports outputting the version 4.10 compliant NMEA 0183 messages over both Serial and Ethernet connections.

For the serial variant (GC2-SER):

- Serial data is output on the Auxiliary serial port.
- Each message can be enabled or disabled and output rates are configurable.

For the Ethernet variant (GC2-POE):

- Ethernet messages are enabled by default, however can be selectively disabled.
- NMEA 0183 broadcast packets are sent via multicast to IP address **239.192.0.4**.
- These are sent whenever an Ethernet connection is established and cannot be disabled.

The minimum rate is 1 Hz, except for GPHBT & TSS1 whereby the minimum is as indicated in the table **Table 22: NMEA 0183 output messages supported**.

The maximum output rate for any message is 50 Hz.

The NMEA 0183 messages are:

Sentence	Serial Default	Ethernet Default	Description
$GPGGA	Disabled	Enabled (1 Hz)	Time, latitude, longitude, height and HDOP
$GPGLL	Disabled	Enabled (1 Hz)	Latitude and longitude
$GPGNS	Disabled	Enabled (1 Hz)	Time, latitude, longitude, height and HDOP
$GPGSA	Disabled	Enabled (1 Hz)	GNSS DOP and satellites used in solution
$GPGSV	Disabled	Enabled (1 Hz)	GNSS satellites in view
$GPHBT	Disabled	Enabled (0.167 Hz) 60 seconds	Heartbeat supervision sentence
$GPHDG	Disabled	Enabled (1 Hz)	Magnetic deviation and variation
$GPHDM	Disabled	Enabled (1 Hz)	Magnetic Heading
$GPHDT	Enabled (8 Hz)	Enabled (8 Hz)	True heading
$GPHEV	Disabled	Enabled (1 Hz)	Heave
$GPRMC	Enabled (8 Hz)	Enabled (8 Hz)	Time, date, latitude, longitude and 2D velocity
$GPROT	Disabled	Enabled (1 Hz)	Rate of turn
$GPVBW	Disabled	Enabled (1 Hz)	Dual ground/water speed
$GPVLW	Disabled	Enabled (1 Hz)	Dual ground/water distance
$GPVTG	Disabled	Enabled (1 Hz)	Course over ground and ground speed
$GPZDA	Disabled	Enabled (1 Hz)	Time and date
$PASHR	Disabled	Enabled (1 Hz)	Time, orientation and orientation error
$TSS1	Disabled	Disabled	Heave, pitch and roll
$PFEC,GPatt	Disabled	Enabled (1 Hz)	Attitude and heading
$PFEC,GPhve	Disabled	Enabled (1 Hz)	Heave

Table 22: NMEA 0183 output messages supported

8.7 Sensor Ranges

GNSS Compass supports dynamic ranging on its sensors. Each of the three sensors have three different range settings. At lower ranges the sensor performance is better, but at higher ranges GNSS Compass can be used in more extreme dynamics. The best performance is achieved by choosing the lowest range that your application won't generate over-range events.

Sensor over-range events can be detected in the **Filter Status field**. In the web UI and GNSS Compass Manager the status indicator will go orange to indicate that a sensor has gone over-range. When a sensor goes over-range this causes the filter to become inaccurate, and in some cases it can cause the filter to reset.

By default GNSS Compass comes configured to the lowest (most sensitive) sensor ranges. In this configuration it is possible to send the gyroscopes over-range by quickly rotating the unit in your hand. It is recommended to monitor the web UI or GNSS Compass Manager when you do this.

The sensor range can be set using the **9.1.3.1 Sensor Ranges** page in the web UI or using the **9.2 Using GNSS Compass Manager**.

8.8 Vehicle Profiles

GNSS Compass supports a number of different pre-configured vehicle profiles. These vehicle profiles impose constraints upon the filter to increase performance. If your application matches one of the available vehicle profiles, it is required that you select it for use in the **Filter Options** page in the web UI or GNSS Compass Manager. For a list of the different vehicle profiles, see **11.5.5.1 Vehicle Types**. If the wrong vehicle profile is selected, it can cause a significant decrease in performance.

8.9 RTK

The GNSS Compass internal GNSS receiver supports RTK GNSS which uses correction data (RTCM messages) from a nearby base station to provide accuracy of up to 0.01 m in real time. An RTK system requires additional infrastructure equipment to generate and receive corrections data, and is not practical for all applications.

There are two different methods for receiving RTK corrections:

- Network
- Radio modem

For applications where GNSS Compass can achieve internet access, network RTK corrections (NTRIP) are recommended.

For applications that are unable to access the internet, radio modems can be used to communicate between GNSS Compass and the base station, see **8.9 RTK**.

8.9.1 Network RTK Corrections (NTRIP)

NTRIP can be configured in three ways:

1. Using the GNSS Compass web UI **9.1.3.8 NTRIP Client** in the Configuration Menu.
2. Using the GNSS Compass Manager application, select **9.2.8.5 NTRIP Client** under the Tools menu.
3. Using the Spatial Manager for Android application. This is convenient for field testing or when temporary RTK corrections are required, for example for performance trials. Download from the **Google Play** store.

Any of these NTRIP clients can connect to a network RTK service to stream RTK corrections to GNSS Compass. This requires that the client is connected to the internet, and a valid subscription with a local network RTK service. Contact **Support** if you need assistance in setting up for network RTK corrections.

8.9.2 Radio Modem RTK Corrections

Figure 22: Trimble R4 Base Station

Figure 23: Trimble TDL 450L Radio Modem

Base station radio modem RTK corrections require both a base station and a radio modem receiver. The base station is set up at a fixed location and transmits corrections to the radio modem receiver that is connected to the mobile GNSS Compass unit (the "rover"). The radio modem receiver and GNSS Compass unit must remain within radio range of the base station to receive these corrections. The base station should be located no more than 50 km from the GNSS Compass, and ideally closer. Advanced Navigation recommends contacting a local surveying company for assistance setting up a base station.

8.9.3 Supported RTCM Messages

The internal GNSS receiver in GNSS Compass supports receiving the following RTCM v3 messages.

Message Number		
1002	1010	1045
1004	1012	MSM4
1005	1019	MSM5
1006	1020	MSM6
1007	1033	MSM7
1008	1044	

Table 23: Supported RTCM v3 messages

8.10 Heave

GNSS Compass can provide vertical heave position at four different points on a ship. The GNSS Compass heave filter is always on and fully automatic. After power on, GNSS Compass requires approximately 5 minutes for its heave filter to converge upon an accurate solution. Heave works without a GNSS fix, however best heave performance is achieved when GNSS Compass has a GNSS fix .

By default GNSS Compass provides heave from the point at which the GNSS Compass unit is mounted, however it can provide heave at four different offset points on the ship. To configure Heave, see the **9.1.3 Configuration Menu** page in the web UI or use the **9.2.7.9 Reference Position Offsets** dialogue in the GNSS Compass Manager.

8.11 Environmental Exposure

Whilst GNSS Compass is environmentally protected, there are limits to this protection that must be observed to avoid damaging the device.

GNSS Compass is only IP67-protected when its connectors are mated (or sealed with the blanking caps). If any of these connections are not tightened to the recommended torque, the unit will not achieve its rated protection.

Spanners or tools should never be used to tighten the connectors. Use your fingers to firmly tighten the connectors.

8.11.1 Temperature

GNSS Compass should not be subjected to temperatures outside of its operating range. Subjecting GNSS Compass to temperatures outside of the operating range can affect the factory sensor calibration, potentially causing a permanent reduction in performance or premature failure. For information about the operating temperature range, see **6.2 Hardware Specifications**.

8.11.2 Water

GNSS Compass complies with IP67 standard, which means that it can be submersed in water to a depth of up to 1 m deep for a maximum of 30 minutes. Submersion to depths beyond 1 metre can cause water entry and destruction of the internal electronics, and the sealing is not designed for prolonged or repetitive immersion. Do not direct streams of water directly at the unit even at low pressure. For cleaning the unit, ensure that no pressure is used.

Note: Connectors must be installed or blanking caps must be used if the unit is likely to be exposed to water.

8.11.3 Salt

The GNSS Compass housing and stainless fittings to provide good corrosion resistance. The GNSS Compass should be regularly rinsed with water when used in salt water environments.

8.11.4 Dirt and Dust

GNSS Compass is completely sealed against dirt and dust entry whenever all connectors are mated. When disconnecting the connectors, any dirt or dust should be rinsed or wiped off with fresh water and then dried to minimise the chance of contaminants entering the connectors or plugs.

8.11.5 pH Level

Environments with acidic or alkaline water or atmospheres can cause the GNSS Compass enclosure to corrode or discolor. If GNSS Compass comes into contact with these environments it should be rinsed in fresh water as soon as possible. It is not recommended to operate GNSS Compass in non-neutral pH environments.

8.11.6 Shocks

GNSS Compass is a rugged piece of equipment that can withstand reasonable amounts of shock. However, continuous shocks may cause premature failure as a result of materials fatigue, and may also affect the sensor calibration resulting in degraded performance.

Shocks applied directly to the GNSS Compass enclosure can affect the unit. Therefore, care should be taken when handling the unit prior to mounting. When mounted in a vehicle, the effect of most operating shocks is negligible.

8.11.7 Atmospheres

Hydrogen-rich atmospheres may damage the MEMS. GNSS Compass is not rated for use where explosive gases or dust may be present.

8.12 Upgrading the Firmware

GNSS Compass contains both Device Firmware and GNSS Receiver Firmware which are both updated periodically.

GNSS Compass Device Firmware can be downloaded from the **product page** of the Advanced Navigation website.

Contact support at **support@advancednavigation.com** for the latest GNSS Receiver firmware.

The process for upgrading the GNSS Compass Firmwares will depend on the device. See the following table for information on how to upgrade each device's firmwares.

Device Type	Firmware Type	Interface	Process
Serial (GC2-SER)	Device Firmware	GNSS Compass Manager	**9.2.8.2 Firmware Update**
	GNSS Receiver Firmware	GNSS Compass Manager	**9.2.8.3 GNSS Firmware Update**
Ethernet (GC2-POE)	Device Firmware	Web UI (recommended)	**9.1.4.1 Firmware Update**
	GNSS Receiver Firmware	GNSS Compass Manager	**9.2.8.3 GNSS Firmware Update**

Table 24: Rules for updating the GNSS Compass Firmwares

See **9.2.8.2 Firmware Update** for instructions on how to upgrade the firmware using the GNSS Compass Manager or see **Firmware Update** for instructions to update the firmware using the web UI.

9 Configuring and Monitoring GNSS Compass

GNSS Compass can be configured and monitored through:

- the **web user interface**, accessed on a connected computer via Ethernet. Applicable to the GC2-POE Ethernet variant only
- GNSS Compass **Manager**, accessed on a computer via a serial adaptor. Applicable to the GC2-SER Serial variant only
- the Advanced Navigation Packet Protocol (**9.4 Using ANPP**)

The GNSS Compass Web UI is the recommended interface to configure as it is designed to be simple and easy to use without any software or system requirements. The web UI is compatible with all modern web browsers.

9.1 Using the Web User Interface

The web user interface allows you to manage GNSS Compass through the following:

- **9.1.1 Main View**
- **9.1.2 View Menu**
- **9.1.3 Configuration Menu**
- **9.1.4 Tools Menu**

9.1.1 Main View

The Main View is accessible from other pages via the **Map** menu item under the **View** menu.

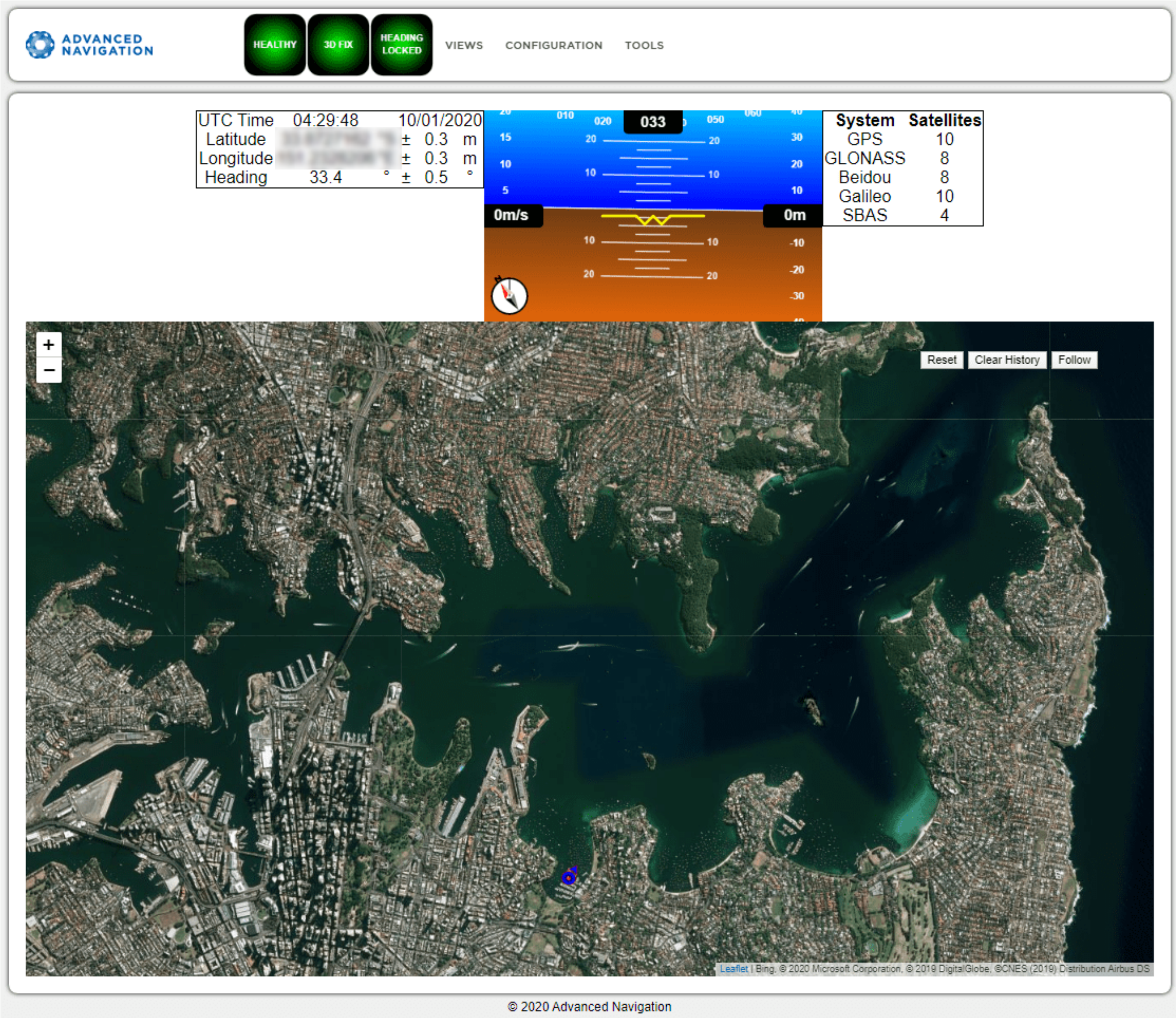

Figure 24: GNSS Compass Web UI Home Page

9.1.1.1 Status Indicator

The Status Indicator section contains the current GNSS Compass status, the GNSS fix type indicator, and the heading status. These are visible on every page.

- Status Indicator: This indicator shows any problems with GNSS Compass. Once the filter has initialised it will show “HEALTHY”.
- GNSS Fix: This indicator shows the status of the GNSS fix. Under normal operating conditions it should show “3D FIX”. When satellite visibility is poor it may show either “2D FIX” or “NO FIX”.
- Heading Status: This indicator shows the current status of the heading filter. When there is a valid source of heading it will show “HEADING LOCKED”.

9.1.1.2 Current Time, Position and Heading

This section displays the current UTC time, position, and heading. The data will only be valid if GNSS Compass has a HEALTHY status, there is a 3D GNSS fix or better, and the Heading is initialised.

9.1.1.3 Altitude Indicator

The Attitude Indicator visualises roll and pitch using a standard artificial horizon. Heading, velocity and height are shown to the side. All units are SI (metric) and degrees.

9.1.1.4 Satellites Table

The Satellites table shows the number of satellites visible by the primary antenna. More detailed information can be found in the Satellites screen under the **View** menu.

9.1.1.5 Map

The map shows the GNSS Compass position on Earth as well as a red trail showing position history since the last reset. When the filter initialises the map will automatically reset the view to the GNSS Compass position. To move the camera click and drag on the map. To zoom in and out, use the mouse scroll wheel.

Use **Reset** to reset the map view to the current position of GNSS Compass.

Clear History clears the current red trail showing the position history. This will immediately restart from the current position. Note that this does not affect any logging currently active.

9.1.1.6 Map Controls

Reset

This resets the map view to the current position of GNSS Compass.

Clear History

This clears the current red trail showing the position history. This will immediately restart from the current position. Note that this does not affect any logging currently active.

Follow

This button makes the map follow the device.

9.1.2 View Menu

The View menu contains the options for viewing pages of data from GNSS Compass.

9.1.2.1 Map

This takes the user back to the home page of the web UI with the map display.

9.1.2.2 Device Information

The Device Information page is useful for users when requesting technical support and for tracking their serial number, firmware version, and hardware version.

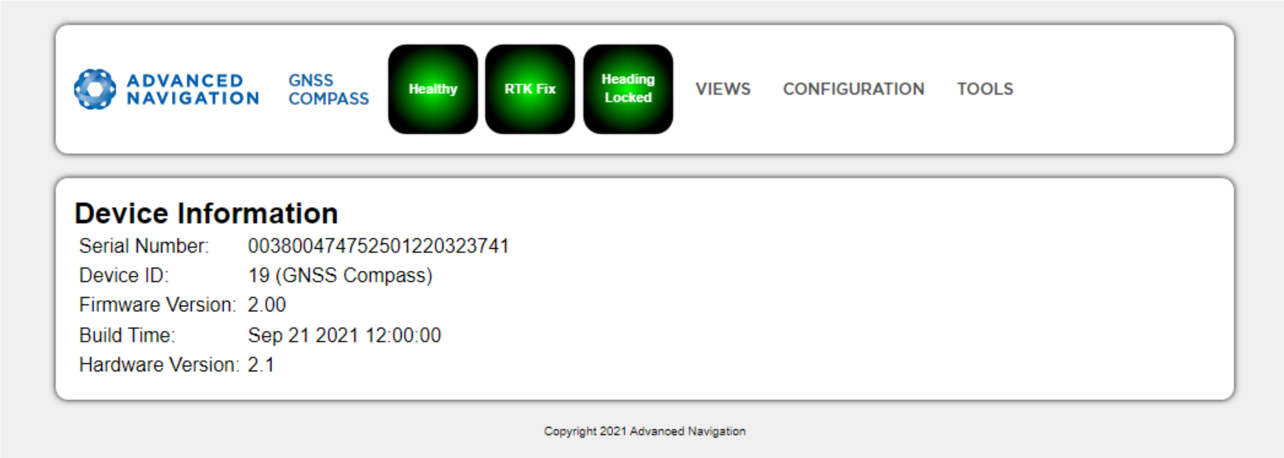

Figure 25: GNSS Compass Web UI Device Information Page

9.1.2.3 Status

The Status shows the current status of GNSS Compass as reported by sections **11.4.1 System State Packet** (ID#20) .

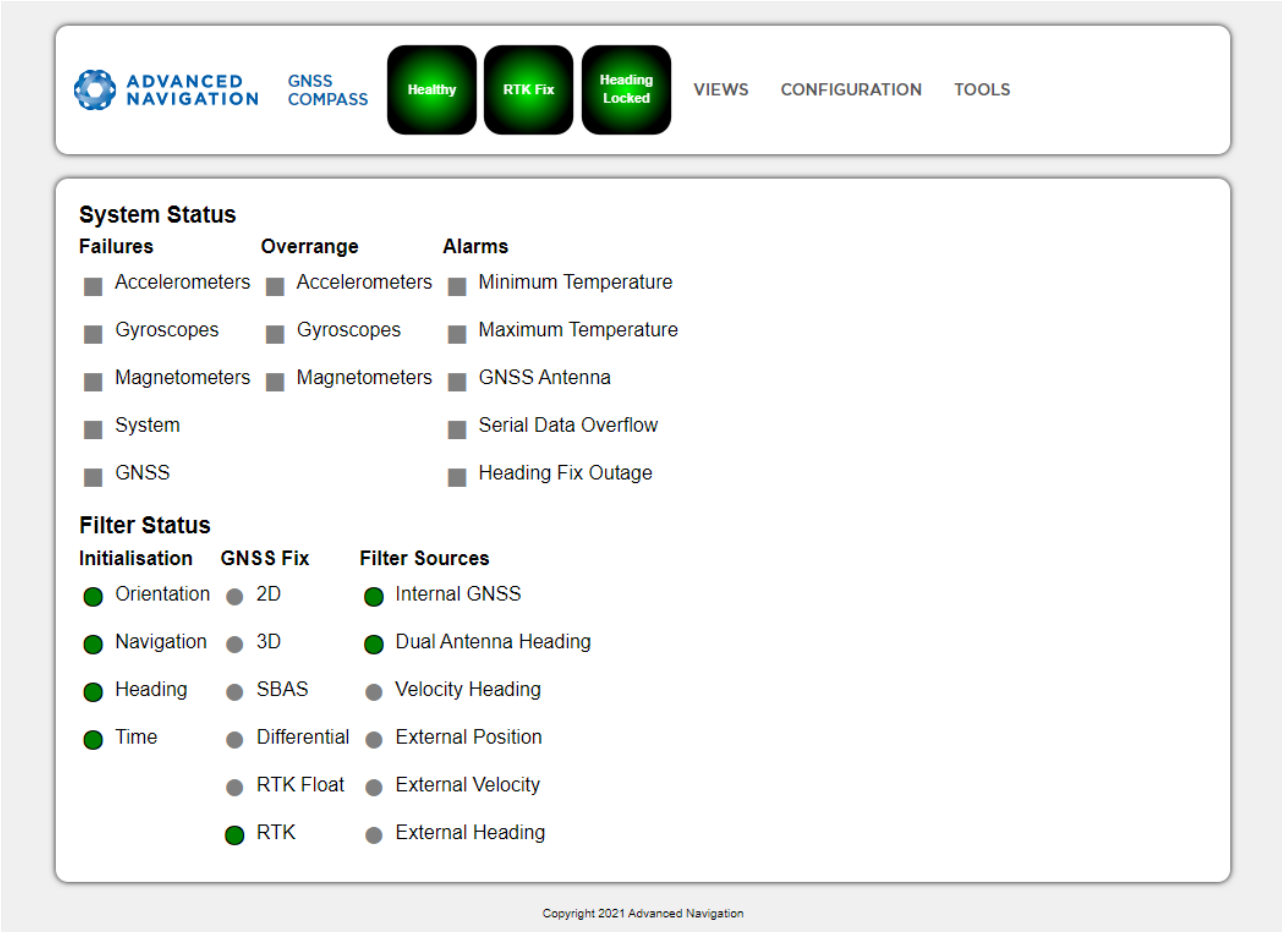

Figure 26: GNSS Compass Web UI Status Page

9.1.2.4 Satellites

The Satellites page shows detailed information on the satellites that are visible to the GNSS Compass GNSS receiver.

The information is displayed as a satellite skyplot, a table and an SNR graph. A maximum of 28 satellites will be displayed, even if more are accessible. This plot shows the SNR of each satellite at the primary and secondary antenna. As a guideline, these should be within 5-10 dB of each other in the absence of cable or antenna faults

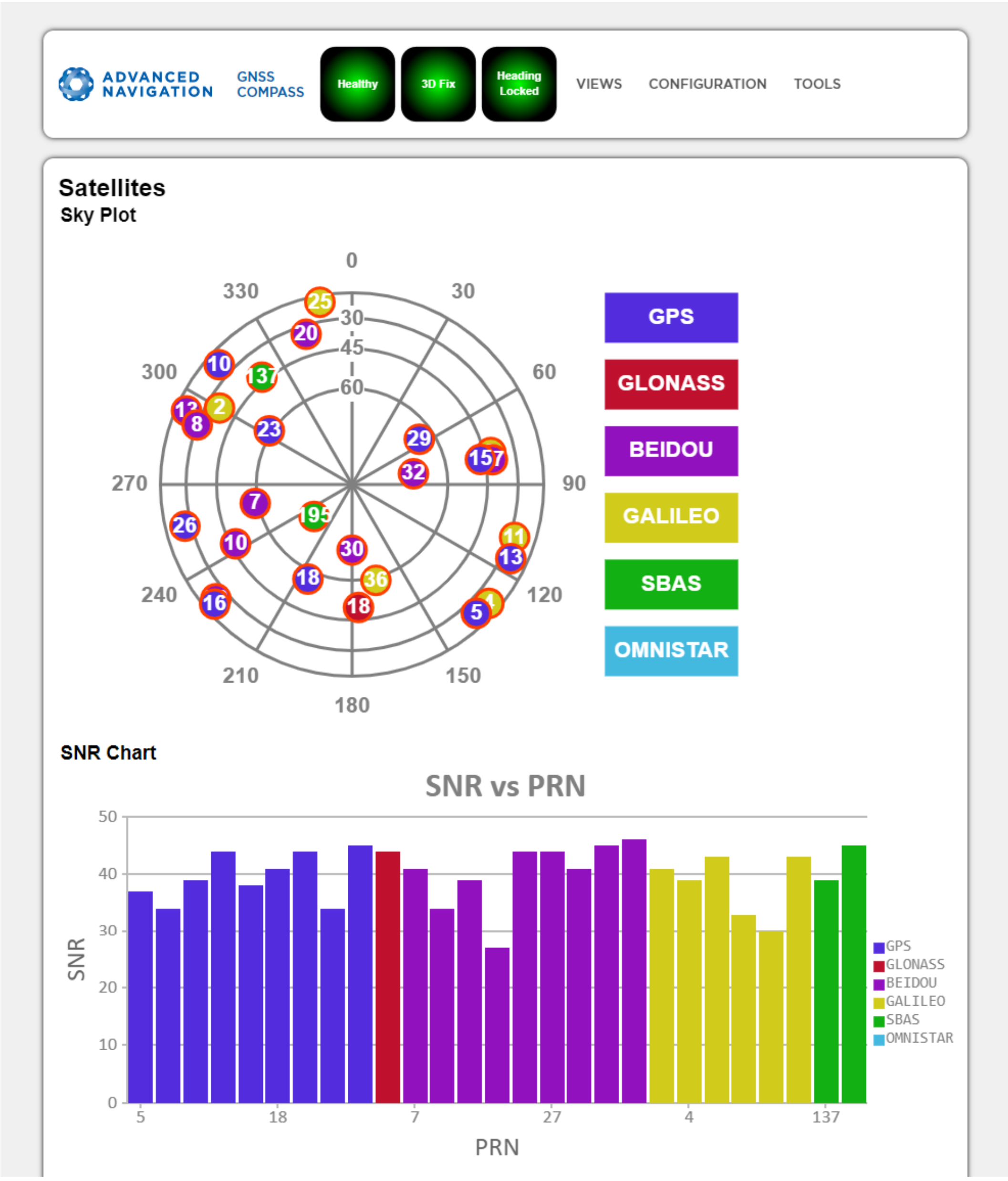

Figure 27: GNSS Compass Web UI Satellites Page

9.1.2.5 Raw Sensors

The Raw Sensors page shows the raw IMU sensor values.

In the lower plot only the air pressure is plotted. The current value from the internal temperature sensors are given on the right. These do not provide general environmental temperature.

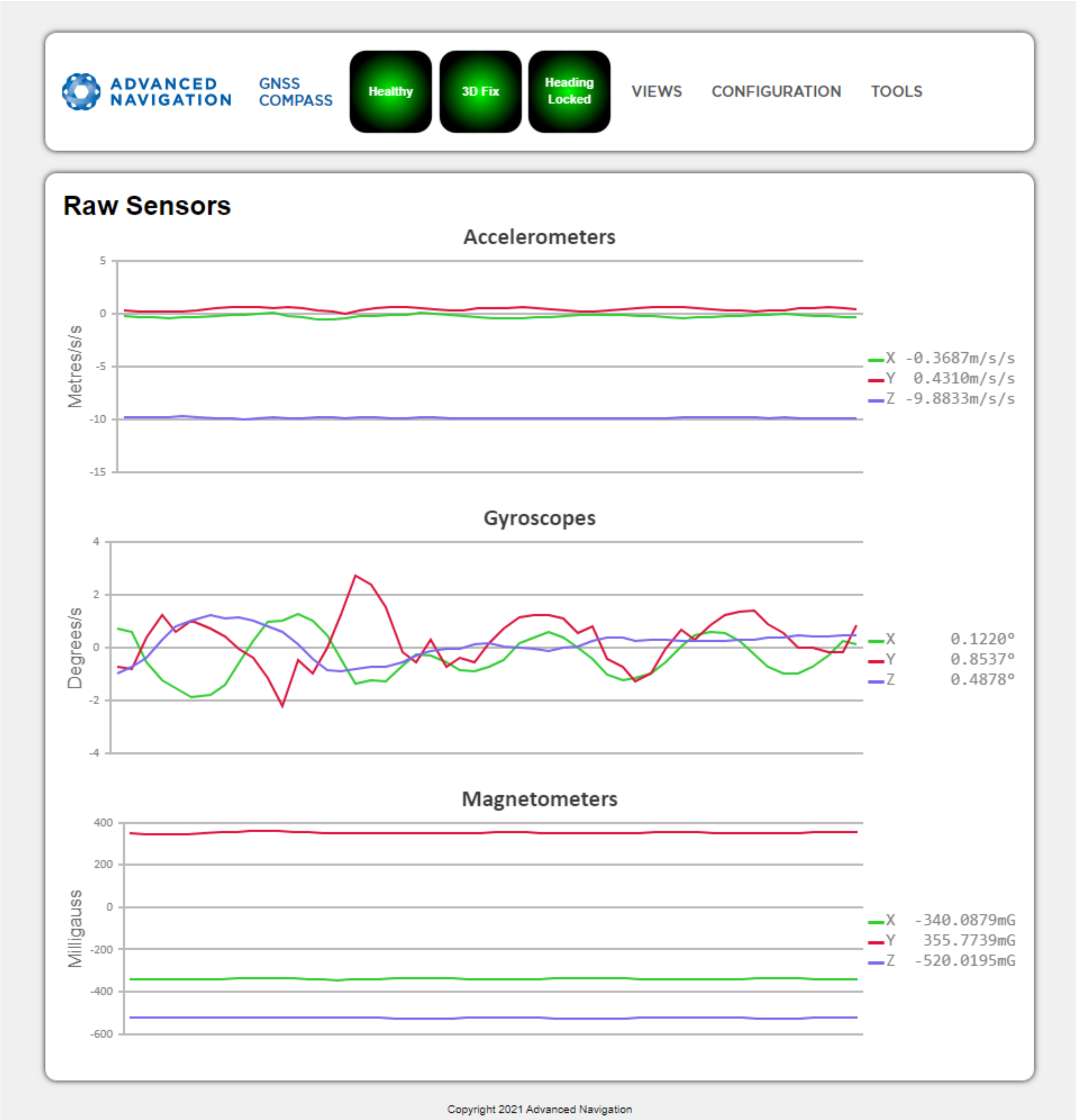

Figure 28: Web UI Raw Sensors Page

9.1.2.6 Orientation

The Orientation page shows the GNSS Compass orientation and angular velocity. Course is determined by measuring sequential positions. Slip is the difference between the heading and the course.

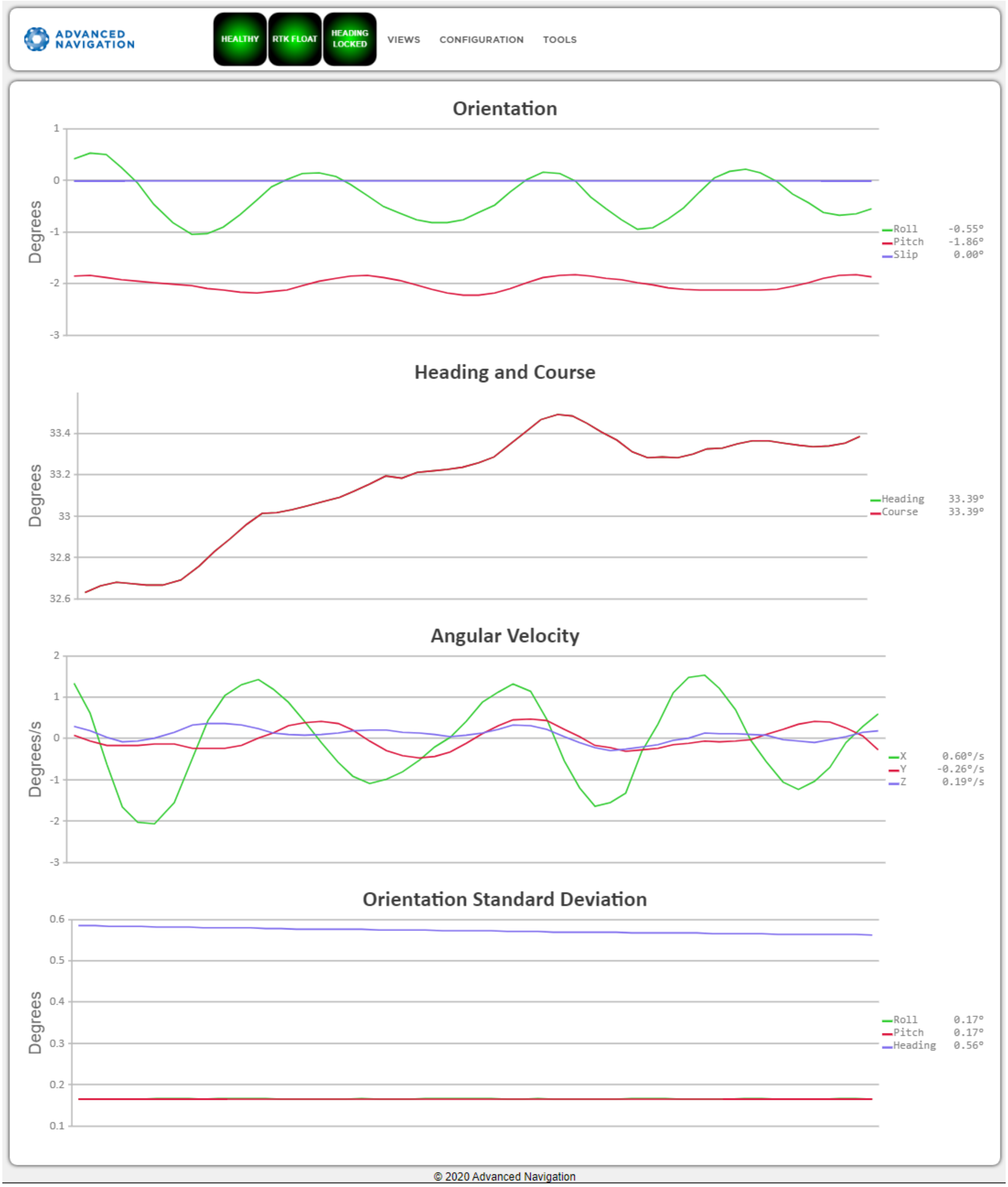

Figure 29: GNSS Compass Web UI Orientation Page

9.1.2.7 Position

The Position page shows the GNSS Compass position and position standard deviation. Latitude and longitude are converted to North and East metres from a reference point that can be reset by refreshing the web page in your browser.

Figure 30: GNSS Compass Web UI Position Page

9.1.2.8 Velocity and Acceleration

The Velocity and Acceleration page shows the GNSS Compass velocity, acceleration and g-force.

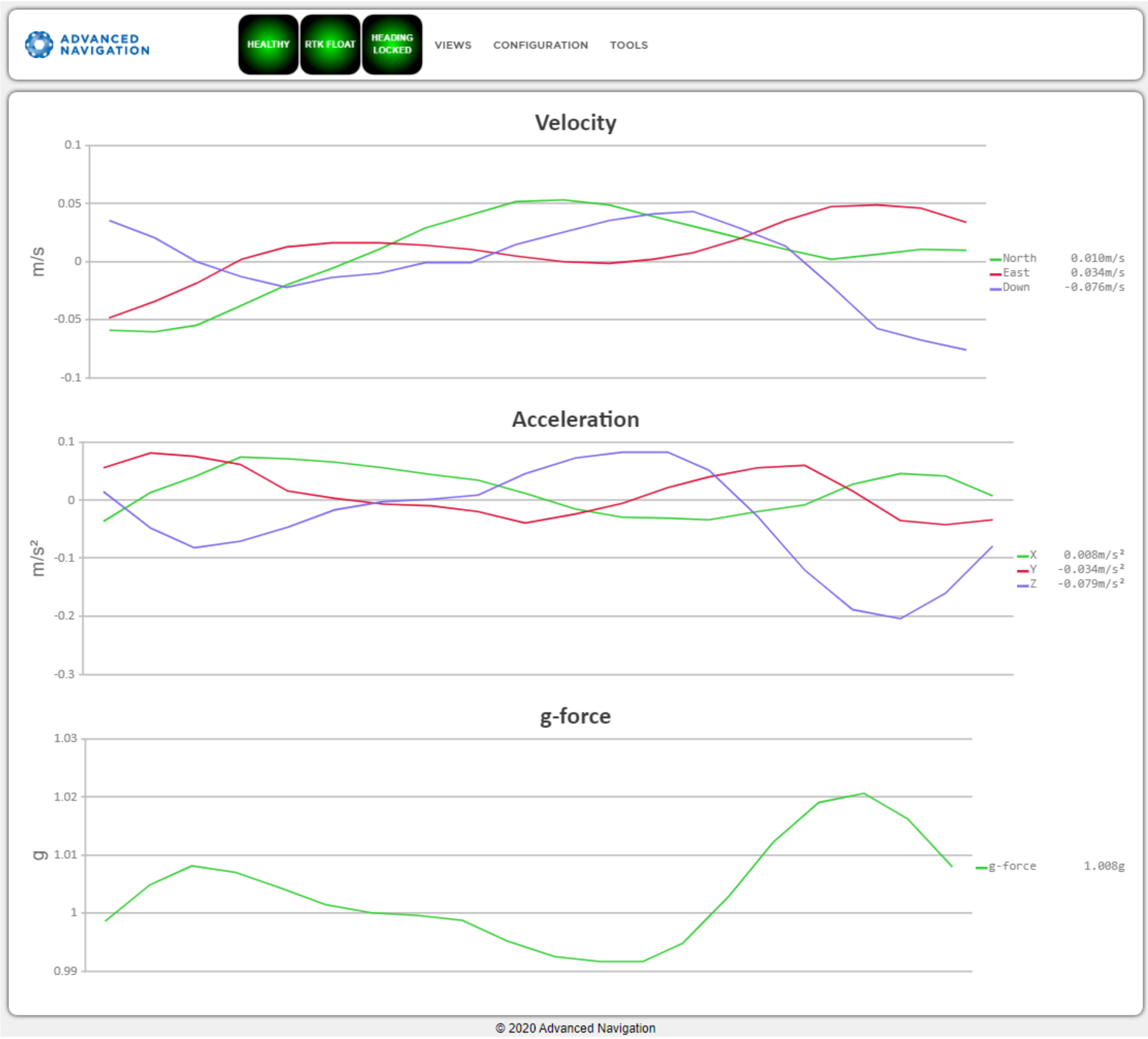

Figure 31: GNSS Compass Web UI Velocity and Acceleration Page

9.1.2.9 GNSS Receiver Information

This page shows information about the GNSS receiver fitted to GNSS Compass.

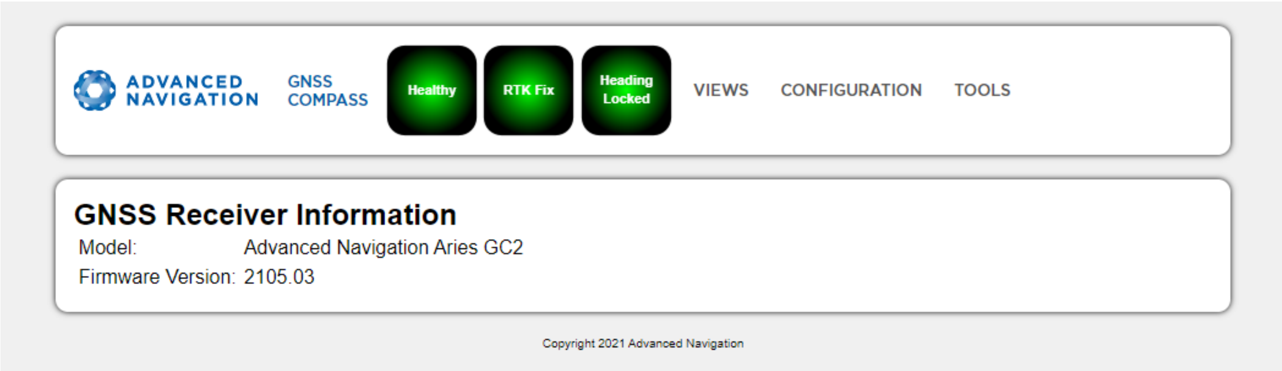

Figure 32: GNSS Compass Web UI GNSS Receiver Information Page

9.1.2.10 Heave

This page displays the heave at up to 4 reference points. Reference point offsets for vessel motion can be configured on the **9.1.3 Configuration Menu** page.

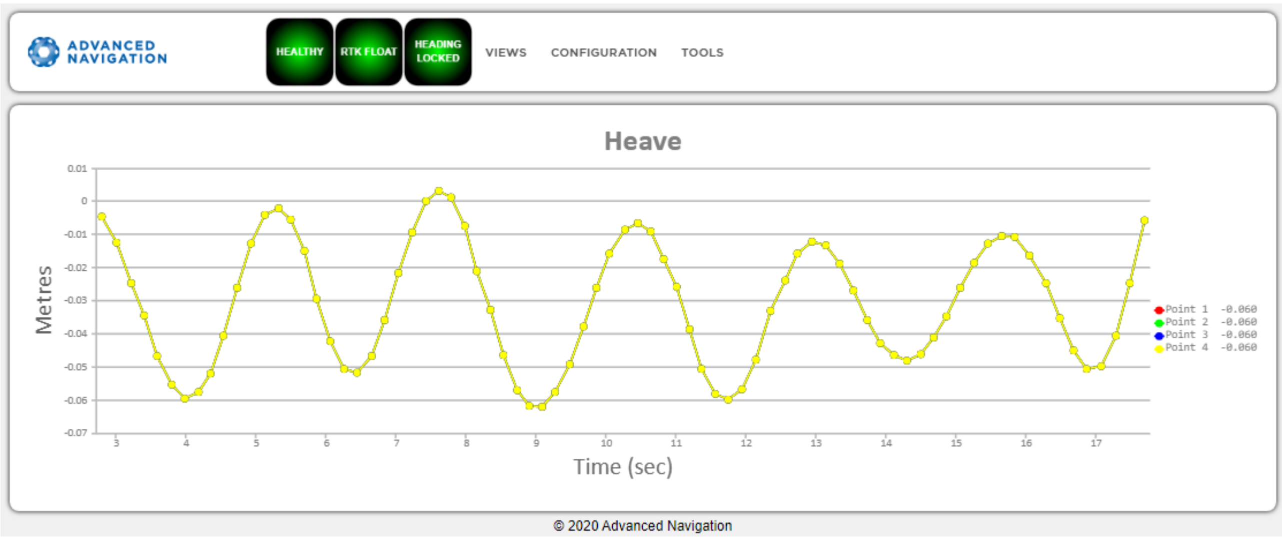

Figure 33: GNSS Compass Web UI Heave Page

9.1.3 Configuration Menu

These menus contain the set of configuration settings for GNSS Compass.

9.1.3.1 Sensor Ranges

The Sensor Ranges page is used to set the dynamic range of the sensors. If you are experiencing over-range events during operation, these settings should used to increase the range of the sensor which is reporting the over-range. The lowest ranges give the best performance, so make changes slowly and monitor the results.

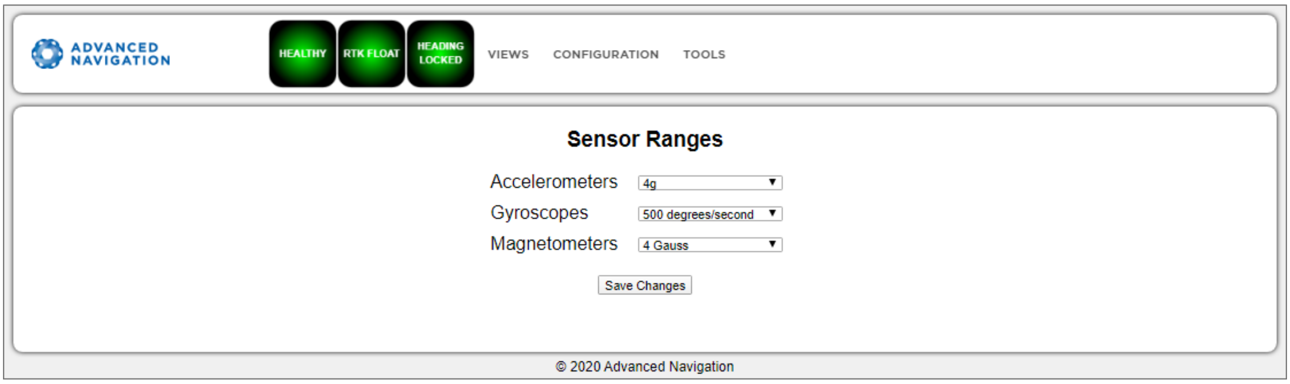

Figure 34: GNSS Compass Web UI Sensor Ranges Page

9.1.3.2 Filter Options

Ensure that the Vehicle Type filter option is selected for all applications. For most standard applications, the other filter options can be left as their defaults.

See [8.1 Filter Initialisation](#) for more information on these specific settings. If you require assistance, contact [support@advancednavigation.com](#).

Figure 35: GNSS Compass Web UI Filter Options Page

9.1.3.3 Data Ports

The Data Ports page allows you to specify which data packets or messages are output on a periodic basis and at what rate via a range of serial and Ethernet ports.

By default NMEA0183 is output over Ethernet. See **8.6 NMEA 0183** for details on messages and output rates.

Other data formats available include NMEA0183, GNSS, TSS1, SIMRAD and other formats. For more information see **10.1.2 Ethernet Functions**.

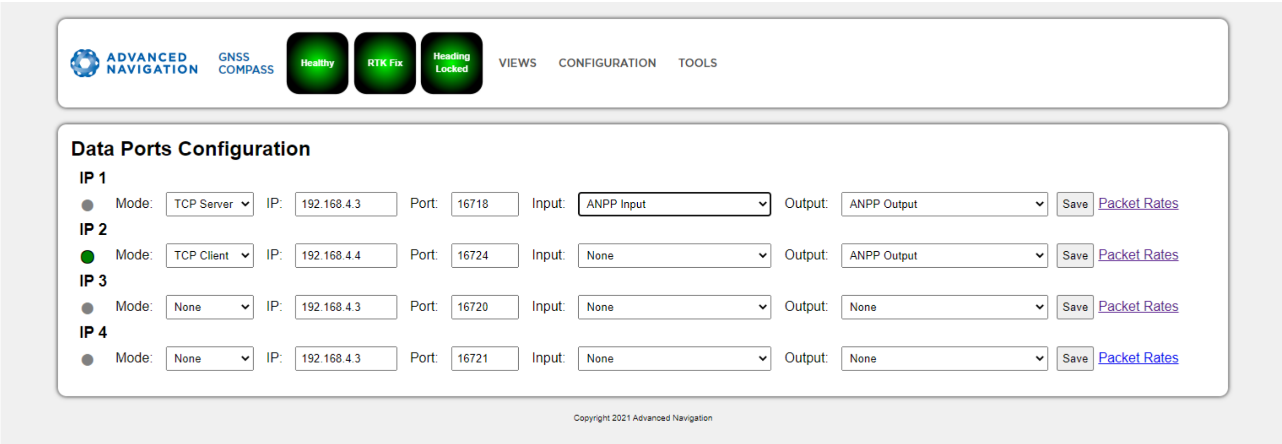

Figure 36: GNSS Compass Web UI Data Ports Page

9.1.3.4 Alignment

The Alignment page is used to set the alignment offsets of the system installation. It is important to set the values on this page correctly to avoid degrading performance.

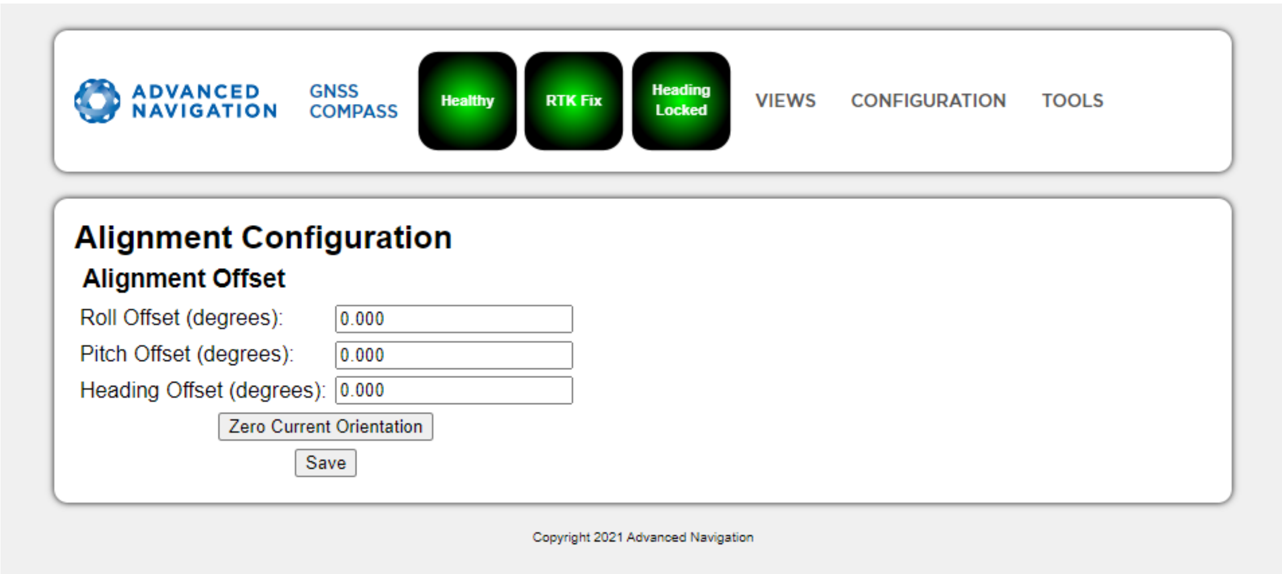

Figure 37: GNSS Compass Web UI Alignment Page

Alignment Offset

If GNSS Compass is installed into the vehicle with the positive X axis pointing forwards and the positive Z axis pointing down, then no alignment offset is required and the roll, pitch and heading offset values can remain at the factory defaults of zero.

If the unit is installed in a different orientation then the roll, pitch and heading offset must be entered. For example, if the unit is installed on its side with the X axis pointing up and the Z axis pointing forwards and no change to the Y axis, then this would result in a pitch offset of +90 degrees with roll and heading remaining zero.

If there is a small misalignment due to mechanical mounting error this can be compensated for by setting the vehicle stationary on a level surface and clicking the **Zero Current Orientation** button.

Note: Zero Current Orientation will only correct for roll and pitch offsets, the Heading offset must be entered manually and saved after using this function.

9.1.3.5 Reset

The Reset button causes the system to perform a power cycle. No configuration settings or state data are lost.

The Cold Start button clears all filters, and connections are reset and must re-established. No configuration settings are lost.

The Factory Reset button resets all GNSS Compass settings back to their factory defaults, including state data and all configuration settings. It also erases the hot start data so that the system is forced to perform a cold start.

Note: A Factory Reset will re-enable the DHCP Client and lose any static IP address settings.

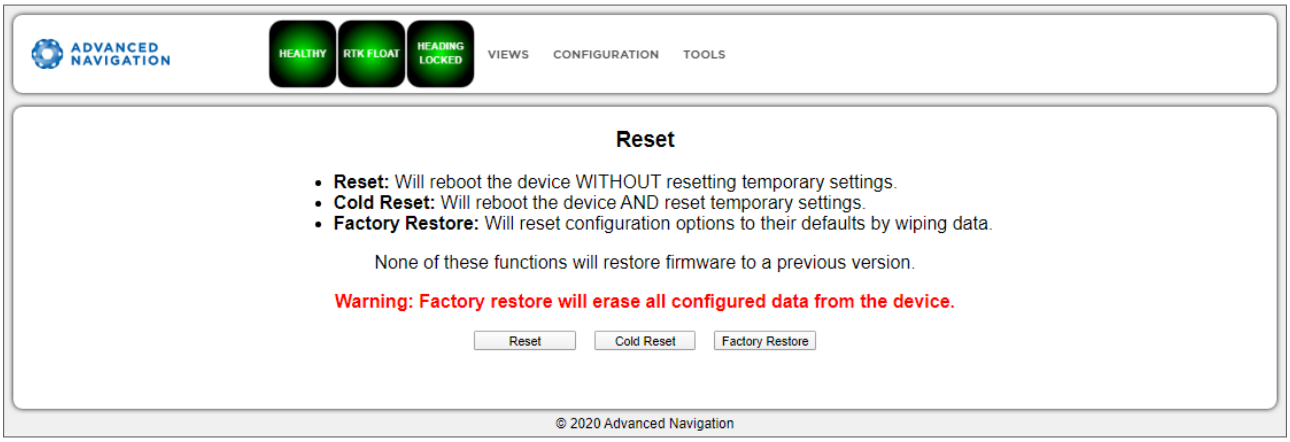

Figure 38: GNSS Compass Web UI Reset Page

9.1.3.6 Manual Initialisation

This page can be used to manually initialise GNSS Compass when a GNSS fix is not available. Setting the position will initialise the navigation filter. Setting the heading will also initialise the heading filter.

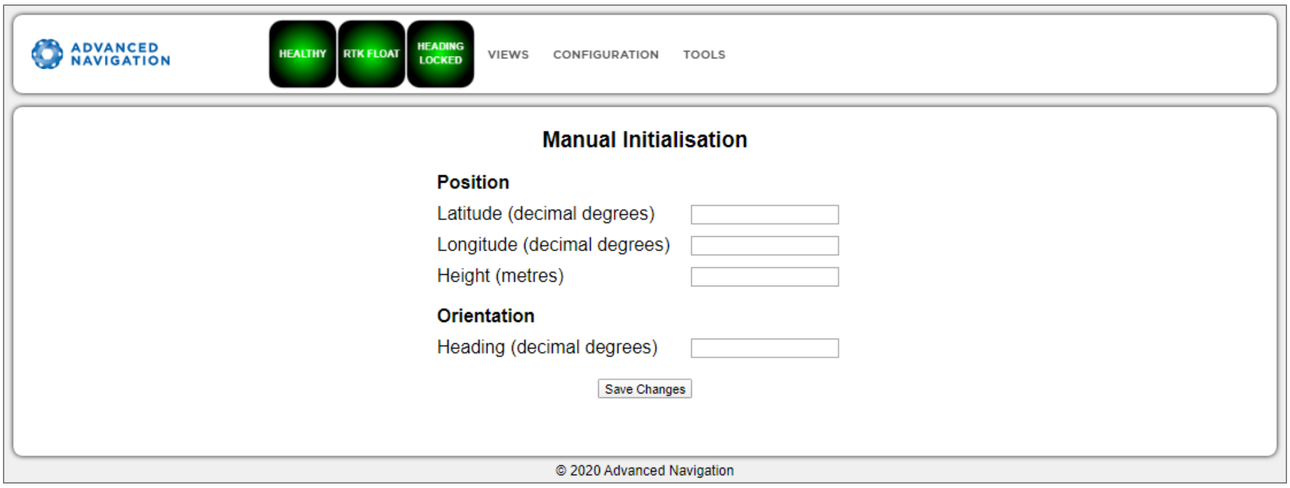

Figure 39: GNSS Compass Web UI Manual Initialisation Page

9.1.3.7 Ethernet Settings

The Ethernet Settings page allows you to enable or disable the DHCP Client. When the DHCP Client is disabled you need to enter the TCP/IP settings if you wish to access the web UI.

If you are only connecting to GNSS Compass via the primary port these settings can be ignored.

The default is for the Ethernet mode to be set to DHCP.

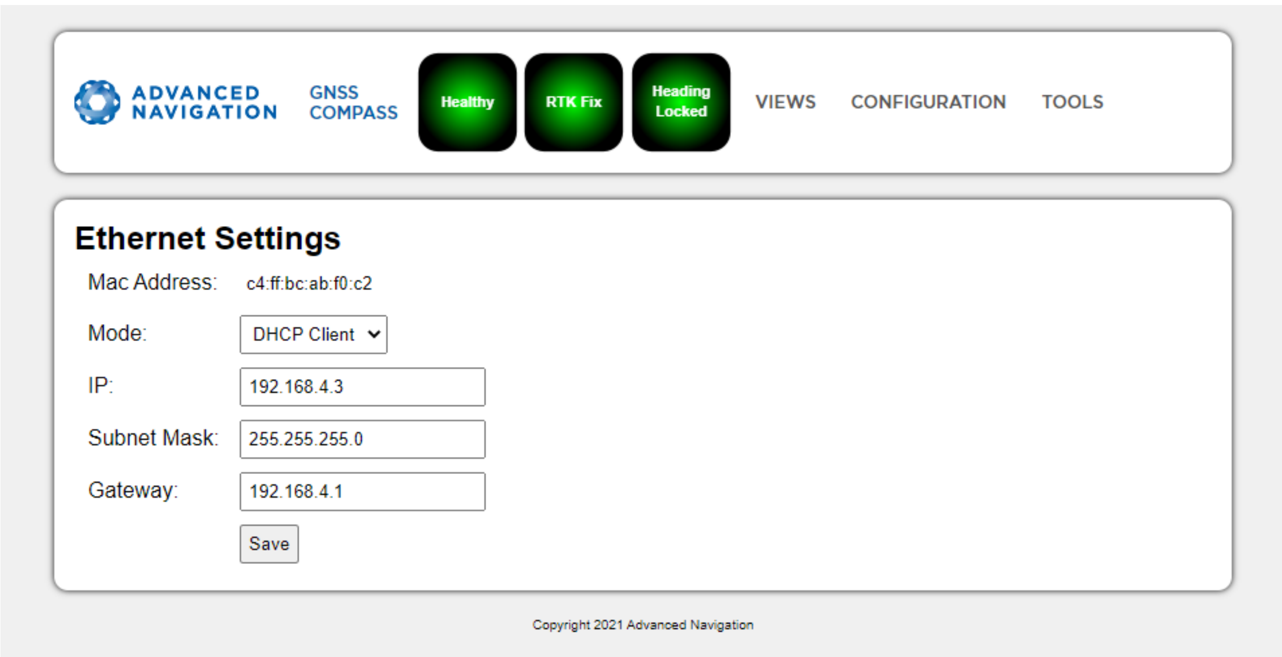

Figure 40: GNSS Compass Web UI Ethernet Settings page

9.1.3.8 NTRIP Client

The NTRIP client built into GNSS Compass can be used to connect to a network DGPS (Differential GPS, a older standard for GNSS corrections of lower performance than RTK) or RTK service to stream correction data to GNSS Compass for DGPS or RTK. The NTRIP client requires that GNSS Compass has an available internet connection to the NTRIP Caster to function.

The source of the corrections data can be either your own base station, configured as an NTRIP Caster, or a third-party service. Either way, you will need the login details for connecting to and authenticating with the NTRIP Caster, and identifying the nearest mountpoint.

These steps are required:

1. Select Enabled.
2. For Host/Server, enter the NTRIP Caster address.
3. For Port, enter the NTRIP Caster port numbe. This is usually 2101.
4. Click Save.
5. Click Get Mountpoints.
6. Select your mountpoint from the Mountpoint drop down list, being mindful that the distance should not exceed 50km.
7. Enter your username in the Username box.
8. Enter your password in the Password box.
9. Click Save.

To disconnect from the NTRIP Caster unselect Enabled and click Save.

Troubleshooting NTRIP Caster Connections

If you cannot get the list of mountpoints, ensure the Host Address and Port number are correct for your NTRIP Caster.

If the Connection Status is not green, and says UNAUTHORISED this indicates an incorrect username or password.

Contact **support@advancednavigation.com** for further assistance with network DGPS or RTK.

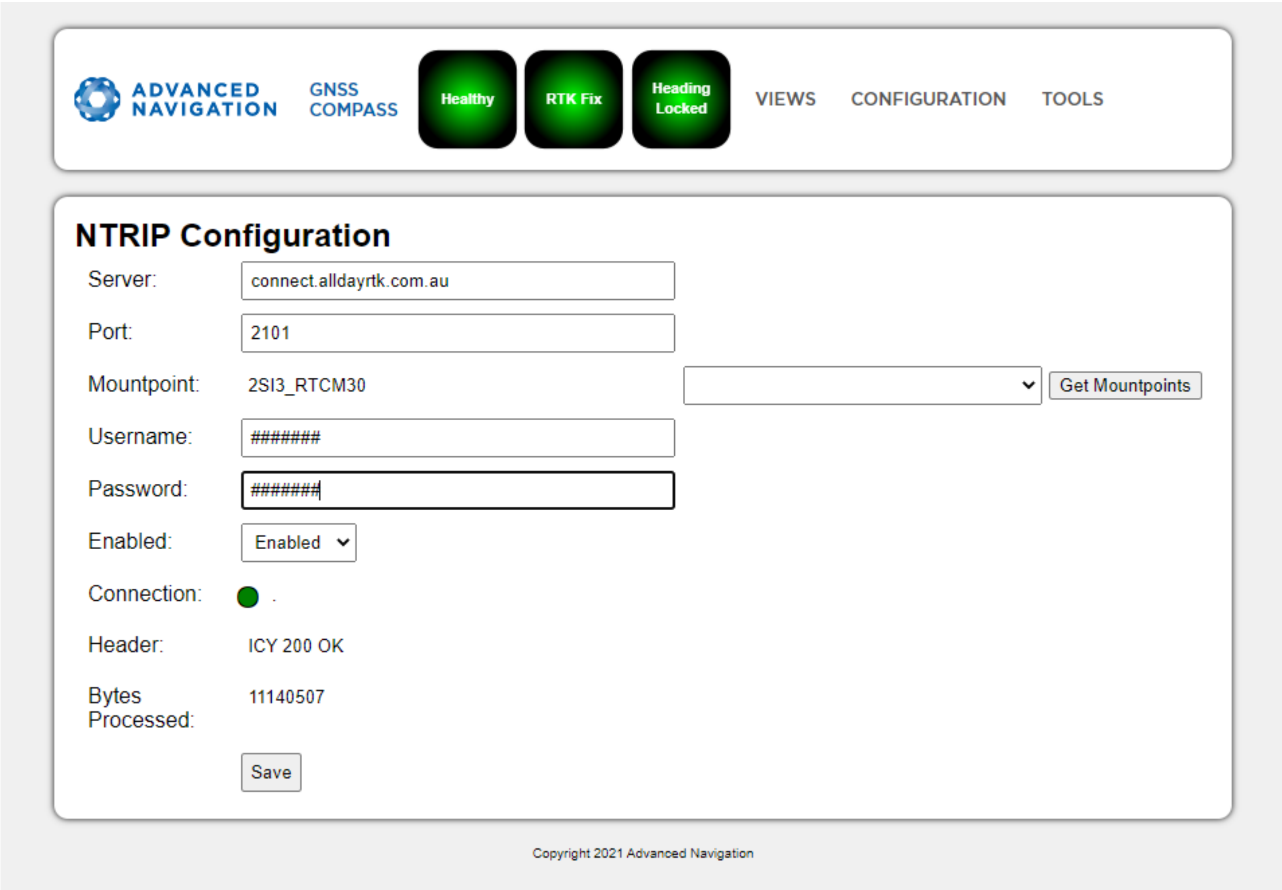

Figure 41: GNSS Compass Web UI NTRIP Client Page

9.1.4 Tools Menu

The Tools menu contains tools for performing certain procedures with GNSS Compass.

9.1.4.1 Firmware Update

This page is used to update the GNSS Compass device firmware,

GNSS Compass contains firmware which is regularly updated to improve performance and add features. Advanced Navigation recommends that you upgrade to the latest version whenever available. The firmware update function is robust, such that power loss, file corruption or other issues cannot cause problems with units. Check the **GNSS Compass** product page of the Advanced Navigation website periodically for updates.

Note: Advanced Navigation device firmware files have the extension .anfw.

Note: To upgrade the Ethernet compass via the web UI, it must be using a dynamic IP from a DHCP server. See **9.1.3.7 Ethernet Settings**

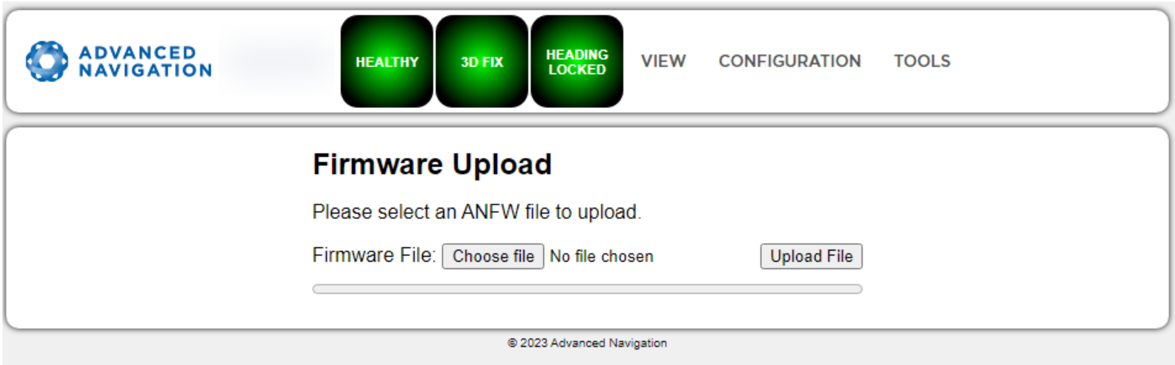

Figure 42: Web UI Firmware Update Page

Click "Choose File" and select the appropriate ANFW file for upload.

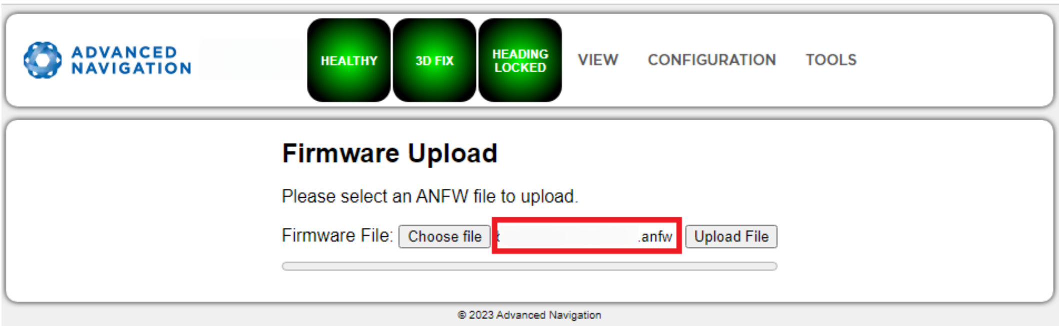

Figure 43: Firmware Update Choose File

Wait while the system uploads the firmware.

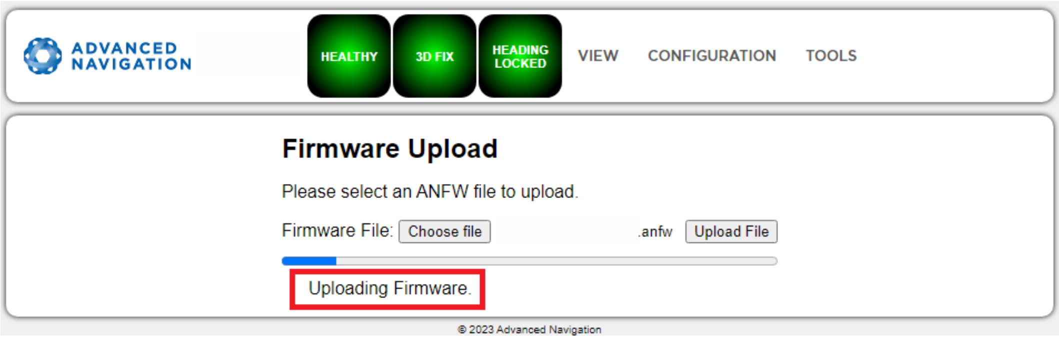

Figure 44: Firmware Update Uploading Firmware

Once uploaded, the system will automatically verify the firmware prior to reboot.

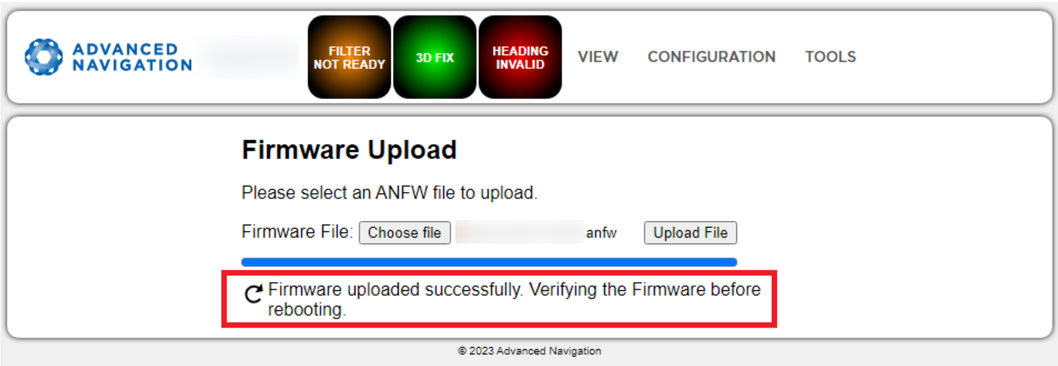

Figure 45: Firmware Update Verifying

Upon successful verification, a dialog box will appear indicating the device is rebooting to apply the update.

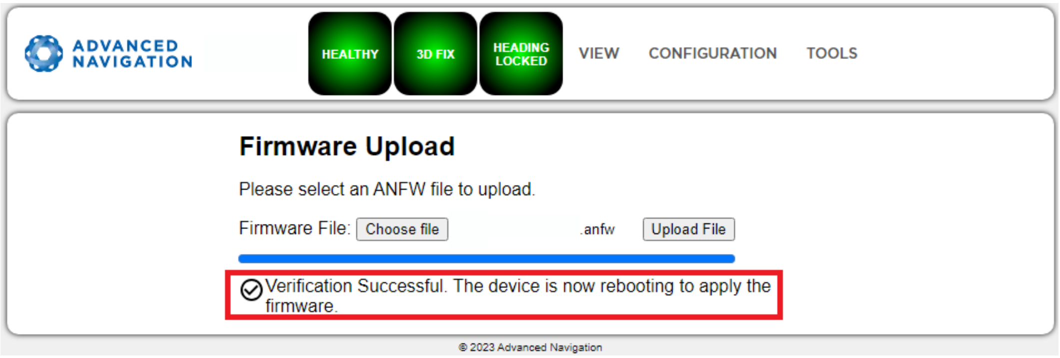

Figure 46: Firmware Update Complete

9.2 Using GNSS Compass Manager

GNSS Compass Manager is a software tool provided by Advanced Navigation for logging, testing, display and configuration of GNSS Compass. It is designed to be simple and easy to use. It should run on most Windows, MacOS and Linux computers.

Note: Java 11 is required to run GNSS Compass Manager. Adoptium JRE 11 is the recommended Java installer to be used on all platforms. Install the latest version of Java 11 from **Adoptium**, selecting the correct operating system and architecture for your computer.

GNSS Compass Manager contains almost identical functionality to the web UI. This section will only include the areas that are different or absent from the web UI. Refer to the documentation for **9.1 Using the Web User Interface** as required.

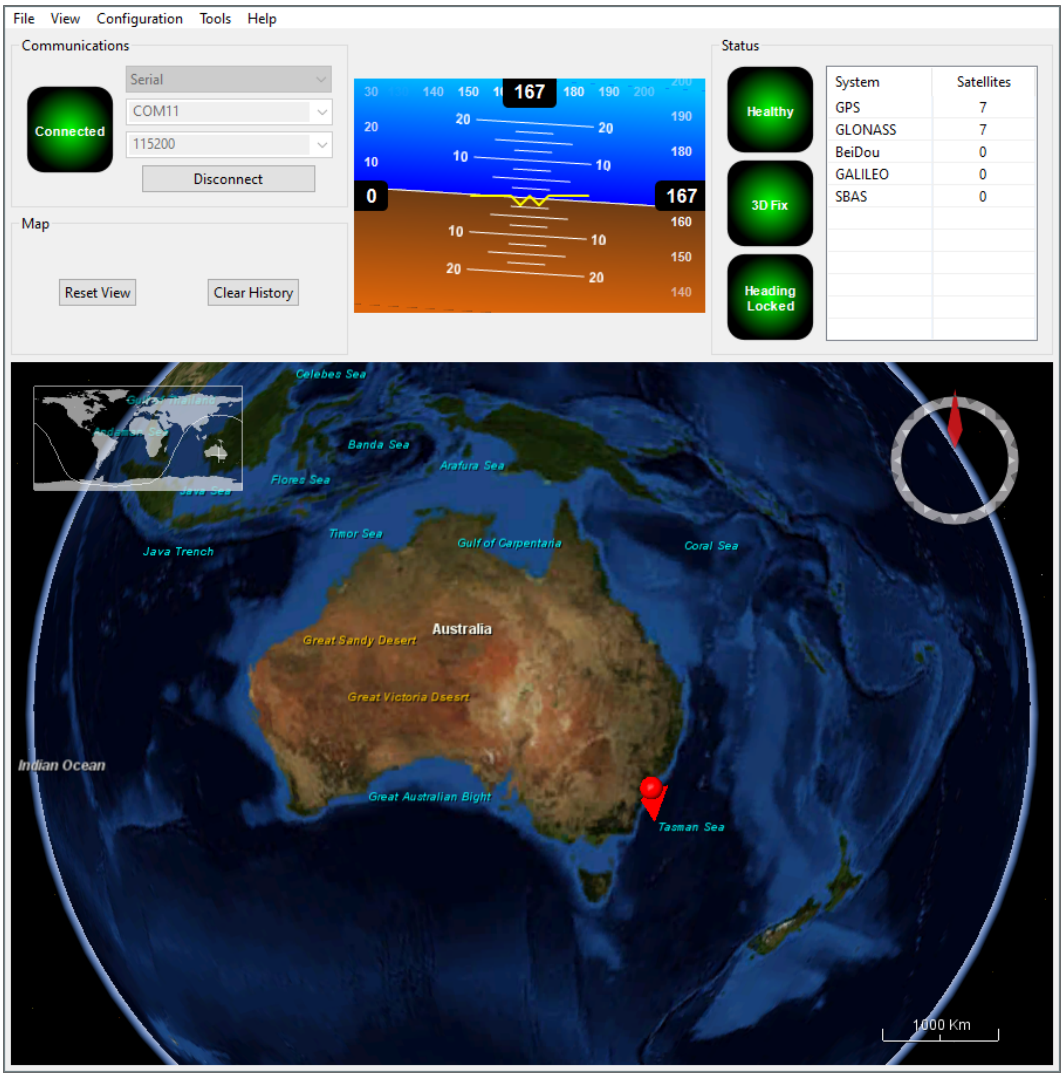

Figure 47: Screenshot of GNSS Compass Manager

9.2.1 GNSS Compass Manager Software Changelog

Version	Date	Changes
7.3	11 April 2024	Improved usage and syntax information in the command line help Added support for more GPIO functions during log conversion Added command line argument to connect to the device on launch Added argument to open the Manager window maximised Updated device information window to show "BOOTLOADER" when applicable to software version
7.2	10 Nov 2023	Clear map history on reconnection Fix incorrect timezone text displayed in terminal.csv Updated leap-seconds list URL Add automatically log configuration at the start of a new log Added support for NavIC satellite system Fixed indicators behaviour on disconnect Updated support for Mac silicon with latest macOS Added ability to Factory Restore via Tools > Device Discovery Corrected list of available auxiliary functions Fix unable to change offsets in alignment window Added support for extra NMEA 0183 messages Removed GNSS status indicator Fixed issue with opening windows containing charts Increased NTRIP client timeout In satellites window, only populate azimuth and elevation fields in the table view when the values have been determined Add ability to set Packet Timer period
7.0	13 February 2023	Updated from JDK8 to JDK11. **JRE11/JDK11 required to run this release** Refresh Port Mode information on reconnection Refresh Packet Rates information on reconnection Fixed Ethernet Settings Static IP setting Improved reliability of firmware update Fixed issue with NTRIP client streaming from some servers When the NTRIP sourcetable says authentication type is any of '', 'B', 'N', then use Basic Authentication. This is to workaround NTRIP servers that incorrectly populate the authentication field Overwrite/clear existing packet rates on import of configuration Added support for ARM (aarch64) processors with 64-bit OS Added support for Apple M1 processors and improved MacOS support Various UI improvements
6.2	10 October 2022	Added support for NTRIP Casters that request Username & Password to retrieve source table Added copying version numbers etc from Device Information and GNSS Receiver Information dialog boxes Renamed Log Conversion menu item Added Settings menu item Removed of SBAS corrections option when SBAS is not supported on the device Fixed configuration export for POE variant Improved reliability of Aries GC GNSS Firmware update Various bug fixes

Version	Date	Changes
6.0	29 October 2021	Major update to support v2.0 hardware and v2.0+ firmware

Table 25: GNSS Compass Manager Software Changelog

9.2.2 System Requirements

GNSS Compass Manager is only available for systems with x64 and ARM architectures.

GNSS Compass Manager includes a 3D mapping display which requires an internet connection. If your machine does not meet the graphics requirements the mapping view will only show space without a globe.

Note, when GNSS Compass is running at very high output rates e.g. 1000 Hz, GNSS Compass Manager can consume significant system resources handling such large quantity of data.

9.2.3 Installation and Starting

The latest version of GNSS Compass Manager can be downloaded from the **GNSS Compass** product page of the Advanced Navigation website. Installation notes are as follows:

- **Java 11 is required** to run GNSS Compass Manager.
  Adoptium JRE 11 is the recommended Java installer to be used on all platforms. Install the latest version of Java 11 from **Adoptium**, selecting the correct operating system and architecture for your computer.
- No installation process required for the GNSS Compass Manager application on a Windows system — it can be run from any directory by simply double clicking on it. To open the program on some systems it may be necessary to right click and select open with → Java Runtime Environment.
- On MacOS systems it may be necessary to run the application from a terminal window:
  `java -jar -XstartOnFirstThread GNSS CompassManager.jar`
- On Linux systems it may be necessary to run the application from a terminal window:
  `java -jar GNSS CompassManager.jar`

The GNSS Compass Evaluation Kit includes an FTDI USB to RS232 / RS422 adaptor cable. The drivers are normally installed automatically, but if not they are available for download from **www.ftdichip.com/Drivers/VCP.htm**.

9.2.4 Troubleshooting

If the application will not start, the most common reason is that you have 32-bit Java installed on a 64-bit operating system. Uninstall Java and reinstall the 64-bit version.

If the globe does not appear in the 3D map area, this indicates that either your graphics card is not powerful enough, your graphics card driver is out of date, or you have no internet connection.

- Ensure the RS232 / RS422 switch is in the correct mode. The GNSS Compass factory default mode is RS422.
- Ensure you select the correct COM port. This can be easily identified by unplugging and re-plugging in the USB connector.
- Ensure you have the correct baud rate selected in GNSS Compass Manager. The factory default value for the baud rate is 115200 bps for the Primary and Auxiliary ports.

Contact technical support **support@advancednavigation.com** if you have any questions or require further assistance.

9.2.4.1 Windows

There is a well known problem with USB serial devices under Windows known as “crazy mouse”. The problem occurs when the system mistakenly installs the USB serial device as a mouse. If you experience this problem, often a restart will resolve it. Otherwise there is a tool that can fix this issue available at **http://www.stentec.com/anonftp/pub/wingps/pnpblockersetup.exe**.

If the serial port does not show up when you plug in the FTDI USB to RS232/RS422 adaptor cable, you may need to install the drivers from **www.ftdichip.com/Drivers/VCP.htm**.

When operating GNSS Compass on Windows at a high data rate, data can be lost due to the latency of the FTDI driver. To resolve this problem the latency of the driver should be reduced to 1 ms:

1. Start the Windows Device Manager (1) and find the Ports section (2).
2. Identify the specific COM port being used (3) by dis-connecting and re-connecting the USB to RS232 / RS422 adaptor cable.
3. Right click on the identified COM port and select Properties. Select the Port Settings tab (4) and select Advanced (5).
4. Change the Latency Timer value (6) to 1 msec then press OK (7), and OK again for the previous window.

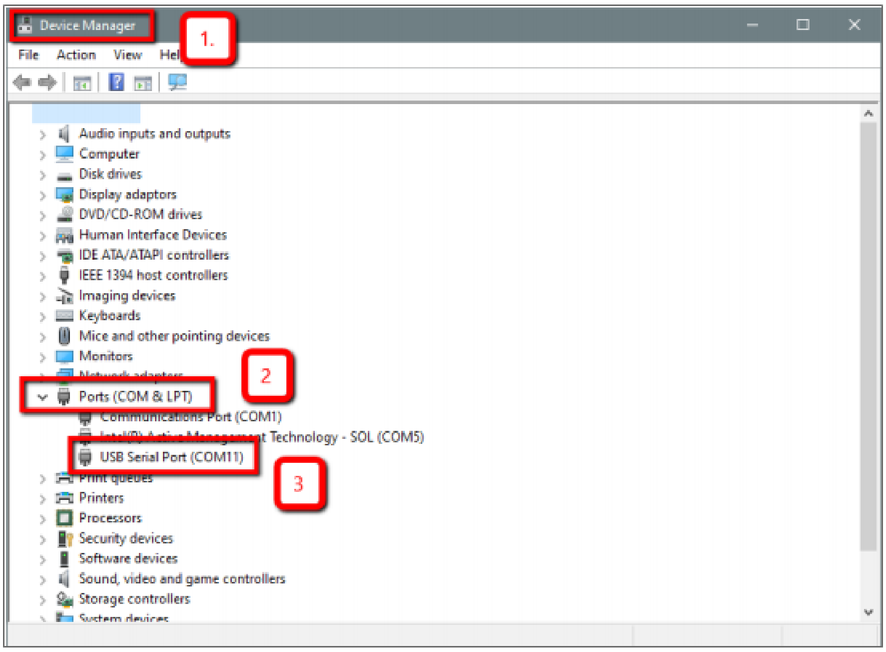

Figure 48: Setting the Windows Port Latency Value - 1

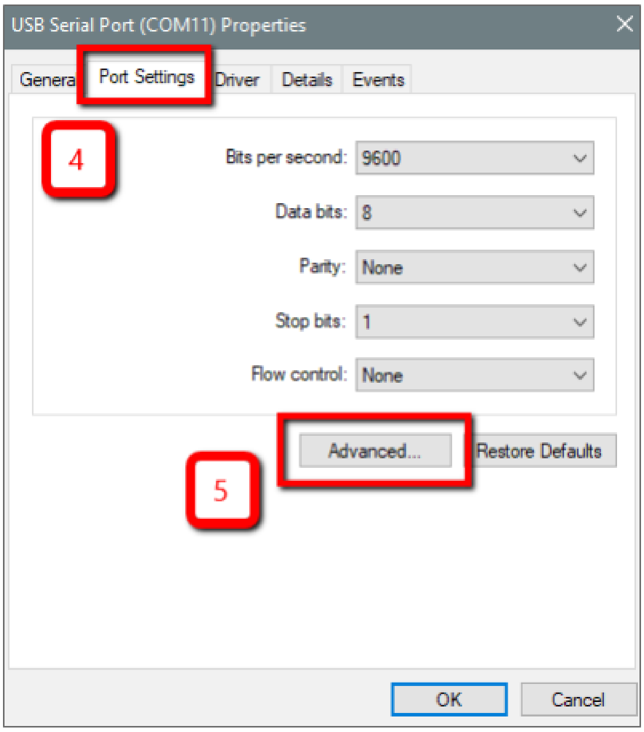

Figure 49: Setting the Windows Port Latency Value - 2

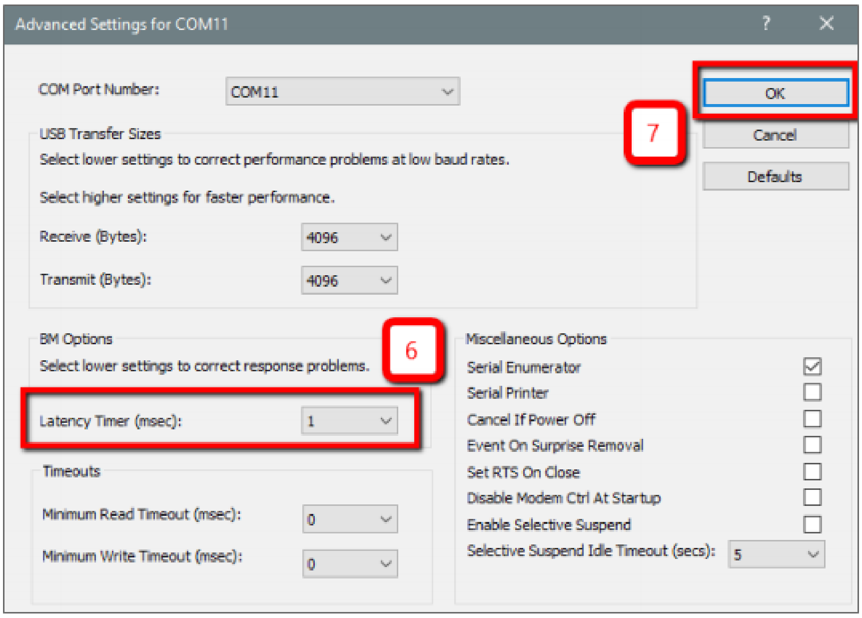

Figure 50: Setting the Windows Port Latency Value - 3

9.2.4.2 Linux

If serial ports do not show up, the typical reason is a lack of permissions. The user should add themselves to the dialout group with the command:

```
sudo adduser username dialout
```

Compiz causes issues with the 3D mapping. If you are experiencing problems it is recommended to turn off Compiz.

Modemmanager can also sometimes cause problems on Linux installations. If you are not using a modem, it is recommended to remove modemmanager with the command:

```
sudo apt-get remove modemmanager
```

9.2.5 Main View

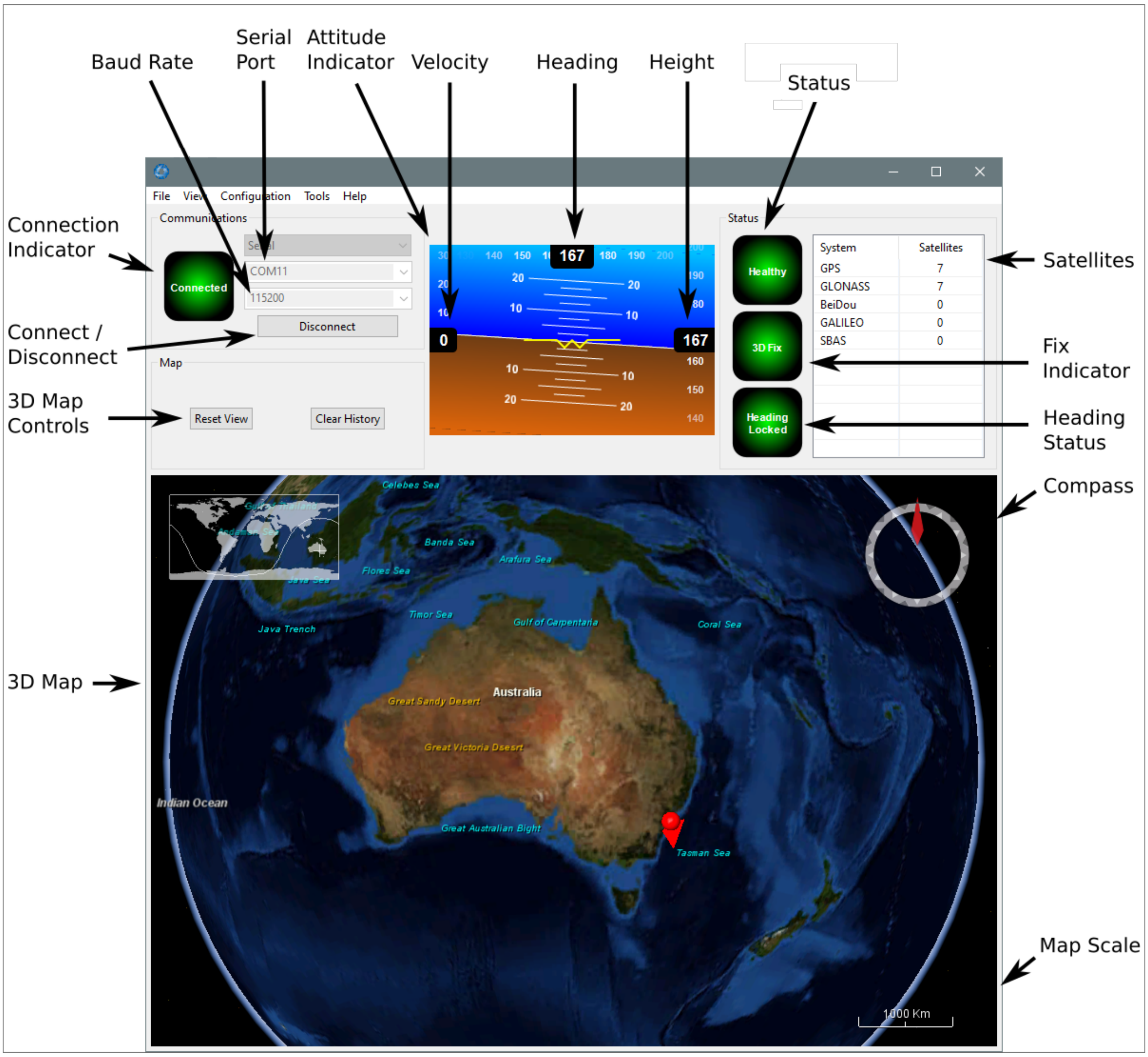

Figure 51: Manager Main View

9.2.5.1 Serial Port

The Serial Port dialogue is used to connect to GNSS Compass. Select the serial port and baud rate and click **Connect**. The default baud rate of GNSS Compass is 115200. The Connection Indicator displays whether there is communication with a GNSS Compass unit.

9.2.5.2 Attitude Indicator

The aircraft style Attitude Indicator shows roll and pitch through a virtual horizon. Around the sides heading, speed and height are shown. All units are SI (metric) and degrees.

9.2.5.3 Satellites Table

The Satellites table shows the number of satellites visible by the primary antenna. More detailed information can be found in the **9.2.6.4 Satellites** sub section under the **9.2.6 View Menu**.

9.2.5.4 Status Indicator

The Status indicator section contains a GNSS Compass status indicator, a fix indicator and a satellites table.

- GNSS Compass Status Indicator - This indicator shows any problems with GNSS Compass. Before a GNSS position fix is achieved it will show the status “Filter not initialised”. Once the filter has initialised it should show “Healthy”. Clicking on the indicator will show the detailed status flags.
- Fix Indicator - This shows the status of the GNSS position fix. Under normal operating conditions it should show either “3D Fix” or “SBAS Fix”. When satellite visibility is poor it may show either “2D Fix” or “No Fix”.
- Satellites Table - The Satellites table shows the number of active satellites being used in the current GNSS solution. More detailed information can be found in the satellites view.

9.2.5.5 3D Map

The 3D map shows the GNSS Compass position on the Earth as well as a red trail of position history. When the filter initialises the map will automatically reset the view to the GNSS Compass position. To move the camera click and drag on the map. To zoom in and out use the mouse scroll wheel. To change the camera view right click and drag or shift click and drag.

9.2.5.6 3D Map Controls

- Reset View : This resets the map view to current position.
- Clear History: This clears the current position history, this is the red trail shown on the map.

9.2.5.7 Baud Rate

This displays the current and available baud rates options for the serial connection.

9.2.5.8 Connect / Disconnect

This button enables the serial connection to be either connected or disconnected.

9.2.6 View Menu

9.2.6.1 View

The View menu contains a number of different options for viewing data from GNSS Compass.

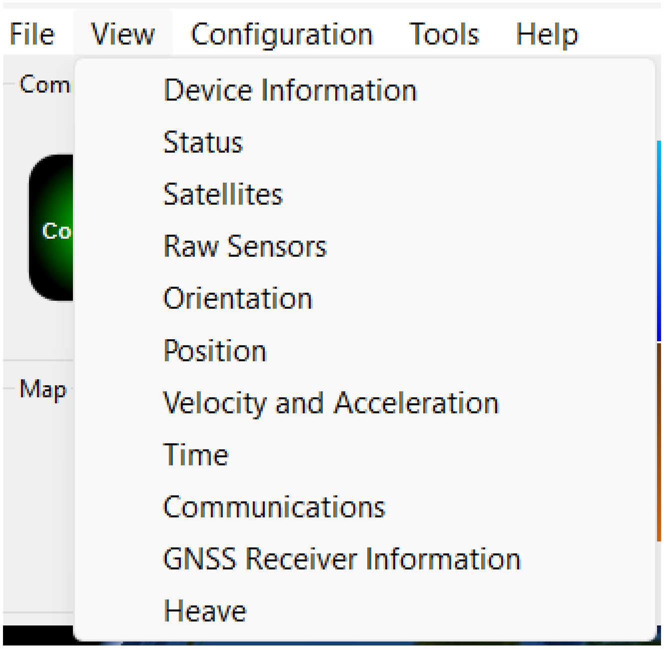

Figure 52: Manager View Menu

9.2.6.2 Device Information

Device information is useful during technical support and for tracking your serial number, firmware and hardware version.

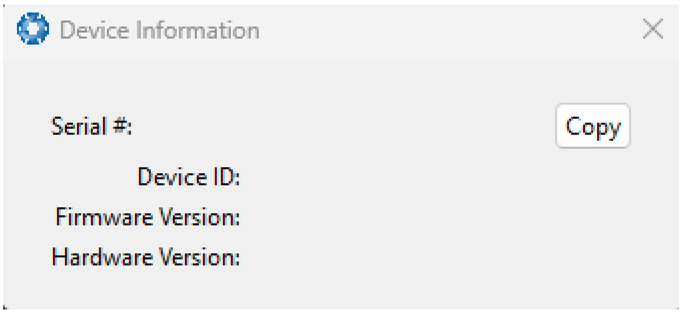

Figure 53: Manager Device Information

9.2.6.3 Status

The Status shows the current status of GNSS Compass as reported by sections **11.4.1 System State Packet** (ID#20) .

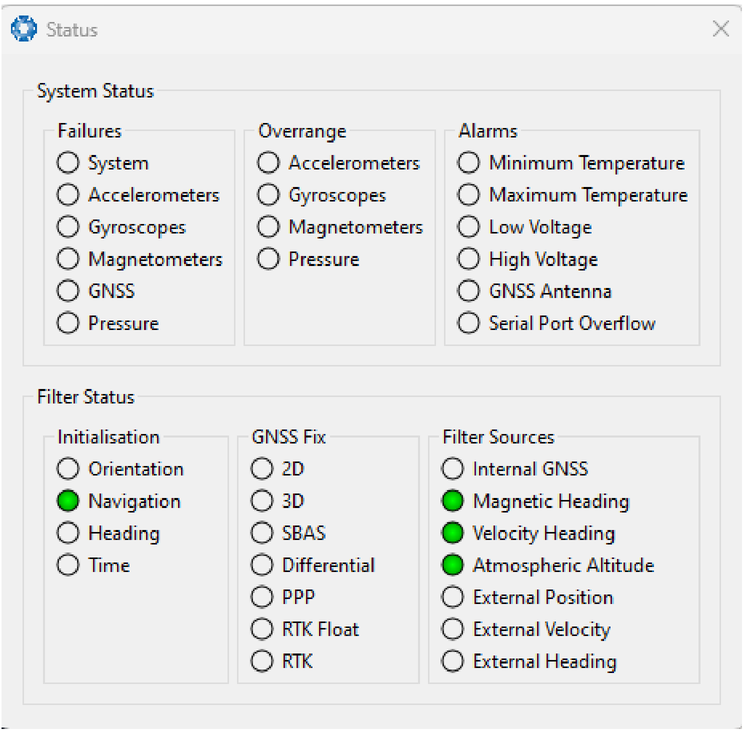

Figure 54: Manager Status Dialogue

9.2.6.4 Satellites

The Satellites dialogue shows detailed information on the satellites that are visible to the GNSS Compass GNSS receiver.

The information is displayed as a satellite skyplot, a table and an SNR (Signal-to-Noise Ratio) graph. A maximum of 28 satellites will be displayed, even if more are accessible. This plot shows the SNR of each satellite at the primary and secondary antenna. As a guideline, these should be within 5-10 dB of each other in the absence of cable or antenna faults. Elevation and azimuth are in units of degrees.

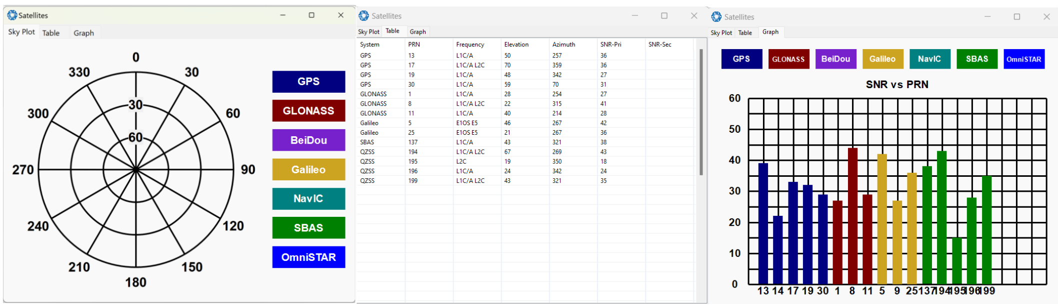

Figure 55: Manager Satellites Table

9.2.6.5 Raw Sensors

Raw sensors dialogue shows the raw sensor values including the IMU temperature of the GNSS Compass.

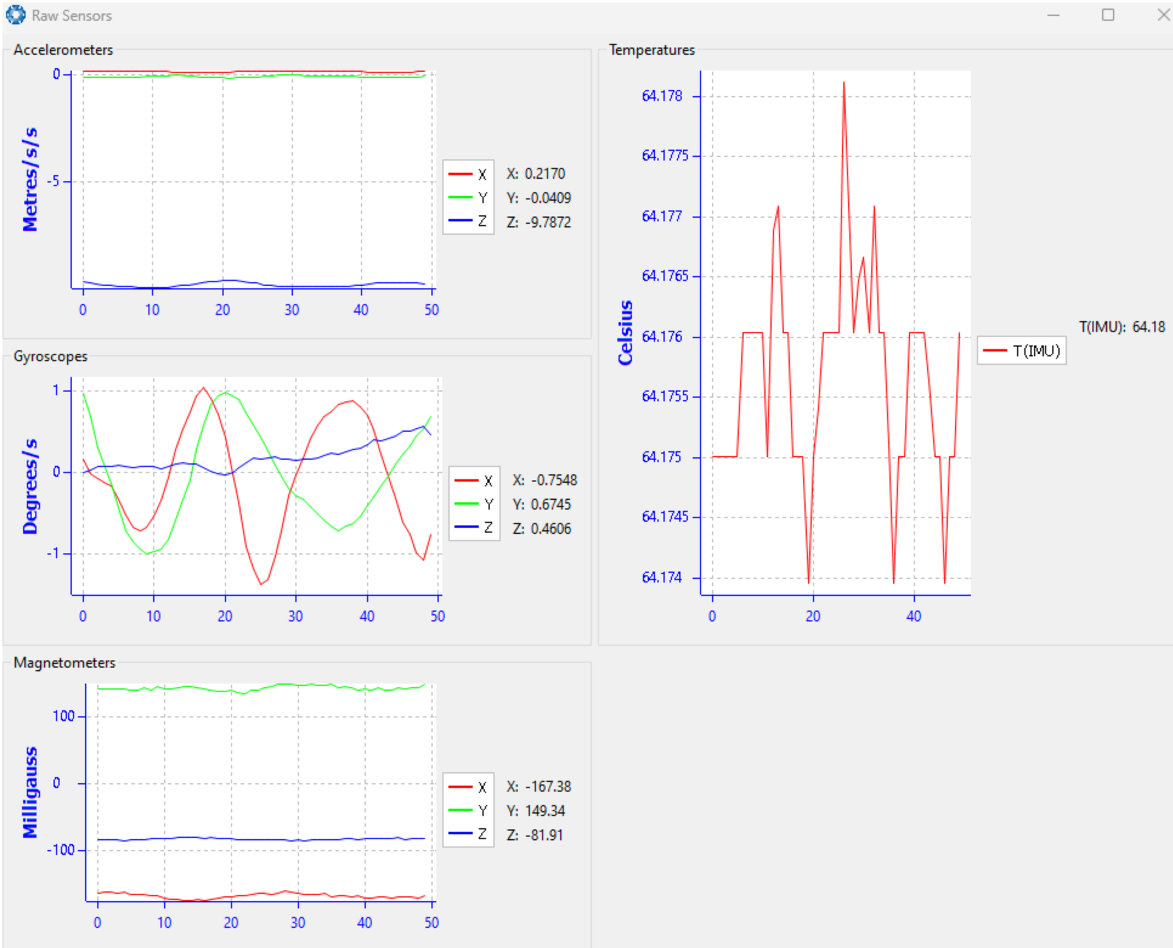

Figure 56: Manager Raw Sensor Outputs

9.2.6.6 Orientation

Orientation shows the GNSS Compass orientation, angular velocity and orientation error. To enhance the user's understanding of some of the less intuitive metrics, **Course** is defined as the path determined by measuring sequential positions, and **Slip** is the difference between the heading and the course.

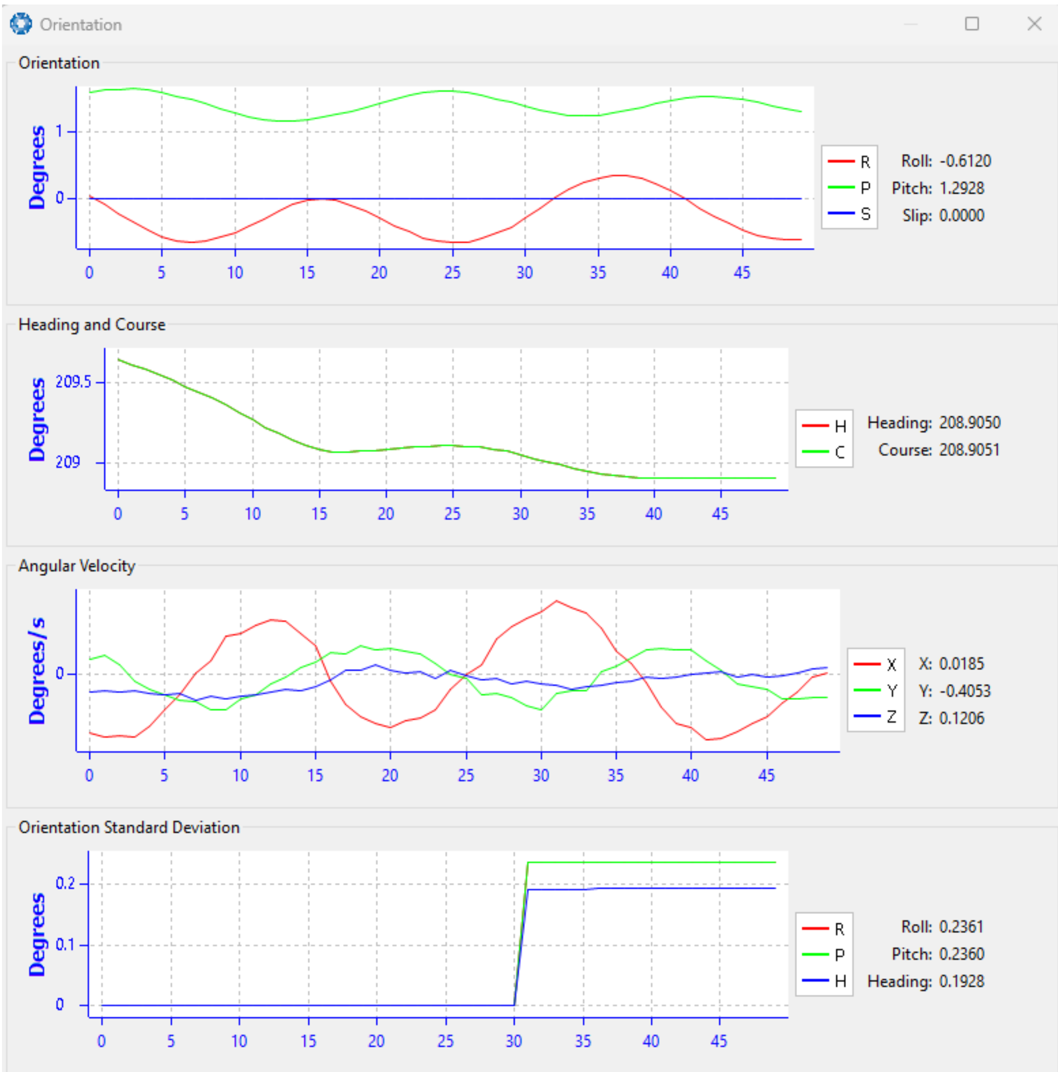

Figure 57: Manager Orientation Outputs

9.2.6.7 Position

Position shows the GNSS Compass position and position error. Latitude and longitude are converted to North and East metres from a reference point that can be reset.

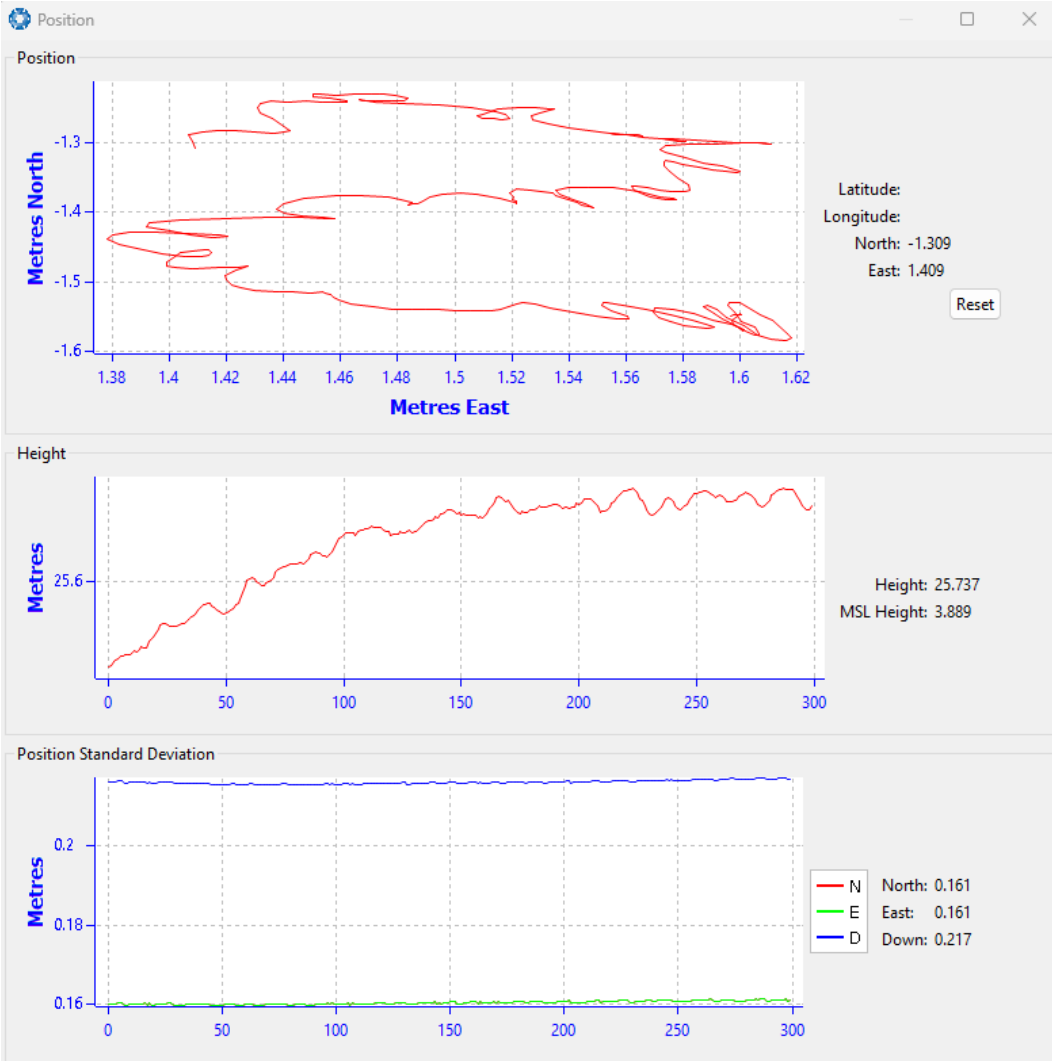

Figure 58: Manager Position Outputs

9.2.6.8 Velocity and Acceleration

Velocity and Acceleration shows the GNSS Compass velocity, acceleration and g-force.

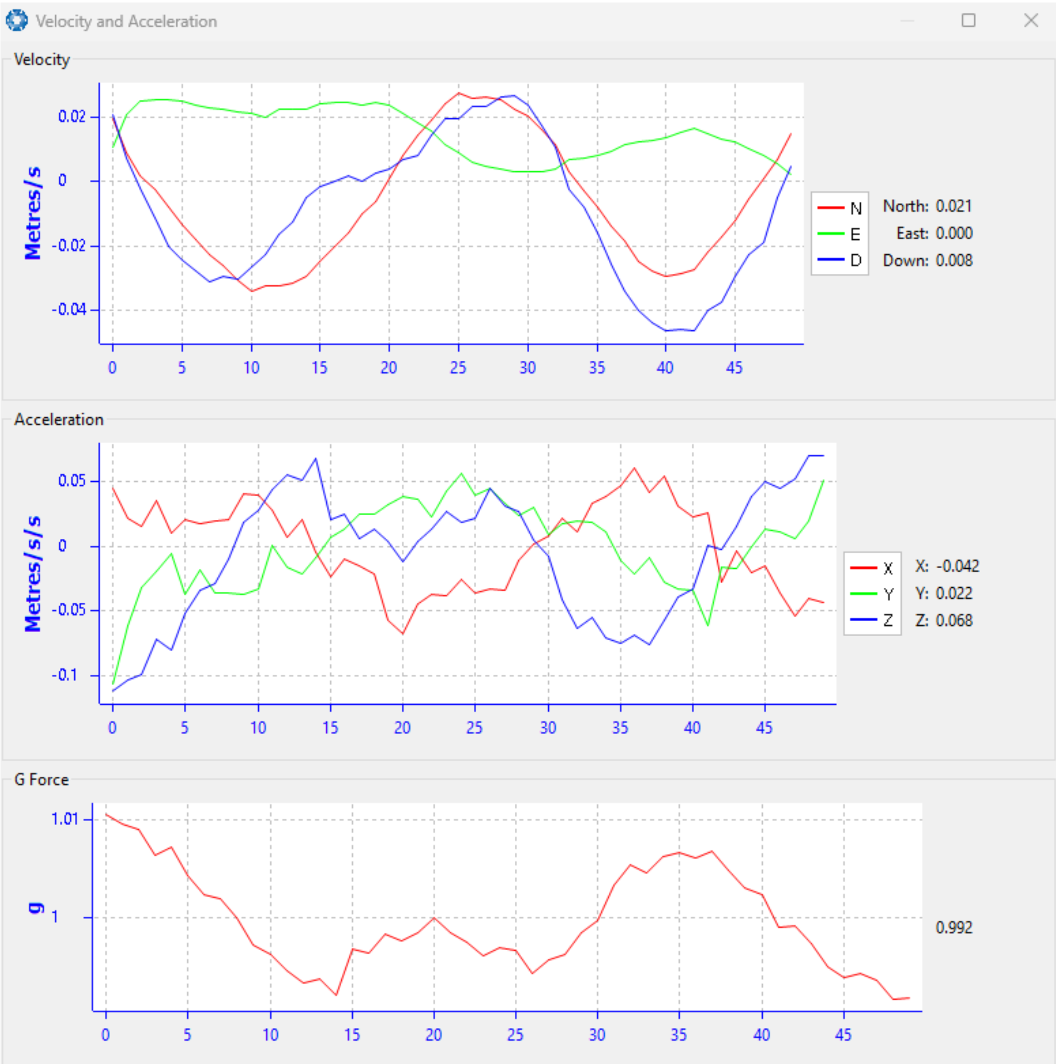

Figure 59: Manager Velocity and Acceleration Outputs

9.2.6.9 Time

This dialogue box allows the to view the time for the connected device. Views are in Unix, UTC, or Local time formats to best suit user requirements to ensure accurate timekeeping and synchronisation across systems.

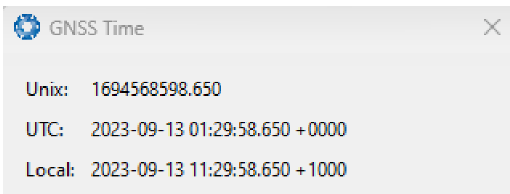

Figure 60: Time Dialogue

9.2.6.10 Communications

This dialogue shows statistics on the data packets received from GNSS Compass and can be useful in diagnosing signal integrity problems.

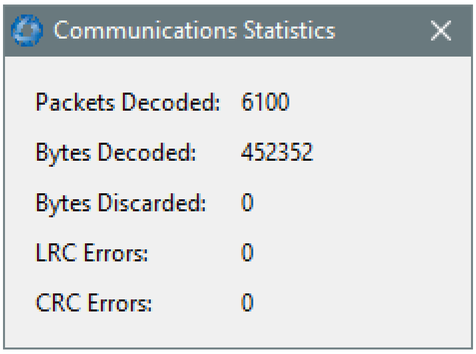

Figure 61: Manager Communications Dialogue

9.2.6.11 GNSS Receiver Information

This dialogue shows information about the GNSS receiver fitted to the GNSS Compass.

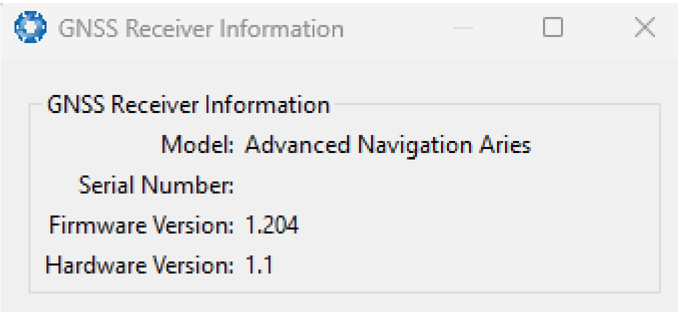

Figure 62: Manager GNSS Receiver Information Dialogue

9.2.6.12 Heave

For the Heave dialogue to display data, the Heave Packet (ID 58) must be configured in the **9.2.7.4 Packet Rates** dialog. Reference point offsets for heave are configured in the **9.2.7.9 Reference Position Offsets** dialog.

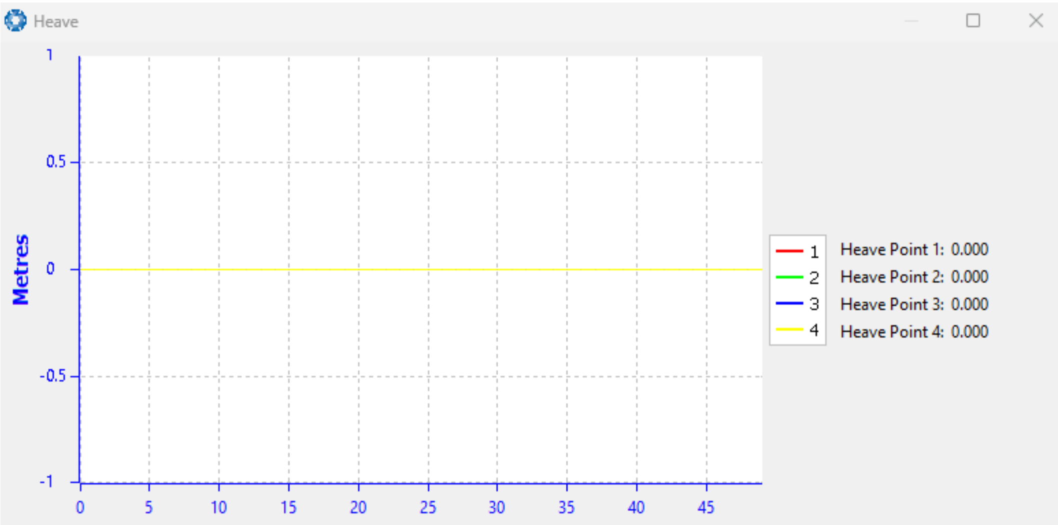

Figure 63: Manager Vessel Motion Outputs

9.2.7 Configuration Menu

The Configuration menu contains a number of dialogues for the configuration of GNSS Compass.

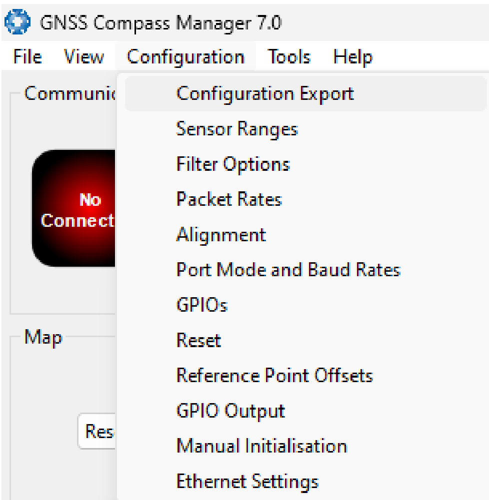

Figure 64: Manager Configuration Menu

9.2.7.1 Configuration Export

The Configuration Export dialogue can be used to export all the GNSS Compass settings to a file. This file can be imported at a later date or on other units. This is useful to restore a unit to a pre set configuration at a later date or for batch configuration of multiple units.

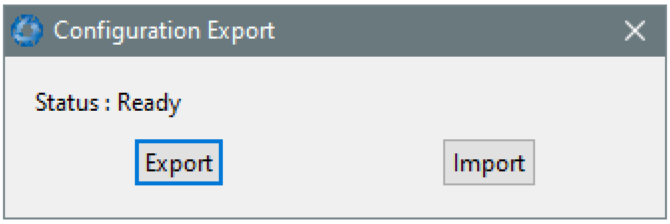

Figure 65: Manager Configuration Export Dialogue

9.2.7.2 Sensor Ranges

The Sensor Ranges dialogue is used to set the dynamic range of the sensors. If the user is experiencing over-range events during operation, these settings should be used to increase the range of the sensor which is reporting the over-range. The lowest ranges give the best performance, the user should make changes slowly and monitor the results.

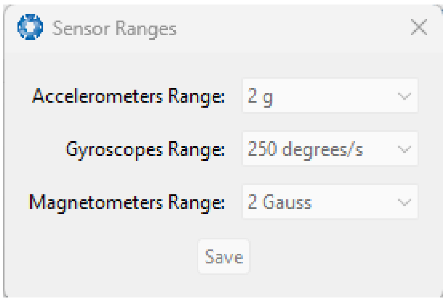

Figure 66: Manager Sensor Ranges Dialogue

9.2.7.3 Filter Options

For most applications the default filter options should be used and only the vehicle profile set. If in doubt please contact **support@advancednavigation.com**.

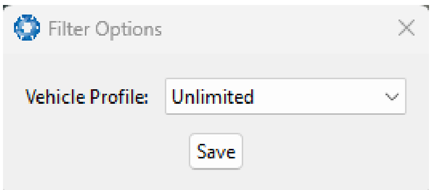

Figure 67: Manager Filter Options

9.2.7.4 Packet Rates

The Packet Rates dialogue allows the user to specify which packets output on a periodic basis and at what rate. The default packets enabled are the System State Packet (ID 20) and the Raw Sensors Packet (ID 28) at 20Hz and these typically provide all the data that a user will require. These two packets need to be enabled for the data graphs to update in GNSS Compass Manager. Other state packets can be enabled as required.

Note: Packet rate configuration applies only to the data port which the Manager is connected to. To configure other ports, the Manager must be connected to that port.

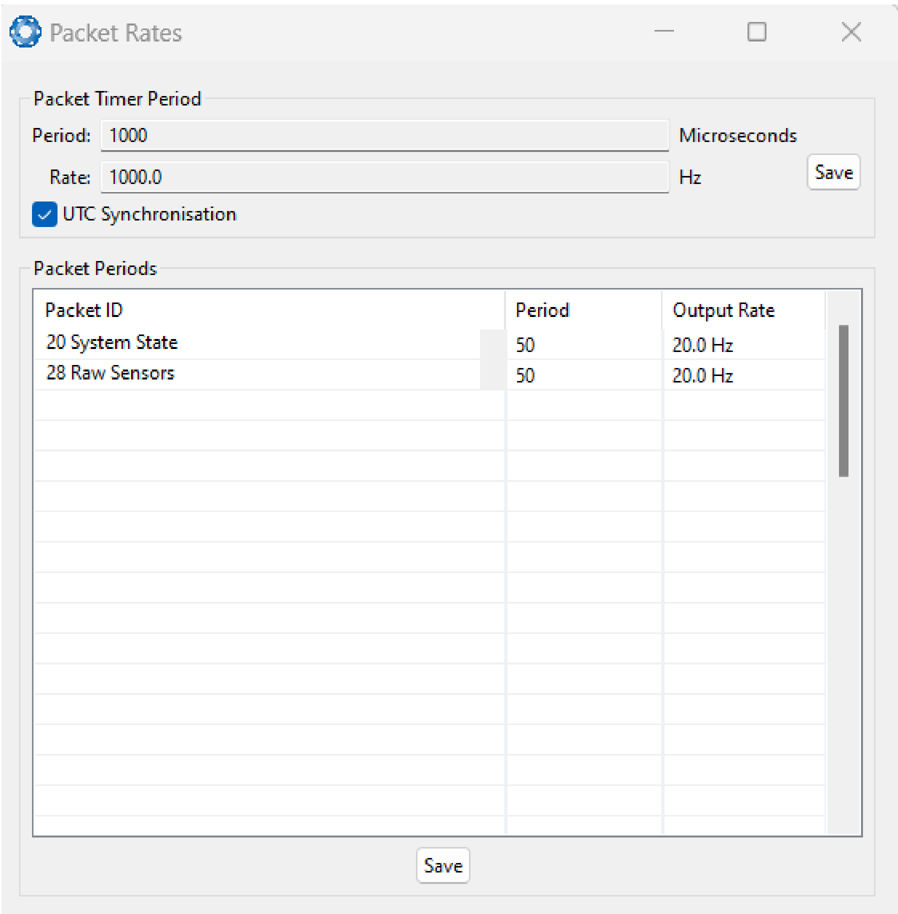

Figure 68: Manager Packet rates

9.2.7.5 Alignment

The Alignment dialogue is used to set the alignment offsets of the system installation. It is important to set the values in this dialogue correctly for accurate results.

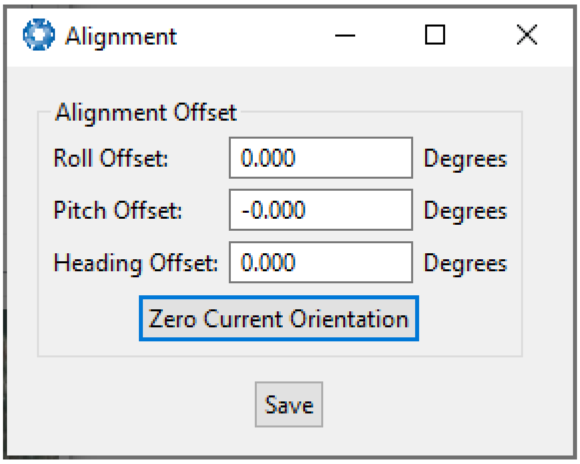

Figure 69: Manager Alignment Dialogue

Alignment Offset

If GNSS Compass is installed into the vehicle with the positive X-axis pointing forwards and the positive Z-axis pointing down, then no alignment offset is required and the roll, pitch and heading offset values can remain at the factory defaults of zero.

If the unit is installed in a different orientation then the roll, pitch and heading offset must be entered. For example if the unit is installed on its side with the X-axis pointing up and the Z-axis pointing forwards and no change to the Y-axis, then this would result in a pitch offset of +90 degrees with roll and heading remaining zero.

If there is a small misalignment due to mechanical mounting error this can be compensated for by setting the vehicle stationary on a level surface and pressing the **Zero Current Orientation** button.

Note: Zero Current Orientation will only correct for roll and pitch offsets, the Heading offset must be entered manually and saved before using this function.

All the other offsets will be measured in the realigned body co-ordinate frame (X positive forward, Z positive down) after being corrected for any alignment offset entered.

9.2.7.6 Port Mode and Baud Rates

Some machines running Microsoft Windows do not support higher baud rates. When changing baud rates, it is recommended to test the baud rate configuration first, without ticking the Permanent box. This way, if it is not possible to communicate at the higher baud rate, a power cycle can be used to revert to the previous baud rate setting.

The factory default baud rate value for these ports is 115200 bps.

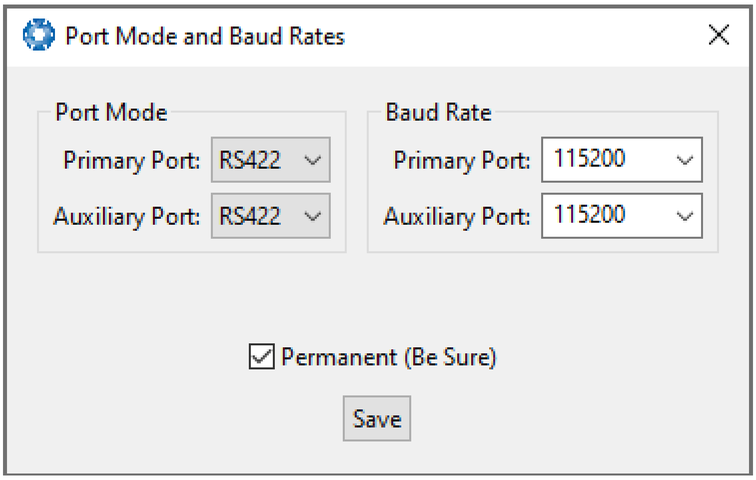

Figure 70: Manager Baud Rates Dialogue

9.2.7.7 GPIO

This page allows the user to configure the input and output functions of the Auxiliary ports. These functions change dynamically and are effective immediately upon clicking **Save Changes**.

The default values for these settings are Inactive. The dedicated 1PPS signal is active by default.

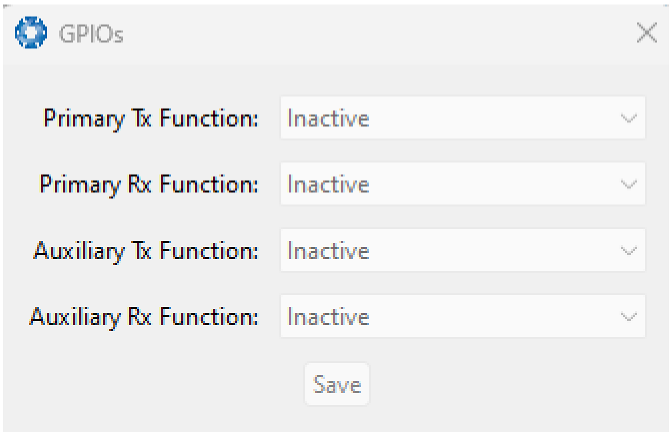

Figure 71: Manager GPIO configuration Dialogue

9.2.7.8 Reset

The Reset button causes the system to perform a power cycle. No configuration settings or state data are lost. The Cold Start button clears all filters, and connections are reset and must re-established. No configuration settings are lost. The Factory Restore button resets all GNSS Compass settings back to their factory defaults, including state data and all configuration settings. It also erases the hot start data so that the system is forced to perform a cold start.

Note: A Factory Restore will re-enable the DHCP Client and lose any static IP address settings.

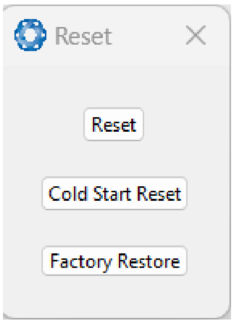

Figure 72: Manager Reset Dialogue

9.2.7.9 Reference Position Offsets

The Reference Point Offsets dialogue allows the user to set measurement points away from its default position at the physical centre of the GNSS Compass unit. The primary reference point offset applies to data from all ANPP packets as well as all peripheral output such as NMEA messages and Heave Point 1.

When the values are zero the measurement point is the centre of the GNSS Compass unit. This can be offset to a different position on the profile by entering the offset value from the centre of the GNSS Compass unit to the desired position in the body co-ordinate frame (X positive forwards, Z positive down).

Note: These values only apply to the Heave Packet. NMEA, TSS and Simrad heave is not affected by the values in this dialogue which are always measured at the centre of the GNSS Compass unit.

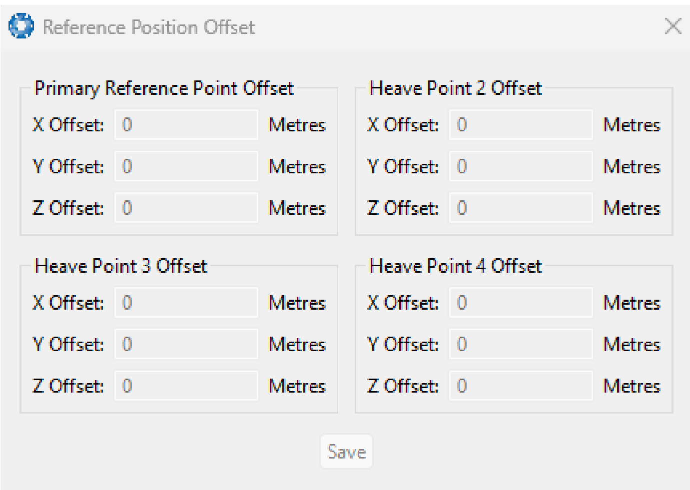

Figure 73: Manager Reference Position Offset

9.2.7.10 GPIO Output

The GPIO output configuration dialogue allows the user to configure the NMEA0183, TSS1 and SIMRAD output rates for the Auxiliary port. These output rates will be observed with respect to the actual output selected in the 9.2.7.7 GPIO port configuration.

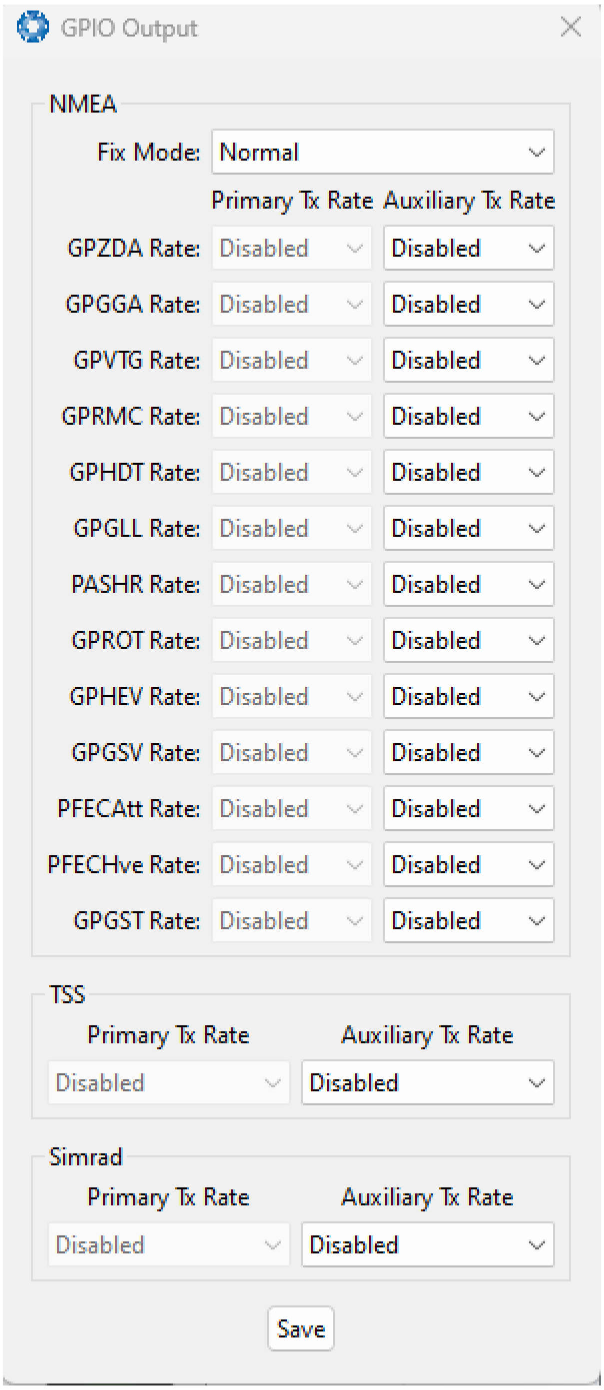

Figure 74: Manager GPIO Output Dialogue

9.2.7.11 Manual Initialisation

The Manual Initialisation dialogue can be used to manually initialise GNSS Compass when a GNSS fix is not available. Setting the position will initialise the navigation filter. Setting the heading will also initialise the heading filter.

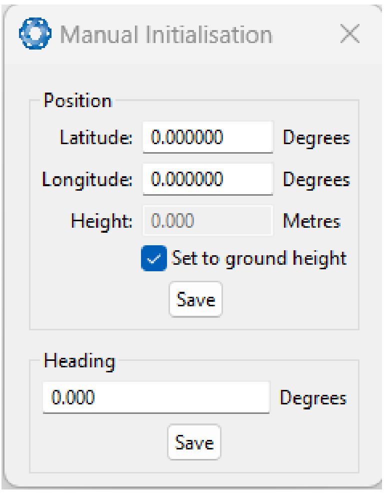

Figure 75: Manual Initialisation Dialogue

9.2.7.12 Ethernet Settings

The Ethernet Settings dialogue allows the user to enable or disable the DHCP Client. When the DHCP Client is disabled you need to enter the TCP/IP settings if the user wishes to access the web UI. If the user is connecting to GNSS Compassvia the primary port these settings can be ignored. The default is for the Ethernet mode to be set to DHCP.

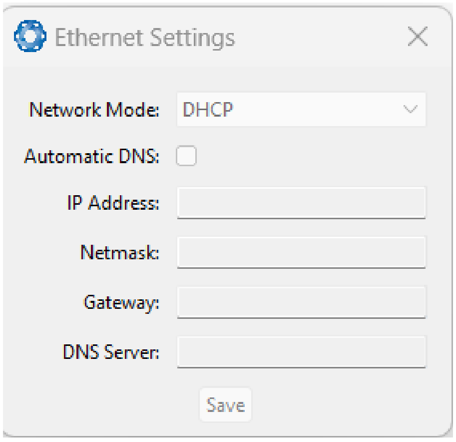

Figure 76: Manager Ethernet Settings Dialogue

9.2.8 Tools Menu

The **Tools** menu contains tools for performing certain procedures with GNSS Compass.

Figure 77:

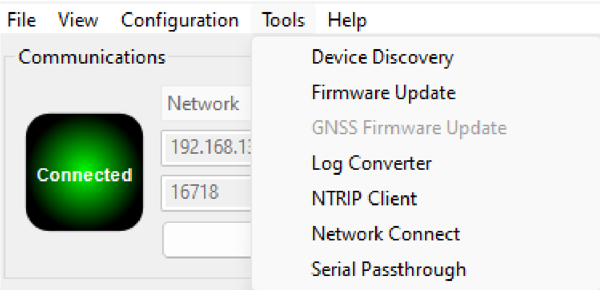

Figure 78: Manager Tools Menu

9.2.8.1 Device Discovery

Device discovery allows network discovery and reconfiguration of devices on the local network regardless of network settings.

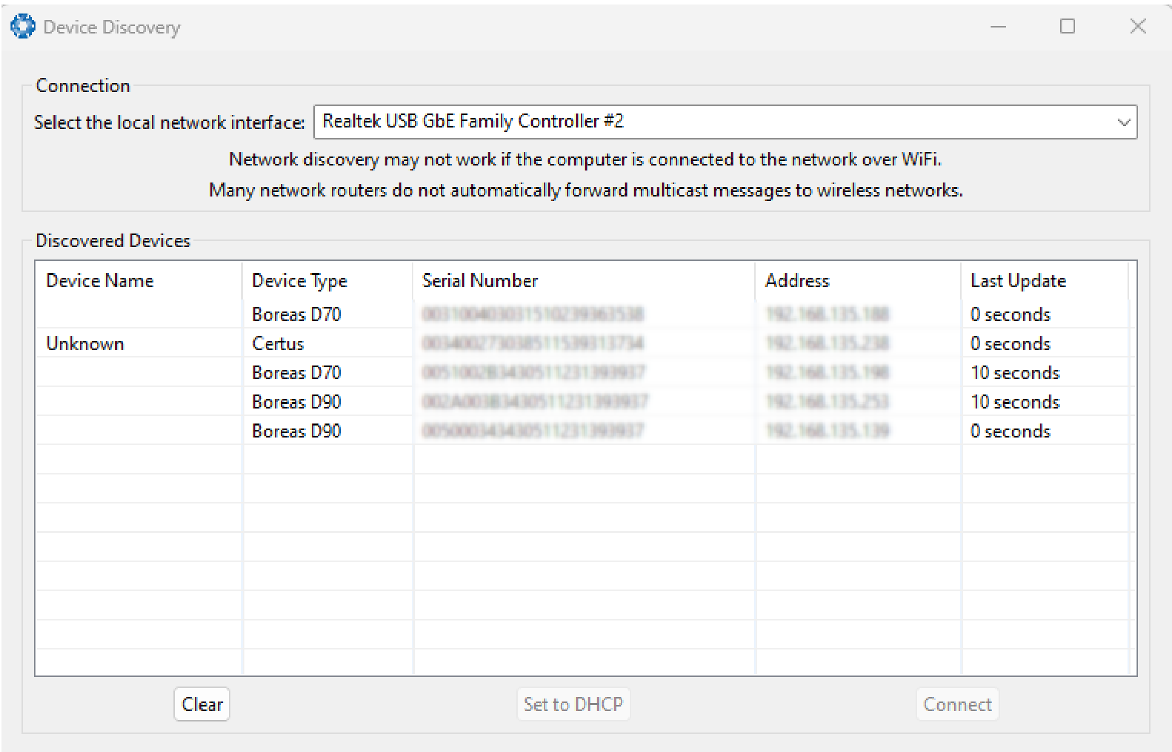

Figure 79: Device Discovery Dialogue

Set to DHCP

Once discovered devices on uncontactable network addresses can be reset to DHCP by pressing the “Set to DHCP” button for that device.

9.2.8.2 Firmware Update

This dialogue is used to update the GNSS Compass device firmware.

GNSS Compass contains firmware which is regularly updated to improve performance and add features. Advanced Navigation recommends that you upgrade to the latest version whenever available. The firmware update function is robust, such that power loss, file corruption or other issues cannot cause problems with units. Check the **GNSS Compass** product page of the Advanced Navigation website periodically for updates.

Note: Advanced Navigation device firmware files have the extension .anfw.

After the appropriate file is uploaded, the Firmware Update dialogue will display "**Firmware Update Ready**" in the status line.

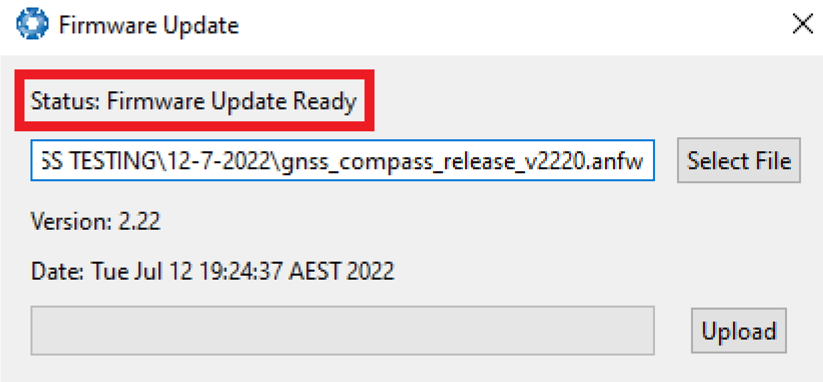

Figure 80: Firmware Update Ready Dialogue

Once the user clicks "upload", the dialogue status line will update to "**In Progress**"

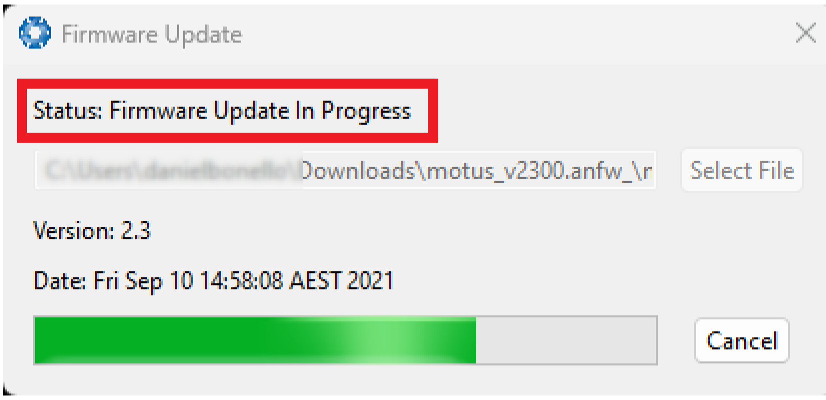

Figure 81: Firmware Update In Progress Dialogue

During this process, the user will notice the connection indicator change from "**Connected**" to "**Bootloader**." This change confirms that the upload is functioning properly.

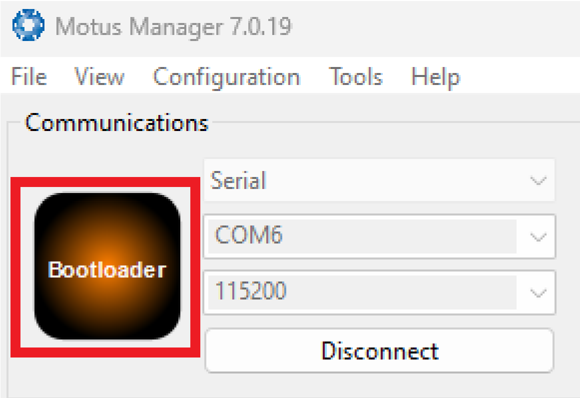

Figure 82: Firmware Update Bootloader Indicator

After the upload finishes, the system will restart. The device indicator will then display "**Connected**," and the firmware update status line will show "**Complete**."

Figure 83: Firmware Update Complete Dialogue

After the update, the user can close the firmware update dialogue and verify the update by looking at the version in the Device Information dialogue, found under the view menu of the manager.

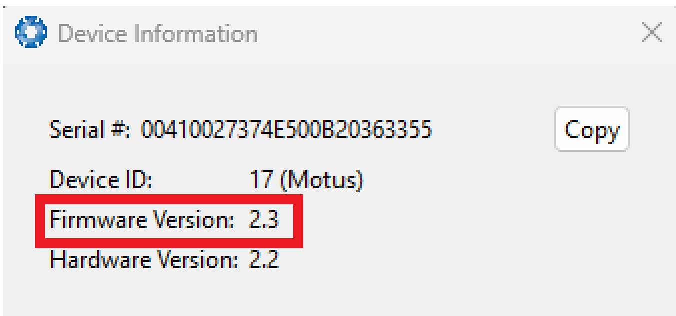

Figure 84: Device Information Dialogue

9.2.8.3 GNSS Firmware Update

Note: To upgrade the GNSS Compass Ethernet variant via the web UI, it must be using a dynamic IP from a DHCP server. See 9.1.3.7 Ethernet Settings

Note: 9.2.8.7 Serial Passthrough must be disabled in order to update the GNSS Firmware

GNSS Compass GNSS Firmware Update dialogue enables users to update the firmware specific to their GNSS Receiver.

The following must be met in order to upgrade the GNSS Receiver firmware:

- Hardware version v2.0 or later
- Device firmware must be the latest. Check the GNSS Compass product page of the Advanced Navigation website periodically for updates.
- For Serial (SER) variants, use the primary serial port and set the baud rate to **115200**. The update will not work if the baud rate is set to any other value.
- For Ethernet (POE) variants, use a network connection to TCP port **16718**. Avoid using a network connection that is expected to be unreliable, such as over a cellular or satellite modem.

Follow these steps to upgrade the GNSS Receiver Firmware:

1. Navigate to the GNSS Firmware Update page form the Tools menu (shown above)
2. Once unzipped, the GNSS Receiver Firmware consists of two files, a PRIMARY file and a SECONDARY file. In the dialog box, in the first file selection field, select the **primary** file. In the second file selection field, select the **secondary** file.
3. Select **Update**.

   It is expected that the process will take a few minutes. The progress bar and percent complete should be incrementing.

   If the progress stops with an error or stalls, then power cycle the device, reconnect and select **Update** to restart the update.
4. When the process is complete, power cycle the device. To confirm the upgrade was successful, navigate to **View** → **GNSS Receiver Information**. The firmware version must match the version number in the primary and secondary firmware files.

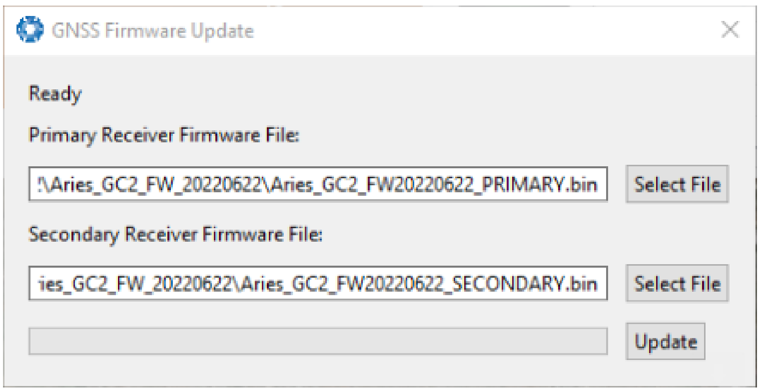

Figure 85: GNSS Receiver Firmware Upgrade Dialogue

9.2.8.4 Log Converter

This tool allows the user to convert GNSS Compass log files into various standard formats that are interchange and readable by many programs. The Position Offset settings are used to project the exported position of origin to a point other than the actual centre of the GNSS Compass unit. For most users, these values should be left at zero.

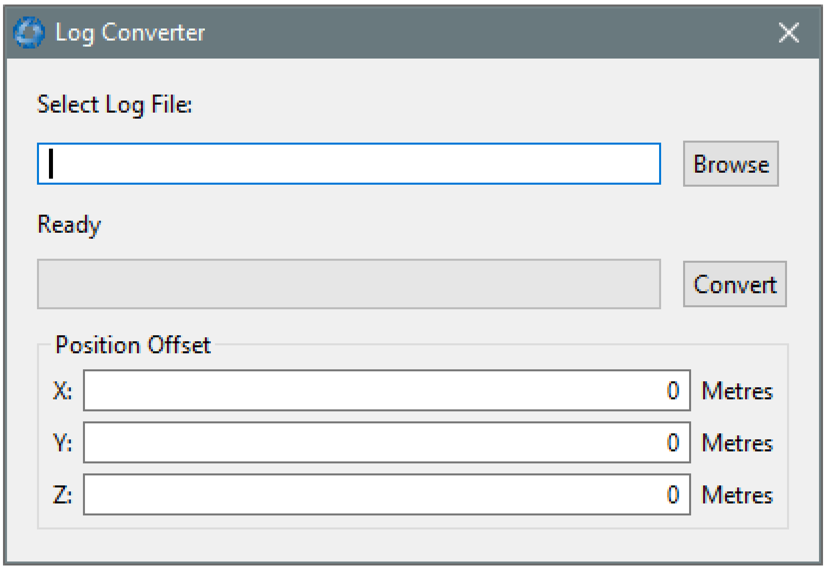

Figure 86: Manager Log Converter Dialogue

To configure the Log path, navigate to *Settings*, under the File menu.

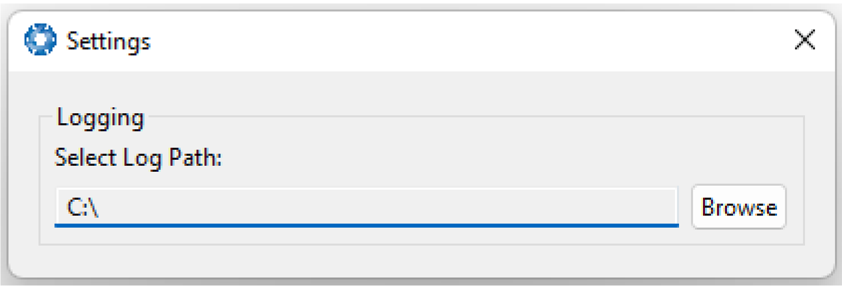

Figure 87: Settings menu for configuring Log Path

9.2.8.5 NTRIP Client

The NTRIP client can be used to connect to a network DGPS or RTK service to stream correction data to GNSS Compass for DGPS or RTK. The NTRIP client requires an internet connection to function. Contact **Support** for guidance on getting set up with network DGPS or RTK.

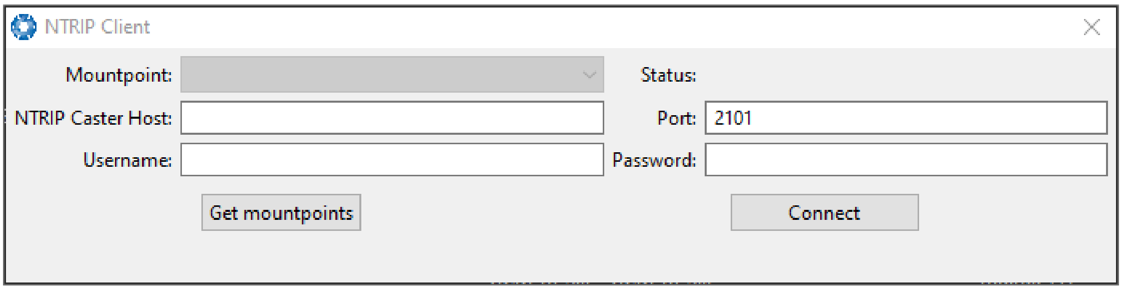

Figure 88: Manager NTRIP Client Dialogue

Note: These settings refer to the NTRIP Client built into the GNSS Compass . The GNSS Compass also contains a built in NTRIP client, to configure, this needs to be configured within the GNSS Compass web UI, see **9.1.3.8 NTRIP Client**

9.2.8.6 Network Connect

The network connect dialogue allows GNSS Compass Manager to make a connection to GNSS Compass over a TCP/IP network rather than the primary serial port connection.

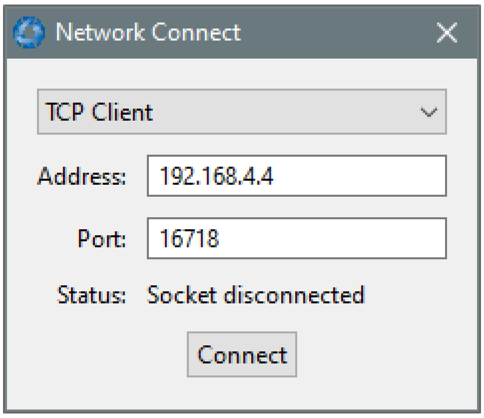

Figure 89: Manager Network Connect Dialogue

9.2.8.7 Serial Passthrough

This function allows pass-through communication through the Auxiliary port.

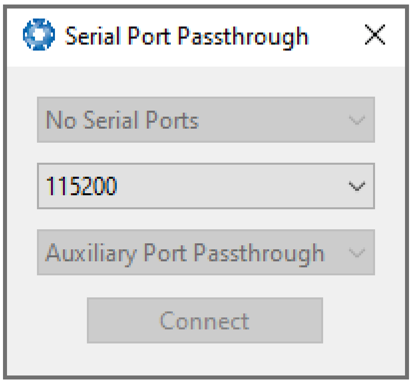

Figure 90: Manager Serial Port Passthrough Dialogue

9.2.9 Logging

GNSS Compass Manager features a fully automatic logging system. Every time the serial port **Connect** button is clicked GNSS Compass Manager starts a new log file in the current directory. The log file is given the file name GNSS CompassLog_date_time.anpp and contains all of the raw data received from GNSS Compass in the AN packet protocol. The log files are closed when the serial port is disconnected.

To convert these log files into easily accessible formats, the 9.2.8.4 Log Converter dialogue in the **Tools** menu can be used. The Log Converter creates a folder and generates files in the CSV (comma separated values) format that can be easily opened with Microsoft Excel, Matlab, LibreOffice and most other data analysis programs. It also creates a GPX file and a KML file that are designed to be opened with Google Earth Pro.

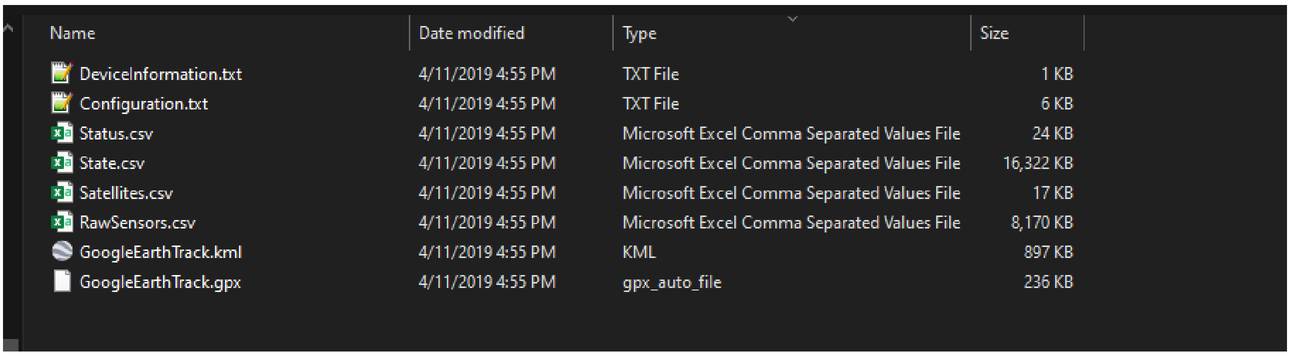

Figure 91: Files Generated by the Log Converter

Note: This data logging is performed by the GNSS Compass Manager application.

9.3 Using the Android App

The Spatial Manager Android app provides logging and visualisation functions for Android phones and tablets. It is particularly useful for field testing purposes. You can use this app to connect to your GNSS Compass via Bluetooth and:

- Monitor position and orientation in real time
- Log real-time data for later analysis and review

- Configure NTRIP stream corrections
- Configure device alignment offsets and manual initialisation

You will require a Serial to Bluetooth adaptor with Bluetooth v2.0 support connected to the primary serial port.

The app can be found by searching the Google Play store for "Advanced Navigation Spatial Manager". Refer to the in-app Quick Start guide for more information. Contact **support@advancednavigation.com** if you have any questions about the Android app.

9.4 Using ANPP

GNSS Compass can be configured and monitored using the Advanced Navigation Packet Protocol (ANPP), which is detailed fully in **11 Advanced Navigation Packet Protocol**.

A software development kit (SDK) is available at no extra charge to assist you when developing your own applications. It contains example code in a number of programming languages, ready to compile and test.

10 Interfacing

Communication with GNSS Compass is possible on the following ports:

- 10.1 Ethernet
- 10.2 Serial Interface
- 8.6 NMEA 0183
- 8.5 NMEA 2000
- 10.3 1PPS Signal

Each port has different input and output capabilities.

10.1 Ethernet

The Ethernet interface offers a 100 MBit port for connection to a network, router or laptop/computer. The interface offers a web UI, as well as 4 (four) configurable data ports. Each Data Port

- can be configured as a TCP Server, TCP Client or a UDP Client as detailed in 10.1.1 Ethernet Modes
- can be configured with an Input and/or Output for a number of protocols as detailed in 10.1 Ethernet.
- should only be used to establish a connection with a single remote computer/device at any one time.

10.1.1 Ethernet Modes

Ethernet Mode	Description	Required Configuration
TCP Server	GNSS Compass will establish a TCP Server listening on the defined port. A connected client is able to receive Output data and send Input data based on the defined Input and Output functions.	Port
TCP Client	GNSS Compass will continuously attempt to establish a TCP connection to the defined Destination IP and Port. Once established, a connected client is able to receive Output data and send Input data based on the defined Input and Output functions.	Client Destination IP address Port
UDP Client	GNSS Compass will send UDP Output data to the defined Destination IP and Port. A client can also send UDP Input data to GNSS Compass this same Port.	Client Destination IP address Port

Table 26: Ethernet Data Port Modes

10.1.2 Ethernet Functions

Function Type	Name
Ethernet Input	10.1.2.1 NMEA Input
	10.1.2.8 GNSS Receiver Passthrough
	10.1.2.2 ANPP Input
Ethernet Output	10.1.2.3 NMEA Output
	10.1.2.4 ANPP Output
	10.1.2.5 TSS1 Output
	10.1.2.6 Simrad 1000 Output
	10.1.2.7 Simrad 3000 Output
	10.1.2.8 GNSS Receiver Passthrough

Table 27: Ethernet Data Port Functions

10.1.2.1 NMEA Input

Description:

This function accepts external data in the NMEA 0183 format. Advanced Navigation recommends against using NMEA 0183 input wherever possible due to the inefficiency, low accuracy and precision and weak error checking of the format. All NMEA messages received must have a valid checksum. Supported messages are listed below. The recommended combination of messages are RMC with optional messages GPGSV and GPGSA. If RMC is not available, GGA and VTG can be used.

Message ID	Description	Notes
GPGGA GNGGA	3D position	All constellations
GPGLL GNGLL	2D position	All constellations
GPRMC GNRMC	2D position, 2D velocity and coarse time	All constellations
GPVTG GNVTG	2D velocity	All constellations
GPHDT GNHDT HEHDT	Heading	All constellations
GPGSV GNGSV	Satellites	Only GPS (GPGSV)
GPGSA GNGSA	Dilution of Precision	
xxPIPS	Depth below surface	
xxVBW	Water speed, ground speed	
xxHDM	Magnetic heading	
PSIMSSB	SSBL position	
xxVHW	Water speed and heading	
xxDBS	Depth below surface	

Table 28: Supported NMEA messages

10.1.2.2 ANPP Input

Description: This function accepts data in the ANPP format as specified in **11 Advanced Navigation Packet Protocol**.

10.1.2.3 NMEA Output

Description: This function outputs a configurable combination of the NMEA messages GPZDA, GPGGA, GPVTG, GPRMC, GPHDT, PASHR, GPROT, GPHEV, GPGSV, PFECGPAtt, and PFECGPHve at up to 50 Hz. The messages output and the output rate can be configured using the web UI or GNSS Compass Manager. An example output is shown below.

```
$GPZDA,031644.460,07,05,2013,00,00*52

$GPGGA,031644.460,3352.3501851,S,15112.2355488,E,6,00,1.4,150.
0,M,0.0,M,,*7E

$GPVTG,089.19,T,089.19,M,000.00,N,000.00,K,E*27

$GPRMC,031644.460,A,3352.3501851,S,15112.2355488,E,0.0,89.2,07
0513,12.5,W,E*02

$GPHDT,89.2,T*06

$PASHR,031644.460,089.19,T,-00.01,-00.47,-00.00,,,,0,0*2E
```

10.1.2.4 ANPP Output

Description: This function outputs data in the ANPP format as specified in **11 Advanced Navigation Packet Protocol**. This function is for ANPP peripheral devices only.

10.1.2.5 TSS1 Output

Description: This function outputs the TSS1 format at a user configurable rate of up to 50 Hz. The output rate can be configured using the page in the web UI.

10.1.2.6 Simrad 1000 Output

Description: This function outputs the Simrad 1000 format at a user configurable rate of up to 50 Hz. The output rate can be configured using the **9.1.3.3 Data Ports** page in the **9.1 Using the Web User Interface**.

10.1.2.7 Simrad 3000 Output

Description: This function outputs the Simrad 3000 format at a user configurable rate up to 50 Hz. The output rate can be configured using the **9.1.3.3 Data Ports** page in the **9.1 Using the Web User Interface**.

10.1.2.8 GNSS Receiver Passthrough

Description: This function allows for pass through connection to the internal GNSS receiver. This is useful for firmware updates of the internal GNSS receiver.

10.2 Serial Interface

There are two serial ports available for use, Primary and Auxiliary. Both ports support ANPP over RS232 or RS422.

10.2.1 Baud Rate

The default baud rate of GNSS Compass is 115,200. The primary and auxiliary port baud rate can be set anywhere from 4,800 to 4,000,000 baud and can be modified using the Baud Rates page in the web UI or GNSS Compass Manager. It is important to select a baud rate that is capable of carrying the amount of data that GNSS Compass has been configured to output. See **11.1.4 Packet Rates** for more details on the data output calculation. The data rate in bytes per second can be calculated by dividing the baud rate by 10. For example if the baud rate is 115,200, the data rate is 11,520 bytes per second. If the selected data rate is insufficient, data may be lost without warning.

The support team can provide a baud rate calculator if it is required. For more information or assistance, contact technical support via email at **support@advancednavigation.com**.

10.2.2 Format

The format is fixed at 1 start bit, 8 data bits, 1 stop bit and no parity. See **11 Advanced Navigation Packet Protocol** for details on the ANPP protocol.

10.3 1PPS Signal

There is a dedicated 1PPS signal available on the **6.7 Serial Connection** of the GC2-SER Serial variant

The signal is normally low and pulses high for 100 milliseconds to signal the precise second, which starts on the rising edge of the signal.

This dedicated 1PPS signal is the recommended 1PPS signal to use as it is more accurate. The validity of this 1PPS signal can be monitored using the time initialised status flag.

11 Advanced Navigation Packet Protocol

The Advanced Navigation Packet Protocol (ANPP) is a binary protocol designed with high error checking, high efficiency and safe design practices. It has a well defined specification and is very flexible. ANPP is proprietary and is used across all Advanced Navigation products. A packet type can be identified by its unique Packet ID. For more information about packets, see 11.1 About Packets.

The following packet types are available:

- 11.3 System Packets - These packets have ID values of less than 20.
- 11.4 State Packets - These packets have ID values between 20 and 179.
- 11.5 Configuration Packets - These packets have IDs greater than 179.

The following table lists Advanced Navigation packets by type.

Packet ID	Name	Length	R/W
System Packets			
0	11.3.1 Acknowledge Packet	4	R
1	11.3.2 Request Packet	Varies	W
2	11.3.3 Boot Mode Packet	1	R/W
3	11.3.4 Device Information Packet	24	R
4	11.3.5 Restore Factory Settings Packet	4	W
5	11.3.6 Reset Packet	4	W
10	11.3.7 Serial Port Passthrough Packet	Varies	R/W
11	11.3.8 IP Configuration Packet	30	R/W

Packet ID	Name	Length	R/W
State Packets			
20	11.4.1 System State Packet	100	R
21	11.4.2 Unix Time Packet	8	R
22	11.4.3 Formatted Time Packet	14	R
23	11.4.4 Status Packet	4	R
24	11.4.5 Position Standard Deviation Packet	12	R
25	11.4.6 Velocity Standard Deviation Packet	12	R
26	11.4.7 Euler Orientation Standard Deviation Packet	12	R
27	11.4.8 Quaternion Orientation Standard Deviation Packet	16	R
28	11.4.9 Raw Sensors Packet	48	R
29	11.4.10 Raw GNSS Packet	74	R/W
30	11.4.11 Satellites Packet	13	R
31	11.4.12 Detailed Satellites Packet	Varies	R
32	11.4.13 Geodetic Position Packet	24	R

Packet ID	Name	Length	R/W
33	11.4.14 ECEF Position Packet	24	R
34	11.4.15 UTM Position Packet	26	R
35	11.4.16 NED Velocity Packet	12	R
36	11.4.17 Body Velocity Packet	12	R
37	11.4.18 Acceleration Packet	12	R
38	11.4.19 Body Acceleration Packet	16	R
39	11.4.20 Euler Orientation Packet	12	R
40	11.4.21 Quaternion Orientation Packet	16	R
41	11.4.22 DCM Orientation Packet	36	R
42	11.4.23 Angular Velocity Packet	12	R
43	11.4.24 Angular Acceleration Packet	12	R
44	11.4.25 External Position and Velocity Packet	60	R/W
45	11.4.26 External Position Packet	36	R/W
46	11.4.27 External Velocity Packet	24	R/W
47	11.4.28 External Body Velocity Packet	16 or 24	R/W
48	11.4.29 External Heading Packet	8	R/W
49	11.4.30 Running Time Packet	8	R
50	11.4.31 Local Magnetic Field Packet	12	R
52	11.4.32 External Time Packet	8	W
54	11.4.33 Geoid Height Packet	4	R
55	11.4.34 RTCM Corrections Packet	Varies	W
58	11.4.35 Heave Packet	16	R
60	11.4.36 Raw Satellite Data Packet	Varies	R
61	11.4.37 Raw Satellite Ephemeris Packet	Varies	R
69	11.4.38 GNSS Receiver Information Packet	Varies	R
73	11.4.39 Automotive Packet	24	R
75	11.4.40 External Magnetometers Packet	17	R/W

Packet ID	Name	Length	R/W
Configuration Packets			
181	11.5.1 Packets Period Packet	Varies	R/W
182	11.5.2 Baud Rates Packet	17	R/W
184	11.5.3 Sensor Ranges Packet	4	R/W
185	11.5.4 Installation Alignment Packet	73	R/W

Packet ID	Name	Length	R/W
186	11.5.5 Filter Options Packet	17	R/W
188	11.5.6 Port Function Configuration Packet	13	R/W
193	11.5.7 Set Zero Orientation Alignment Packet	5	W
194	11.5.8 Reference Point Offsets Packet	49	R/W
195	11.5.9 Port Output Configuration Packet	33	R/W
198	11.5.10 User Data Packet	64	R/W
202	11.5.11 IP Dataports Configuration Packet	30	R/W

Table 29: Advanced Navigation Packets

11.1 About Packets

11.1.1 Packet Structure

The ANPP packet structure and the header format are shown in the tables below. Example source code is provided in multiple languages via the SDK, available from the GNSS Compass product page of the Advanced Navigation website.

Header				
Header LRC	Packet ID	Packet Length	CRC16	Packet Data

Table 30: ANPP Packet Structure

Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Header LRC
2	1	u8	1	Packet ID
3	2	u8	1	Packet Length
4	3	u16	2	CRC

Table 31: ANPP Header Format

11.1.1.1 Header LRC

The header LRC (Longitudinal Redundancy Check) provides error checking on the packet header. It also allows the decoder to find the start of a packet by scanning for a valid LRC. Only the lower 8 bits of the calculation below are provided in the LRC field of the packet header. The LRC can be found using the following:

$$LRC = (PacketID + PacketLength + crc_0 + crc_1) \oplus \mathrm{0xFF} + 1$$

11.1.1.2 Packet ID

The packet ID is used to distinguish the contents of the packet. Packet IDs range from 0 to 255. See 11 Advanced Navigation Packet Protocol.

System packets have packet IDs in the range 0 to 19. These packets are implemented the same by every device using ANPP.

State packets are packets that contain data that changes with time, i.e. temperature. State packets can be set to output at a certain rate. State packets are packet IDs in the range 20 to 179.

Configuration packets are used for reading and writing device configuration. Configuration packets are packet IDs in the range 180 to 255.

11.1.1.3 Packet Length

The packet length denotes the length of the packet data, i.e. from byte index 5 onwards inclusive. Packet length has a range of 0 – 255.

11.1.1.4 CRC

The CRC is a CRC16-CCITT. The starting value is 0xFFFF. The CRC covers only the packet data.

11.1.2 Packet Requests

Any of the state and configuration packets can be requested at any time using the **11.3.2 Request Packet**.

11.1.3 Packet Acknowledgement

When configuration packets are sent to GNSS Compass, it will reply with an acknowledgement packet that indicates whether the configuration change was successful or not. See **11.3.1 Acknowledge Packet**.

External data packets will also generate negative acknowledgement packets if there is a problem with the packet. Positive acknowledgements will not be sent. See **External Data** for a list of External Data Packets.

11.1.4 Packet Rates

The packet rates can be configured either using the web UI, or GNSS Compass Manager or through the **11.5.1 Packets Period Packet**. By default GNSS Compass is configured to output the **11.4.1 System State Packet** at 20 Hz and the **11.4.9 Raw Sensors Packet** at 20 Hz. When configuring packet rates it is essential to ensure the baud rate is capable of handling the data throughput. This can be calculated using the rate and packet size. The packet size is calculated by adding the packet overhead to the packet length; the packet overhead is a fixed value of 5. For example to output the system state packet at 50Hz the calculation would be:

Data throughput = (100 (packet length) + 5 (fixed packet overhead)) * 50 (rate)

Data throughput = 5250 bytes per second

Minimum baud rate = data throughput x 11 = 57750 Baud

Closest standard baud rate = 115200 Baud

When multiple packets are set to output at the same rate, the order the packets output is from lowest ID to highest ID.

11.1.5 Packet Timing

Packets are output in order of packet ID from lowest ID to highest ID and all packets that are output in one sequence have their data matched to the same time of validity. The time of validity can be found in either the **11.4.1 System State Packet**, the **11.4.2 Unix Time Packet** or the **11.4.3 Formatted Time Packet**. For example if the **11.4.2 Unix Time Packet**, **11.4.4 Status Packet** and **11.4.16 NED Velocity Packet** packet were all set to output at 10 Hz, at each 0.1 second period the three packets would output consecutively by order of packet ID with all data synchronised between them and the **11.4.2 Unix Time Packet** providing the time of validity for the other two packets.

11.2 Data Types

The following data types are used in the packet protocol. All data types in the protocol are little endian byte ordering.

Abbreviation	Bytes	Also known as
u8	1	unsigned char, unsigned byte, uint8_t
s8	1	char, byte, int8_t
u16	2	unsigned short, uint16_t
s16	2	short, int16_t
u32	4	unsigned int, unsigned long, uint32_t
s32	4	int, long, int32_t
u64	8	unsigned long long, uint64_t
s64	8	long long, int64_t
fp32	4	float
fp64	8	double

Table 32: Data Type Abbreviations used in the ANPP

11.3 System Packets

11.3.1 Acknowledge Packet

Acknowledgement Packet				
Packet ID				0
Length				4
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Packet ID being acknowledged
2	1	u16	2	CRC of packet being acknowledged
3	3	u8	1	11.3.1.1 Acknowledge Result

Table 33: Acknowledge Packet

11.3.1.1 Acknowledge Result

Value	Description
0	Acknowledge success
1	Acknowledge failure, CRC error
2	Acknowledge failure, packet size incorrect
3	Acknowledge failure, values outside of valid ranges
4	Acknowledge failure, system flash memory failure
5	Acknowledge failure, system not ready
6	Acknowledge failure, unknown packet

Table 34: Acknowledge Result

11.3.2 Request Packet

Request Packet				
Packet ID				1
Length				1 x number of packets requested
Read / Write				Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Packet ID requested
+				Field 1 repeats for additional packet requests

Table 35: Request Packet

11.3.3 Boot Mode Packet

Boot Mode Packet				
Packet ID				2
Length				1
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	11.3.3.1 Boot Mode Types

Table 36: Boot Mode Packet

11.3.3.1 Boot Mode Types

Value	Description
0	Bootloader
1	Main Program

Table 37: Boot Mode Types

11.3.4 Device Information Packet

Device Information Packet				
Packet ID				3
Length				24
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	Software version
2	4	u32	4	11.3.4.1 Device ID
3	8	u32	4	Hardware revision
4	12	u32	4	GNSS Compass Serial number part 1
5	16	u32	4	GNSS Compass Serial number part 2

Device Information Packet				
6	20	u32	4	GNSS Compass Serial number part 3

Table 38: Device Information Packet

11.3.4.1 Device ID

Value	Description
1	Spatial
4	Spatial FOG
5	Spatial Dual
11	Orientus (>v3)
13	Air Data Unit
14	Subsonus
16	Spatial FOG Dual
17	Motus
19	GNSS Compass
21	Subsonus Tag
22	Poseidon
26	Certus
27	Aries
28	Boreas D90
41	Boreas D70

Table 39: Device IDs

11.3.5 Restore Factory Settings Packet

Note: A Factory Reset will re-enable the DHCP Client and lose any static IP address settings.

Restore Factory Settings Packet				
Packet ID				4
Length				4
Read / Write				Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	Verification sequence (set to 0x85429E1C)

Table 40: Restore Factory Settings Packet

11.3.6 Reset Packet

Reset Packet				
Packet ID				5
Length				4
Read / Write				Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	11.3.6.1 Verification Sequence Values

Table 41: Reset Packet

11.3.6.1 Verification Sequence Values

Value	Description
0x21057A7E	Standard hot start reset
0x9A5D38B7	Cold start reset

Table 42: Verification Sequence Values

11.3.7 Serial Port Passthrough Packet

Serial Port Passthrough Packet				
Packet ID				10
Length				Variable, up to 255 bytes
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Passthrough Route
2	1			Passthrough Data

Table 43: Serial Port Passthrough Packet

11.3.7.1 Passthrough Route

Value	Description
1	Reserved
2	Auxiliary

Table 44: Passthrough Route

11.3.8 IP Configuration Packet

IP Configuration Packet				
Packet ID				11
Length				30
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	u8	1	11.3.8.1 DHCP Mode
3	2	u32	4	IP Address
4	6	u32	4	IP Netmask
5	10	u32	4	IP Gateway
6	14	u32	4	DNS Server
7	18	u32	4	GNSS Compass Serial number part 1
8	22	u32	4	GNSS Compass Serial number part 2
9	26	u32	4	GNSS Compass Serial number part 3

Table 45: IP Configuration Packet

11.3.8.1 DHCP Mode

Bit	Description
0	DHCP Enabled
1-7	Reserved (set to zero)

Table 46: DHCP Mode

11.3.8.2 Discovery Network Setting Overwrite

Settings 7,8 and 9 are optional over standard network interfaces but required to overwrite settings over multi-cast discovery. To overwrite network settings for a device over multi-cast send this packet to address 239.48.81.7 port 48817, the serial number must be set to the serial number of the device you want to overwrite settings for.

11.4 State Packets

GNSS Compass supports a ANPP number of packets providing extensive functionality. However for the majority of users the easiest approach is to configure GNSS Compass using the web UI or GNSS Compass Manager software and then support only the single system state packet shown in **11.4.1 System State Packet**. Advanced functionality can be added as required through the other packets.

This section covers the following topics:

Packet ID	Name	Length	R/W
46	11.4.27 External Velocity Packet	24	R/W
47	11.4.28 External Body Velocity Packet	16 or 24	R/W
48	11.4.29 External Heading Packet	8	R/W
49	11.4.30 Running Time Packet	8	R
50	11.4.31 Local Magnetic Field Packet	12	R
52	11.4.32 External Time Packet	8	W
54	11.4.33 Geoid Height Packet	4	R
55	11.4.34 RTCM Corrections Packet	Varies	W
58	11.4.35 Heave Packet	16	R
60	11.4.36 Raw Satellite Data Packet	Varies	R
61	11.4.37 Raw Satellite Ephemeris Packet	Varies	R
69	11.4.38 GNSS Receiver Information Packet	Varies	R
73	11.4.39 Automotive Packet	24	R
75	11.4.40 External Magnetometers Packet	17	R/W

Table 47: State Packets

11.4.1 System State Packet

System State Packet				
Packet ID				20
Length				100
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u16	2	11.4.1.1 System Status
2	2	u16	2	11.4.1.2 Filter Status
3	4	u32	4	11.4.1.4 Unix Time Seconds
4	8	u32	4	11.4.1.5 Microseconds
5	12	fp64	8	Latitude (rad)
6	20	fp64	8	Longitude (rad)
7	28	fp64	8	Height (m)
8	36	fp32	4	Velocity north (m/s)
9	40	fp32	4	Velocity east (m/s)
10	44	fp32	4	Velocity down (m/s)
11	48	fp32	4	Body acceleration X (m/s/s)
12	52	fp32	4	Body acceleration Y (m/s/s)
13	56	fp32	4	Body acceleration Z (m/s/s)
14	60	fp32	4	G force (g)
15	64	fp32	4	Roll (radians)
16	68	fp32	4	Pitch (radians)
17	72	fp32	4	Heading (radians)
18	76	fp32	4	Angular velocity X (rad/s)
19	80	fp32	4	Angular velocity Y (rad/s)
20	84	fp32	4	Angular velocity Z (rad/s)
21	88	fp32	4	Latitude standard deviation (m)
22	92	fp32	4	Longitude standard deviation (m)
23	96	fp32	4	Height standard deviation (m)

Table 48: System State Packet

11.4.1.1 System Status

This field contains 16 bits that indicate problems with the system. These are boolean fields with a zero indicating false and one indicating true.

Use the Raw GNSS packet #29 to identify which of the GNSS receivers or antennas has a problem.

Bit	Description
0	System Failure
1	Accelerometer Sensor Failure
2	Gyroscope Sensor Failure
3	Magnetometer Sensor Failure
4	GNSS Failure (Secondary Antenna)
5	GNSS Failure (Primary Antenna)
6	Accelerometer Over Range
7	Gyroscope Over Range
8	Magnetometer Over Range
9	Reserved
10	Minimum Temperature Alarm
11	Maximum Temperature Alarm
12	Reserved
13	Reserved
14	GNSS Antenna Connection (open or short circuit, primary or secondary antenna)
15	Data Output Overflow Alarm

Table 49: System Status

11.4.1.2 Filter Status

This field contains 16 bits that indicate the status of the filters. These are boolean fields with a zero indicating false and one indicating true.

Bit	Description
0	Orientation Filter Initialised
1	Navigation Filter Initialised
2	Heading Initialised
3	UTC Time Initialised
4	11.4.1.3 GNSS Fix Status
5	
6	
7	Event 1 Occurred
8	Event 2 Occurred
9	Internal GNSS Enabled
10	Dual Antenna Heading Active
11	Velocity Heading Enabled
12	GNSS Fix Interrupted
13	External Position Active
14	External Velocity Active
15	External Heading Active

Table 50: Filter Status

11.4.1.3 GNSS Fix Status

Value	Bit 6	Bit 5	Bit 4	Description
0	0	0	0	No GNSS fix
1	0	0	1	2D GNSS fix
2	0	1	0	3D GNSS fix
3	0	1	1	SBAS GNSS fix
4	1	0	0	Differential GNSS fix
5	1	0	1	PPP GNSS fix
6	1	1	0	RTK Float GNSS fix
7	1	1	1	RTK Fixed GNSS fix

Table 51: GNSS Fix Status

11.4.1.4 Unix Time Seconds

This field provides the Unix time in seconds, using the standard epoch of January 1, 1970.

11.4.1.5 Microseconds

This field provides the sub-second component of time. It is represented as microseconds since the last second. Minimum value is 0 and maximum value is 999999.

11.4.2 Unix Time Packet

Unix Time Packet				
Packet ID				21
Length				8
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	Unix time stamp (seconds). See **11.4.1.4 Unix Time Seconds**
2	4	u32	4	**Microseconds**

Table 52: Unix Time Packet

11.4.3 Formatted Time Packet

Formatted Time Packet				
Packet ID				22
Length				14
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	Microseconds
2	4	u16	2	Year
3	6	u16	2	Year day, 0 - 365
4	8	u8	1	Month, 0 - 11
5	9	u8	1	Month Day, 1 - 31
6	10	u8	1	Week Day, 0 – 6 (0 = Sunday)
7	11	u8	1	Hour, 0 - 23
8	12	u8	1	Minute, 0 - 59
9	13	u8	1	Second, 0 - 59

Table 53: Formatted Time Packet

11.4.4 Status Packet

Status Packet				
Packet ID				23
Length				4
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u16	2	**System Status**
2	2	u16	2	**Filter Status**

Table 54: Status Packet

11.4.5 Position Standard Deviation Packet

Position Standard Deviation Packet				
Packet ID				24
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Latitude standard deviation (m)
2	4	fp32	4	Longitude standard deviation (m)
3	8	fp32	4	Height standard deviation (m)

Table 55: Position Standard Deviation Packet

11.4.6 Velocity Standard Deviation Packet

Velocity Standard Deviation Packet				
Packet ID				25
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Velocity north standard deviation (m/s)
2	4	fp32	4	Velocity east standard deviation (m/s)
3	8	fp32	4	Velocity down standard deviation (m/s)

Table 56: Velocity Standard Deviation Packet

11.4.7 Euler Orientation Standard Deviation Packet

Euler Orientation Standard Deviation Packet				
Packet ID				26
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Roll standard deviation (rad)
2	4	fp32	4	Pitch standard deviation(rad)
3	8	fp32	4	Heading standard deviation(rad)

Table 57: Euler Orientation Standard Deviation Packet

11.4.8 Quaternion Orientation Standard Deviation Packet

Quaternion Orientation Standard Deviation Packet				
Packet ID				27
Length				16
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Q0 standard deviation
2	4	fp32	4	Q1 standard deviation
3	8	fp32	4	Q2 standard deviation
4	12	fp32	4	Q3 standard deviation

Table 58: Quaternion Orientation Standard Deviation Packet

11.4.9 Raw Sensors Packet

Raw Sensors Packet				
Packet ID				28
Length				48
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Accelerometer X (m/s/s)
2	4	fp32	4	Accelerometer Y (m/s/s)
3	8	fp32	4	Accelerometer Z (m/s/s)
4	12	fp32	4	Gyroscope X (rad/s)
5	16	fp32	4	Gyroscope Y (rad/s)
6	20	fp32	4	Gyroscope Z (rad/s)
7	24	fp32	4	Magnetometer X (mG)
8	28	fp32	4	Magnetometer Y (mG)
9	32	fp32	4	Magnetometer Z (mG)
10	36	fp32	4	IMU Temperature (deg C)
11	40	fp32	4	Pressure (Pascals)
12	44	fp32	4	Pressure Temperature (deg C)

Table 59: Raw Sensors Packet

11.4.10 Raw GNSS Packet

This packet represents the raw data as it is received from the GNSS receiver. The position is not corrected for antenna position offset and the velocity is not compensated for the antenna lever arm offset. The INS position and velocity that are in the other packets are corrected for antenna position offset and lever arm.

Raw GNSS Packet				
Packet ID				29
Length				74
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	Unix time stamp (seconds)
2	4	u32	4	Microseconds
3	8	fp64	8	Latitude (rad)
4	16	fp64	8	Longitude (rad)
5	24	fp64	8	Height (m)
6	32	fp32	4	Velocity north (m/s)
7	36	fp32	4	Velocity east (m/s)
8	40	fp32	4	Velocity down (m/s)
9	44	fp32	4	Latitude standard deviation (m)
10	48	fp32	4	Longitude standard deviation (m)
11	52	fp32	4	Height standard deviation (m)
12	56	fp32	4	Tilt (rad)
13	60	fp32	4	Heading (rad)
14	64	fp32	4	Tilt standard deviation (rad)
15	68	fp32	4	Heading standard deviation (rad)
16	72	u16	2	Status. See 11.4.10.1 Raw GNSS Status

Table 60: Raw GNSS Packet

11.4.10.1 Raw GNSS Status

Bit	**Description**
0	GNSS Fix Status
1	
2	
3	Doppler velocity valid
4	Time valid
5	External GNSS
6	Tilt valid

Bit	Description
7	Heading valid
8	Floating ambiguity heading
9-15	Reserved (set to zero)

Table 61: Raw GNSS Status

11.4.11 Satellites Packet

Satellites Packet				
Packet ID				30
Length				13
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	HDOP
2	4	fp32	4	VDOP
3	8	u8	1	GPS satellites
4	9	u8	1	GLONASS satellites
5	10	u8	1	BeiDou satellites
6	11	u8	1	GALILEO satellites
7	12	u8	1	SBAS satellites

Table 62: Satellites Packet

11.4.12 Detailed Satellites Packet

Detailed Satellites Packet				
Packet ID				31
Length				7 x number of satellites
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Satellite System
2	1	u8	1	Satellite number (PRN)
3	2	u8	1	11.4.12.2 Satellite Frequencies
4	3	u8	1	Elevation (deg)
5	4	u16	2	Azimuth (deg)
6	6	u8	1	SNR
+				Fields 1-6 repeat for additional satellites

Table 63: Detailed Satellites Packet

Each packet can contain information for up to 36 satellites. If there are more than 36 satellites to report, only one packet will be sent per epoch.

11.4.12.1 Satellite Systems

Value	System
0	Unknown
1	GPS
2	GLONASS
3	BeiDou
4	Galileo
5	SBAS
6	QZSS
7	Reserved
8	Reserved
9	Reserved

Table 64: Satellite Systems

11.4.12.2 Satellite Frequencies

Bit	Description
0	L1 C/A
1	L1 C
2	L1 P

Bit	Description
3	L1 M
4	L2 C
5	L2 P
6	L2 M
7	L5

Table 65: Satellite Frequencies

11.4.13 Geodetic Position Packet

Geodetic Position Packet				
Packet ID				32
Length				24
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp64	8	Latitude (rad)
2	8	fp64	8	Longitude (rad)
3	16	fp64	8	Height (m)

Table 66: Geodetic Position Packet

11.4.14 ECEF Position Packet

ECEF Position Packet				
Packet ID				33
Length				24
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp64	8	ECEF X (m)
2	8	fp64	8	ECEF Y (m)
3	16	fp64	8	ECEF Z (m)

Table 67: ECEF Position Packet

11.4.15 UTM Position Packet

UTM Position Packet				
Packet ID				34
Length				26
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**

UTM Position Packet				
1	0	fp64	8	Northing (m)
2	8	fp64	8	Easting (m)
3	16	fp64	8	Height (m)
4	24	u8	1	Zone number
5	25	s8	1	Zone character

Table 68: UTM Position Packet

11.4.16 NED Velocity Packet

NED Velocity Packet				
Packet ID				35
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Velocity north (m/s)
2	4	fp32	4	Velocity east (m/s)
3	8	fp32	4	Velocity down (m/s)

Table 69: NED Velocity Packet

11.4.17 Body Velocity Packet

Body Velocity Packet				
Packet ID				36
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Velocity X (m/s)
2	4	fp32	4	Velocity Y (m/s)
3	8	fp32	4	Velocity Z (m/s)

Table 70: Body Velocity Packet

11.4.18 Acceleration Packet

This packet includes the acceleration due to gravity.

Acceleration Packet	
Packet ID	37
Length	12
Read / Write	Read

Acceleration Packet				
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Acceleration X (m/s/s)
2	4	fp32	4	Acceleration Y (m/s/s)
3	8	fp32	4	Acceleration Z (m/s/s)

Table 71: Acceleration Packet

11.4.19 Body Acceleration Packet

This packet does not include the acceleration due to gravity.

Body Acceleration Packet				
Packet ID				38
Length				16
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Body acceleration X (m/s/s)
2	4	fp32	4	Body acceleration Y (m/s/s)
3	8	fp32	4	Body acceleration Z (m/s/s)
4	12	fp32	4	G force (g)

Table 72: Body Acceleration Packet

11.4.20 Euler Orientation Packet

Euler Orientation Packet				
Packet ID				39
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Roll (rad)
2	4	fp32	4	Pitch (rad)
3	8	fp32	4	Heading (rad)

Table 73: Euler Orientation Packet

11.4.21 Quaternion Orientation Packet

Quaternion Orientation Packet				
Packet ID				40
Length				16
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	QS
2	4	fp32	4	QX
3	8	fp32	4	QY
4	12	fp32	4	QZ

Table 74: Quaternion Orientation Packet

11.4.22 DCM Orientation Packet

DCM Orientation Packet				
Packet ID				41
Length				36
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	DCM[0][0]
2	4	fp32	4	DCM[0][1]
3	8	fp32	4	DCM[0][2]
4	12	fp32	4	DCM[1][0]
5	16	fp32	4	DCM[1][1]
6	20	fp32	4	DCM[1][2]
7	24	fp32	4	DCM[2][0]
8	28	fp32	4	DCM[2][1]
9	32	fp32	4	DCM[2][2]

Table 75: DCM Orientation Packet

11.4.23 Angular Velocity Packet

Angular Velocity Packet				
Packet ID				42
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Angular velocity X (rad/s)
2	4	fp32	4	Angular velocity Y (rad/s)
3	8	fp32	4	Angular velocity Z (rad/s)

Table 76: Angular Velocity Packet

11.4.24 Angular Acceleration Packet

Angular Acceleration Packet				
Packet ID				43
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Angular acceleration X (rad/s/s)
2	4	fp32	4	Angular acceleration Y (rad/s/s)
3	8	fp32	4	Angular acceleration Z (rad/s/s)

Table 77: Angular Acceleration Packet

11.4.25 External Position and Velocity Packet

External Position and Velocity Packet				
Packet ID				44
Length				60
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp64	8	Latitude (rad)
2	8	fp64	8	Longitude (rad)
3	16	fp64	8	Height (m)
4	24	fp32	4	Velocity north (m/s)
5	28	fp32	4	Velocity east (m/s)
6	32	fp32	4	Velocity down (m/s)
7	36	fp32	4	Latitude standard deviation (m)
8	40	fp32	4	Longitude standard deviation (m)
9	44	fp32	4	Height standard deviation (m)
10	48	fp32	4	Velocity north standard deviation (m/s)
11	52	fp32	4	Velocity east standard deviation (m/s)
12	56	fp32	4	Velocity down standard deviation (m/s)

Table 78: External Position and Velocity Packet

11.4.26 External Position Packet

External Position Packet				
Packet ID				45
Length				36
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp64	8	Latitude (rad)
2	8	fp64	8	Longitude (rad)
3	16	fp64	8	Height (m)
4	24	fp32	4	Latitude standard deviation (m) Must be non-zero positive value
5	28	fp32	4	Longitude standard deviation (m) Must be non-zero positive value
6	32	fp32	4	Height standard deviation (m) Must be non-zero positive value

Table 79: External Position Packet

11.4.27 External Velocity Packet

External Velocity Packet				
Packet ID				46
Length				24
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Velocity north (m/s)
2	4	fp32	4	Velocity east (m/s)
3	8	fp32	4	Velocity down (m/s)
4	12	fp32	4	Velocity north standard deviation (m/s)
5	16	fp32	4	Velocity east standard deviation (m/s)
6	20	fp32	4	Velocity down standard deviation (m/s)

Table 80: External Velocity Packet

11.4.28 External Body Velocity Packet

This packet has been defined to support a single velocity standard deviation for all three axes, or, different values for all three axes. Modify the packet length in the packet header accordingly, depending on which format you are using.

External Body Velocity Packet				
Packet ID				47
Length				16 or 24
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Velocity X (m/s)
2	4	fp32	4	Velocity Y (m/s)
3	8	fp32	4	Velocity Z (m/s)
4	12	fp32	4	Velocity X standard deviation (m/s)
5	16	fp32	4	OPTIONAL: Velocity standard deviation Y (m/s)
6	20	fp32	4	OPTIONAL: Velocity standard deviation Z (m/s)

Table 81: External Body Velocity Packet

11.4.29 External Heading Packet

External Heading Packet				
Packet ID				48
Length				8
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Heading (rad)
2	4	fp32	4	Heading standard deviation (rad)

Table 82: External Heading Packet

11.4.30 Running Time Packet

This packet provides the running time in seconds since the most recent power on.

Running Time Packet				
Packet ID				49
Length				8
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	Running time (seconds)
2	4	u32	4	11.4.1.5 Microseconds

Table 83: Running Time Packet

11.4.31 Local Magnetic Field Packet

Local Magnetic Field Packet				
Packet ID				50
Length				12
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Local magnetic field X (mG)
2	4	fp32	4	Local magnetic field Y (mG)
3	8	fp32	4	Local magnetic field Z (mG)

Table 84: Local Magnetic Field Packet

11.4.32 External Time Packet

External Time Packet				
Packet ID				52
Length				8
Read / Write				Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	**11.4.1.4 Unix Time Seconds**
2	4	u32	4	**11.4.1.5 Microseconds**

Table 85: External Time Packet

11.4.33 Geoid Height Packet

This packet provides the offset at the current location between the WGS84 ellipsoid and the EGM96 geoid model. This can be used to determine the current height above mean sea level and also depth through the following equations:

Height Above Mean Sea Level = WGS84 Height – Geoid Height

Depth = Geoid Height – WGS84 Height

WGS84 Height is the height at the current location in the System State packet, see **11.4.1 System State Packet**

Geoid Height Packet				
Packet ID				54
Length				4
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Geoid height (m)

Table 86: Geoid Height Packet

11.4.34 RTCM Corrections Packet

This packet is used to encapsulate RTCM v3 correction data to be sent to the GNSS Compass internal GNSS receiver for DGPS or RTK GNSS functionality.

RTCM Corrections Packet				
Packet ID				55
Length				Variable, up to 255 bytes
Read / Write				Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0			RTCM corrections data

Table 87: RTCM Corrections Packet

11.4.35 Heave Packet

Heave Packet				
Packet ID				58
Length				16
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Heave point 1 (m)
2	4	fp32	4	Heave point 2 (m)
3	8	fp32	4	Heave point 3 (m)
4	12	fp32	4	Heave point 4 (m)

Table 88: Heave Packet

11.4.36 Raw Satellite Data Packet

The GNSS Compass Manager Log Converter will automatically convert this packet to RINEX 3.02 format.

Note: This packet is only valid for GNSS Compass v1.x hardware versions

Raw Satellite Data Packet				
Packet ID				60
Length				16 + Satellites * (6 + Frequencies * 26)
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	**Unix time (seconds)**
2	4	u32	4	Nanoseconds
3	8	s32	4	Receiver clock offset (nanoseconds)
4	12	u8	1	Receiver number
5	13	u8	1	Packet number (range 1 to Total)
6	14	u8	1	Total packets
7	15	u8	1	Number of satellites
For each satellite				
8	16	u8	1	**Satellite Systems**
9	17	u8	1	PRN or satellite number
10	18	u8	1	Elevation (degrees)
11	19	u16	2	Azimuth (degrees)
12	21	u8	1	Number of frequencies
For each frequency of each satellite				

Raw Satellite Data Packet				
13	22	u8	1	Satellite Frequencies
14	23	u8	1	Tracking Status
15	24	fp64	8	Carrier phase (cycles)
16	32	fp64	8	Pseudo range (m)
17	40	fp32	4	Doppler frequency (Hz)
18	44	fp32	4	Signal to noise ratio (dB-Hz)

Table 89: Raw Satellite Data Packet

11.4.36.1 Satellite Systems

Value	System
0	Unknown
1	GPS
2	GLONASS
3	BeiDou
4	Galileo
5	SBAS
6	QZSS
7	Reserved
8	Reserved
9	Reserved

Table 90: Satellite Systems

11.4.36.2 Satellite Frequencies

Value	GPS	GLONASS	Galileo	BeiDou	SBAS	QZSS
0	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
1	L1 C/A	G1 C/A	E1 OS	B1	L1 C/A	L1 C/A
2	L1 C		E1 PRS			L1 C
3	L1 P	G1 P				L1 SAIF
4	L1 M					
5	L2 C	G2 C/A	E6 CS	B2		L2 C
6	L2 P	G2 P	E6 PRS			LEX
7	L2 M					
8	L5	G3	E5 a	B3	L5	L5

Value	GPS	GLONASS	Galileo	BeiDou	SBAS	QZSS
9			E5 b			
10			E5 a+b			

Table 91: Satellite Frequencies

11.4.36.3 Tracking Status

Bit	Description
0	Carrier phase valid
1	Carrier phase cycle slip detected
2	Carrier phase half-cycle ambiguity
3	Pseudo range valid
4	Doppler valid
5	SNR valid
6-7	Reserved (set to zero)

Table 92: Tracking Status

11.4.37 Raw Satellite Ephemeris Packet

GNSS Compass Manager will automatically convert this packet to RINEX 3.02 format.

Raw Satellite Ephemeris Packet				
Packet ID				61
Length				Varies
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u32	4	Unix timestamp (seconds)
2	4	u8	1	Satellite System
3	5	u8	1	Satellite number (PRN)
For GPS Satellites (132 bytes)				
5	6	u32	4	Time of ephemeris (Toe) (s)
6	10	u16	2	Issue of Data Clock [IODC] (s)
7	12	u16	2	Issue of Data Ephemeris [IODE] (s)
8	14	fp32	4	Satellite Clock Bias [af0] (s)
9	18	fp32	4	Satellite Clock Drift [af1] (s/s)
10	22	fp32	4	Satellite Clock Drift Rate [af2] (s/s/s)
11	26	fp32	4	Crs (m)
12	30	fp32	4	Delta N (rad/s)

Raw Satellite Ephemeris Packet				
13	34	fp64	8	M0 (rad)
14	42	fp32	4	Cuc (rad)
15	46	fp64	8	Eccentricity [e]
16	54	fp32	4	Cus (rad)
17	58	fp64	8	√A (√m)
18	66	fp32	4	Cic (rad)
19	70	fp64	8	OMEGA0 (rad)
20	78	fp32	4	Cis (rad)
21	82	fp64	8	i0 (rad)
22	90	fp32	4	Crc (m)
23	94	fp64	8	Omega (rad)
24	102	fp64	8	Omega dot (rad/s)
25	110	fp64	8	IDOT (rad/s)
26	118	fp32	4	TGD (s)
27	122	u16	2	Ephemeris week number
28	124	u32	4	Transmission time (s)
29	128	u16	2	User range accuracy (m)
30	130	u16	2	11.4.37.1 GPS Flags
For GLONASS satellites (94 Bytes)				
5	6	fp32	4	Satellite clock bias (s)
6	10	fp32	4	Satellite frequency bias [gamma]
7	14	fp64	8	Satellite position X (m)
8	22	fp64	8	Satellite position Y (m)
9	30	fp64	8	Satellite position Z (m)
10	38	fp64	8	Satellite velocity X (m/s)
11	46	fp64	8	Satellite velocity Y (m/s)
12	54	fp64	8	Satellite velocity Z (m/s)
13	62	fp64	8	Satellite acceleration X (m/s/s)
14	70	fp64	8	Satellite acceleration Y (m/s/s)
15	78	fp64	8	Satellite acceleration Z (m/s/s)
16	86	u32	4	Message frame start time (s)
17	90	u8	1	Age of operational information [E] (days)
18	91	s8	1	Frequency slot number
19	92	u8	1	Satellite Health

Raw Satellite Ephemeris Packet				
20	93	u8	1	Reserved

Table 93: Raw Satellite Ephemeris Packet

11.4.37.1 GPS Flags

Bit	Description
0	Data flag for L2 P-code
1-2	Codes on L2 channel
3	Anti-spoof flag
4-9	Satellite health
10	Fit interval flag
11	URA bad
12-14	Satellite block type

Table 94: GPS Flags

11.4.38 GNSS Receiver Information Packet

11.4.38.1 Aries GNSS Receiver

Aries GNSS Receiver Information Packet				
Packet ID				69
Length				68
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	GNSS manufacturer ID
2	1	u8	1	GNSS receiver model
3	2	s8 [24]	24	GNSS serial number in ASCII character string
4	26	u32	4	Firmware version
5	30	u32	4	Hardware version
6	34		34	Reserved (set to zero)

Table 95: Aries GNSS Receiver Information Packet

11.4.38.2 GNSS Manufacturer IDs and Receiver Models

Manufacturer		Receiver	
ID	**Description**	**Value**	**Description**
0	GNSS Manufacturer Unknown	0	GNSS Receiver Model Unknown

Manufacturer		Receiver	
ID	**Description**	**Value**	**Description**
1	Trimble	0	GNSS Receiver Model Unknown
		1	Trimble BD920
		2	Trimble BD930
		3	Trimble BD982
		4	Trimble MB-One
		5	Trimble MB-Two
		6	Trimble BD940
		7	Trimble BD992
3	Advanced Navigation	0	GNSS Receiver Model Unknown
		1	Aries
		2	Aries GC2

Table 96: GNSS Manufacturer IDs and Receiver Models

11.4.39 Automotive Packet

The value of the slip angle will be zero unless velocity is greater than 3.45 m/s and heading is valid.

Automotive Packet				
Packet ID				73
Length				24
Read / Write				Read
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Virtual odometer distance (m)
2	4	fp32	4	Slip Angle (rad) Value reported is zero, unless heading is valid and the velocity is greater than 3.45 m/s
3	8	fp32	4	Velocity X (m/s)
4	12	fp32	4	Velocity Y (m/s)
5	16	fp32	4	Distance standard deviation (m)
6	20		4	Reserved (set to zero)

Table 97: Automotive Packet

11.4.40 External Magnetometers Packet

Heading can derived using the magnetometers of an additional external Advanced Navigation product to input external magnetometer values.

The 2D, 3D or automatic magnetic calibration of GNSS Compass cannot be used to calibrate the external magnetometer values. External magnetometers need to be calibrated before feeding into GNSS Compass.

To use External Magnetic Heading, disable Magnetic Heading Enabled and Automatic Magnetic Calibration Enabled options in the 9.2.7.3 Filter Options of the Configuration Menu.

When sending external magnetometers the external heading flag will become active.

External Magnetometers Packet				
Packet ID				75
Length				17
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	fp32	4	Delay (s)
2	4	fp32	4	Magnetometer X (milligauss)
3	8	fp32	4	Magnetometer Y (milligauss)
4	12	fp32	4	Magnetometer Z (milligauss)
6	16	u8	1	External Magnetometer Flags

Table 98: External Magnetometers Packet

11.4.40.1 External Magnetometers Flags

Bit	Description
0	Magnetometers failure
1	Magnetometers over-range

Table 99: External magnetometers Flags

11.5 Configuration Packets

Configuration packets can be both read from and written to the GNSS Compass. On many of the configuration packets the first byte is a permanent flag. A zero in this field indicates that the settings will be lost on reset, a one indicates that they will be permanent (i.e. stored in flash).

This section covers the following topics:

Packet ID	Name	Length	R/W
Configuration Packets			
181	11.5.1 Packets Period Packet	Varies	R/W
182	11.5.2 Baud Rates Packet	17	R/W
184	11.5.3 Sensor Ranges Packet	4	R/W
185	11.5.4 Installation Alignment Packet	73	R/W
186	11.5.5 Filter Options Packet	17	R/W
188	11.5.6 Port Function Configuration Packet	13	R/W

Packet ID	Name	Length	R/W
193	11.5.7 Set Zero Orientation Alignment Packet	5	W
194	11.5.8 Reference Point Offsets Packet	49	R/W
195	11.5.9 Port Output Configuration Packet	33	R/W
198	11.5.10 User Data Packet	64	R/W
202	11.5.11 IP Dataports Configuration Packet	30	R/W

11.5.1 Packets Period Packet

This packet allows the user to configure, add, remove, modify and clear state packets (packets 20 through 180).

Packets Period Packet				
Packet ID				181
Length				2 + (5 x number of packet periods)
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u16	1	Flags
2	2	u8	1	Packet ID
3	3	u32	4	Packet Period
+				Fields 2-3 repeat for additional packet periods

Table 100: Packets Period Packet

11.5.1.1 Flags

Bit	Description
0	Permanent
1-3	Port
4	Port field valid
5-7	Reserved
8	Clear Existing Packet Periods
9-15	Reserved

Table 101: Packet period flags

11.5.1.2 Packet Period

This indicates the period in units of the packet timer period. The packet rate can be calculated as follows.

Packet Rate = 1000000/(Packet Period x Packet Timer Period) Hz

For example if the packet timer period is set to 1000 (1 ms). Setting packet ID 20 with a packet period of 50 will give the following.

Packet 20 Rate = 1000000/(50 x 1000)

Packet 20 Rate = 20 Hz

11.5.2 Baud Rates Packet

Baud Rates Packet				
Packet ID				182
Length				17
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	u32	4	Primary RS232 and RS422 see **11.5.2.1 Supported Baud Rate** bit #31: 0 = RS232, 1 = RS422
3	5	u32	4	Auxiliary RS232 see **11.5.2.1 Supported Baud Rate** bit #31: 0 = RS232, 1 = RS422
4	9		8	Reserved (set to zero)

Table 102: Baud Rates Packet

11.5.2.1 Supported Baud Rate

Note: Not all Advanced Navigation products support minimum and maximum baud rates.

Supported Baud Rates - Bits 0-30
2400
4800
9600
19200
38400
57600
115200
230400
250000
460800
500000
800000
921600
1000000
1250000
2000000
4000000

Table 103: Supported Baud Rates

11.5.3 Sensor Ranges Packet

Sensor Ranges Packet				
Packet ID				184
Length				4
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	u8	1	11.5.3.1 Accelerometers Range
3	2	u8	1	11.5.3.2 Gyroscopes Range
4	3		1	Reserved (set to 0)

Table 104: Sensor Ranges Packet

11.5.3.1 Accelerometers Range

Value	Description
0	2 g (19.62 m/s/s)
1	4 g (39.24 m/s/s)
2	16 g (156.96 m/s/s)

Table 105: Accelerometers Range

11.5.3.2 Gyroscopes Range

Value	Description
0	250 degrees/second
1	500 degrees/second
2	2000 degrees/second

Table 106: Gyroscopes Range

11.5.4 Installation Alignment Packet

Installation Alignment Packet				
Packet ID				185
Length				73
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	fp32	4	Alignment DCM[0][0]
3	5	fp32	4	Alignment DCM[0][1]
4	9	fp32	4	Alignment DCM[0][2]

Installation Alignment Packet				
5	13	fp32	4	Alignment DCM[1][0]
6	17	fp32	4	Alignment DCM[1][1]
7	21	fp32	4	Alignment DCM[1][2]
8	25	fp32	4	Alignment DCM[2][0]
9	29	fp32	4	Alignment DCM[2][1]
10	33	fp32	4	Alignment DCM[2][2]
11	37	fp32	4	GNSS antenna offset X (m)
12	41	fp32	4	GNSS antenna offset Y (m)
13	45	fp32	4	GNSS antenna offset Z (m)
14	49	fp32	4	Reserved (set to 0)
15	53	fp32	4	Reserved (set to 0)
16	57	fp32	4	Reserved (set to 0)
17	61	fp32	4	External data offset X (m)[2]
18	65	fp32	4	External data offset Y (m)[2]
19	69	fp32	4	External data offset Z (m)[2]
[2]External data offset is used for NMEA input, External GNSS and Air Data Unit				

Table 107: Installation Alignment Packet

11.5.4.1 Alignment DCM

The alignment DCM (Direction Cosine Matrix) is used to represent an alignment offset of GNSS Compass from its standard alignment. A DCM is used rather than Euler angles for accuracy reasons. To convert Euler angles to DCM, use the formula below with angles in radians.

DCM[0][0] = cos(heading) * cos(pitch)

DCM[0][1] = sin(heading) * cos(pitch)

DCM[0][2] = -sin(pitch)

DCM[1][0] = -sin(heading) * cos(roll) + cos(heading) * sin(pitch) * sin(roll)

DCM[1][1] = cos(heading) * cos(roll) + sin(heading) * sin(pitch) * sin(roll)

DCM[1][2] = cos(pitch) * sin(roll)

DCM[2][0] = sin(heading) * sin(roll) + cos(heading) * sin(pitch) * cos(roll)

DCM[2][1] = -cos(heading) * sin(roll) + sin(heading) * sin(pitch) * cos(roll)

DCM[2][2] = cos(pitch) * cos(roll)

11.5.5 Filter Options Packet

Filter Options Packet				
Packet ID				186
Length				17
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	u8	1	11.5.5.1 Vehicle Types
3	2	u8	1	Internal GNSS enabled (boolean)
4	3	u8	1	Reserved (set to zero)
5	4	u8	1	Reserved (set to zero)
6	5	u8	1	Velocity heading enabled (boolean)
7	6	u8	1	Reversing detection enabled (boolean)
8	7	u8	1	Motion analysis enabled (boolean)
9	8	u8	1	Reserved (set to zero)
10	9		8	Reserved (set to zero)

Table 108: Filter Options Packet

11.5.5.1 Vehicle Types

Value	Description
0	Unlimited
1	Bicycle or Motorcycle
2	Car
3	Hovercraft

Value	Description
4	Submarine
5	3D Underwater Vehicle
6	Fixed Wing Plane
7	3D Aircraft
8	Human
9	Boat
10	Large Ship
11	Stationary
12	Stunt Plane
13	Race Car

Table 109: Vehicle Types

11.5.6 Port Function Configuration Packet

Port Function Configuration Packet				
Packet ID				188
Length				13
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	u8	1	Port 1 transmit function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
3	2	u8	1	Port 1 receive function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
4	3	u8	1	Port 2 transmit function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
5	4	u8	1	Port 2 receive function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
6	3	u8	1	Port 3 transmit function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
7	4	u8	1	Port 3 receive function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
8	3	u8	1	Port 4 transmit function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
9	4	u8	1	Port 4 receive function. See **Table 111: Ports** and **Table 112: Transmit and Receive Functions**
10	6		4	Reserved (set to zero)

Table 110: Port Function Configuration Packet

11.5.6.1 Ports

Port	Ethernet Variant	Serial Variant
1	Port 1 function (default TCP 16718)	Reserved (set to zero)
2	Port 2 function (default TCP 16719)	Auxiliary serial port rate
3	Port 3 function (default TCP 16720)	Reserved (set to zero)
4	Port 4 function (default TCP 16721)	Reserved (set to zero)

Table 111: Ports

11.5.6.2 Transmit and Receive Functions

Value	Description	Auxiliary Function Type
0	Inactive	Transmit, Receive
6	**NMEA Input**	Receive
7	**NMEA Output**	Transmit
11	**ANPP Input**	Receive
12	**ANPP Output**	Transmit
38	**GNSS Receiver Passthrough** / RTCM v3 GNSS corrections messages	Transmit, Receive
40	**Simrad 1000 Output**	Transmit
57	**GNSS Receiver 2 Passthrough**	Transmit, Receive

Table 112: Transmit and Receive Functions

11.5.7 Set Zero Orientation Alignment Packet

Set Zero Orientation Alignment Packet				
Packet ID				193
Length				5
Read / Write				Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	u32	4	Verification sequence (set to 0x9A4E8055)

Table 113: Set Zero Orientation Alignment Packet

11.5.8 Reference Point Offsets Packet

The reference point offsets packet can be used to adjust the measurement point that all data is referenced to. By default all the values of this packet are zero and the measurement point that all data is referenced to is the centre of the GNSS Compass unit. The primary reference point offset can be used to adjust the measurement point to a different location on the vehicle, in the body co-ordinate frame. The primary reference point offset applies to all data output including NMEA etc as well as heave point 1.

The other heave point offsets do not apply to heave point 1 in the **11.4.35 Heave Packet**.

Reference Point Offsets Packet				
Packet ID				194
Length				49
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	fp32	4	Heave point 1 offset X (m) / Primary reference point offset X (m)
3	5	fp32	4	Heave point 1 offset Y (m) / Primary reference point offset Y (m)
4	9	fp32	4	Heave point 1 offset Z (m) / Primary reference point offset Z (m)
5	13	fp32	4	Heave point 2 offset X (m)
6	17	fp32	4	Heave point 2 offset Y (m)
7	21	fp32	4	Heave point 2 offset Z (m)
8	25	fp32	4	Heave point 3 offset X (m)
9	29	fp32	4	Heave point 3 offset Y (m)
10	33	fp32	4	Heave point 3 offset Z (m)
11	37	fp32	4	Heave point 4 offset X (m)
12	41	fp32	4	Heave point 4 offset Y (m)
13	45	fp32	4	Heave point 4 offset Z (m)

Table 114: Reference Point Offsets Packet

11.5.9 Port Output Configuration Packet

Port Output Configuration Packet				
Packet ID				195
Length				33
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u8	1	Permanent
2	1	u8	1	NMEA fix behaviour. See **NMEA Fix Behaviour**
3	2	u16	2	GPZDA rates. See **Port Output Rates**
4	4	u16	2	GPGGA rates.See **Port Output Rates**
5	6	u16	2	GPVTG rates. See **Port Output Rates**
6	8	u16	2	GPRMC rates. See **Port Output Rates**
7	10	u16	2	GPHDT rates. See **Port Output Rates**
8	12	u16	2	GPGLL rates. See **Port Output Rates**
9	14	u16	2	PASHR rates. See **Port Output Rates**
10	16	u16	2	TSS1 rates.See **Port Output Rates**
11	18	u16	2	Simrad rates. See **11.5.9.2 Port Output Rates**
12	20	u16	2	GPROT Rates. See **11.5.9.2 Port Output Rates**
13	22	u16	2	GPHEV Rates. See **11.5.9.2 Port Output Rates**
14	24	u16	2	GPGSV Rates. See **11.5.9.2 Port Output Rates**
15	26	u16	2	PFECAtt Rates. See **11.5.9.2 Port Output Rates**
16	28	u16	2	PFECHve Rates. See **11.5.9.2 Port Output Rates**
17	30	u16	2	GPGST Rates. See **11.5.9.2 Port Output Rates**
18	32		1	Reserved (set to zero)

Table 115: Port Output Configuration Packet

11.5.9.1 NMEA Fix Behaviour

Value	Description
0	Normal
1	Always indicate 3D fix when the navigation filter is initialised

Table 116: NMEA Fix Behaviour

11.5.9.2 Port Output Rates

Port	Ethernet Variant	Serial Variant
1	Port 1 rate (default TCP 16718). See **Output rates Index**	Reserved (set to zero)

Port	Ethernet Variant	Serial Variant
2	Port 2 rate (default TCP 16719). See **Output rates Index**	Auxiliary serial port rate. See **Output rates Index**
3	Port 3 rate (default TCP 16720). See **Output rates Index**	Reserved (set to zero)
4	Port 4 rate (default TCP 16721). See **Output rates Index**	Reserved (set to zero)

Table 117: Port Output Rates

11.5.9.3 Output Rates Index

Value	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	0	0	0	0	Disabled
1	0	0	0	1	0.1 Hz
2	0	0	1	0	0.2 Hz
3	0	0	1	1	0.5 Hz
4	0	1	0	0	1 Hz
5	0	1	0	1	2 Hz
6	0	1	1	0	5 Hz
7	0	1	1	1	10 Hz
8	1	0	0	0	25 Hz
9	1	0	0	1	50 Hz
10	1	0	1	0	8 Hz

Table 118: Output rates Index

11.5.10 User Data Packet

This packet is for storage of users data. The data itself is not used by GNSS Compass.

User Data Packet				
Packet ID				198
Length				64
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0		64	User Data

Table 119: User Data Packet

11.5.11 IP Dataports Configuration Packet

IP Dataports Configuration Packet	
Packet ID	202

IP Dataports Configuration Packet				
Length				30
Read / Write				Read / Write
Field #	**Bytes Offset**	**Data Type**	**Size**	**Description**
1	0	u16	2	Reserved
2	2	u32	4	TCP/UDP IP Address
3	6	u16	2	TCP/UDP Port
4	8	u8	1	11.5.11.1 IP Dataport Mode
+				Fields 2-4 Repeat 3 times (a total of 4 copies) for each of the 4 data ports

Table 120: IP Dataports Configuration Packet

11.5.11.1 IP Dataport Mode

Value	Description
0	MODE_NONE
1	Reserved
2	MODE_TCP_SERVER
3	MODE_TCP_CLIENT
4	MODE_UDP

Table 121: IP Dataport Mode

12 Reference Information

This chapter is a learning reference that briefly covers knowledge essential to understanding GNSS Compass and INS generally. It explains the following concepts in simple terms so that people unfamiliar with the technology may understand it:

- **12.1 Technology Overview**, including Global Navigation Satellite System (GNSS) , Inertial Navigation System (INS) and Attitude and Heading Reference System (AHRS)
- **12.2 The Sensor Co-ordinate Frame**
- **12.3 The Body Co-ordinate Frame**
- **12.4 Roll, Pitch and Heading**
- **12.5 Geodetic Co-ordinate System**
- **12.6 NED Co-ordinate Frame**
- **12.7 ECEF Co-ordinate Frame**

12.1 Technology Overview

12.1.1 GNSS

GNSS stands for Global Navigation Satellite System. A GNSS consists of a set of satellites in medium Earth orbit that broadcast navigation signals with a common operator. These navigation signals can be picked up by a GNSS receiver on the earth to estimate that receiver's position and velocity. For a long time the only operational GNSS was the United States GPS. However, the Russian GLONASS, the Chinese BeiDou GNSS, and the European Union's Galileo GNSS are fully operational.

GNSS provides a fairly accurate absolute position (down to 1.2 metres without assistance and as low as 8 mm with) and velocity (as low as 0.007 metres/second). The main drawback of GNSS is that the receiver must have a clear signal from at least 4 satellites to function. GNSS signals are very weak and struggle to penetrate through buildings, trees and other objects obstructing an uninterrupted view of the sky. GNSS can also occasionally drop out due to disturbances in the upper atmosphere, or the presence of jammers.

12.1.2 AHRS

AHRS stands for Attitude and Heading Reference System. An AHRS uses accelerometers, magnetometer data and gyroscopes combined in a mathematical algorithm to provide orientation. Orientation consists of the three body angles roll, pitch and heading.

12.1.3 INS

INS stands for Inertial Navigation System. An inertial navigation system can provide position and velocity similar to GNSS but with some major differences. The principle of inertial navigation is the measurement of acceleration, which is then integrated into velocity. The velocity is then further integrated to estimate position. Due to noise in the measurement and the compounding of that noise through the integration steps, inertial navigation has an error that increases exponentially over time. Inertial navigation systems have a very low relative error over short time periods but over long time periods the error can increase enormously.

12.1.4 GNSS/INS

By combining GNSS and INS together in a mathematical algorithm, it is possible to take advantage of the benefits of the long-term precision of GNSS and the short-term accuracy of inertial sensors. This provides an enhanced position and velocity solution that can withstand GNSS drop outs.

12.2 The Sensor Co-ordinate Frame

Inertial sensors have 3 different axes: X, Y and Z and these determine the references around which angles and accelerations are measured. It is very important to align these axes correctly in installation, otherwise the system won't work correctly.

These axes are marked on the top of the device as shown in **Figure 92: GNSS Compass Axes** below, with the X axis pointing in the direction of the forward mark, the Z axis pointing down through the base of the unit and the Y axis pointing off to the right.

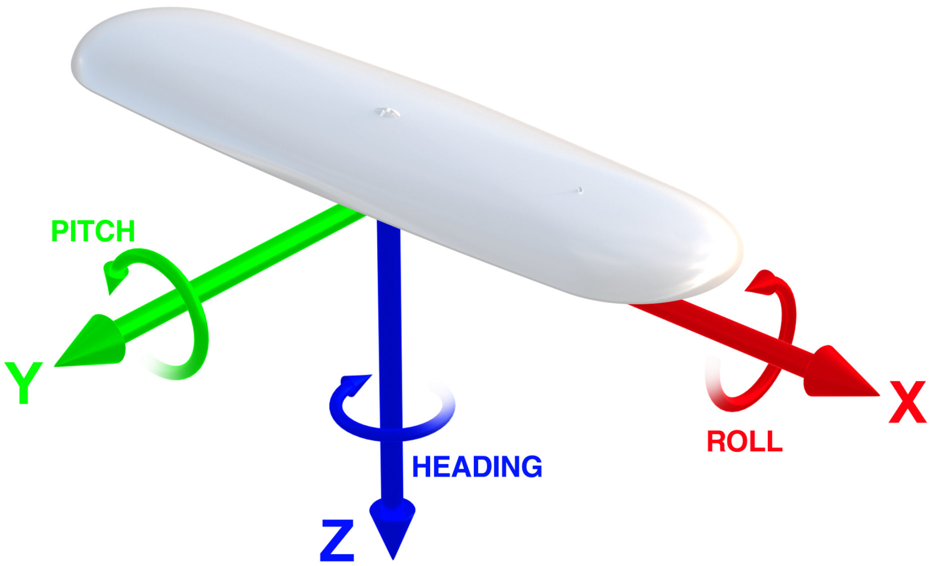

Figure 92: GNSS Compass Axes

12.2.1 Right Hand Rule

When installed in an application the X axis should be aligned such that it points forwards and the Z axis aligned so that it points down when the system is level. A good way to remember the sensor axes is the right hand rule, which is visualised in **Figure 93: First Right-hand Rule**.

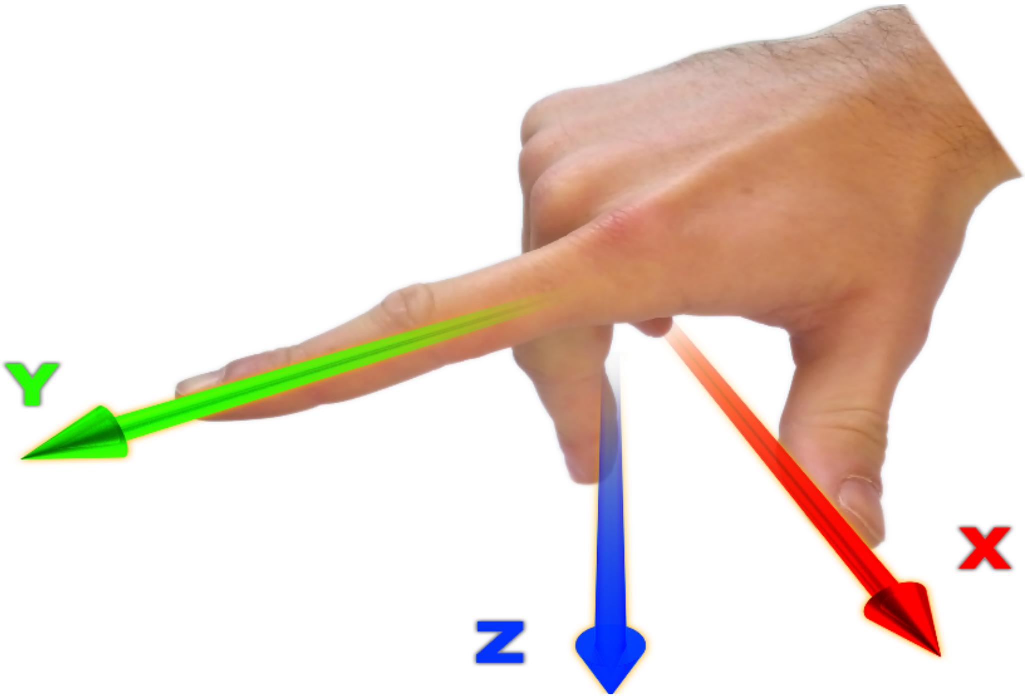

Figure 93: First Right-hand Rule

You take your right hand and extend your thumb, index and middle. Your thumb then denotes the positive X axis, your index denotes the positive Y axis and your middle denotes the positive Z axis.

12.3 The Body Co-ordinate Frame

Also known as the vehicle co-ordinate (reference) frame, this can be described most easily using a car (the body or vehicle) as an example. The forward direction of travel for a car is the positive X axis, out to the right of the car is the positive Y axis, and down is the positive Z axis. The distinction between the sensor co-ordinate frame and the body co-ordinate frame becomes important when the INS device is not mounted with its axes aligned to the vehicle axes, for example when the INS is mounted with a 90 degree heading rotation. Offset measurements, which are described later in this document, will always be in the body co-ordinate frame to remove any INS alignment variations. Generally any data output by the INS using the X, Y and Z axes will be using the body co-ordinate frame.

12.4 Roll, Pitch and Heading

Orientation can be described by the three angles roll, pitch and heading: these are known as the Euler angles. The rotation axes of roll, pitch and heading are shown visually in **Figure 92: GNSS Compass Axes**. The arrow indicates the positive rotation direction.

Roll is the angle around the X axis and is zero when the unit is level. Pitch is the angle around the Y axis and is zero when the unit is level. Heading is the angle around the Z axis and is zero when the positive X axis is pointing to true north.

12.4.1 Second Right Hand Rule

The two right hand rules are often the best way to memorise the sensor axes and directions of positive rotation. The first right hand rule gives the positive axis directions and is described in **12.2 The Sensor Co-ordinate Frame**. The second right hand rule shown in the figure below provides the direction of positive rotation. To use it, point your thumb in the positive direction of that axis, then the direction that your fingers curl over shows the positive rotation on that axis.

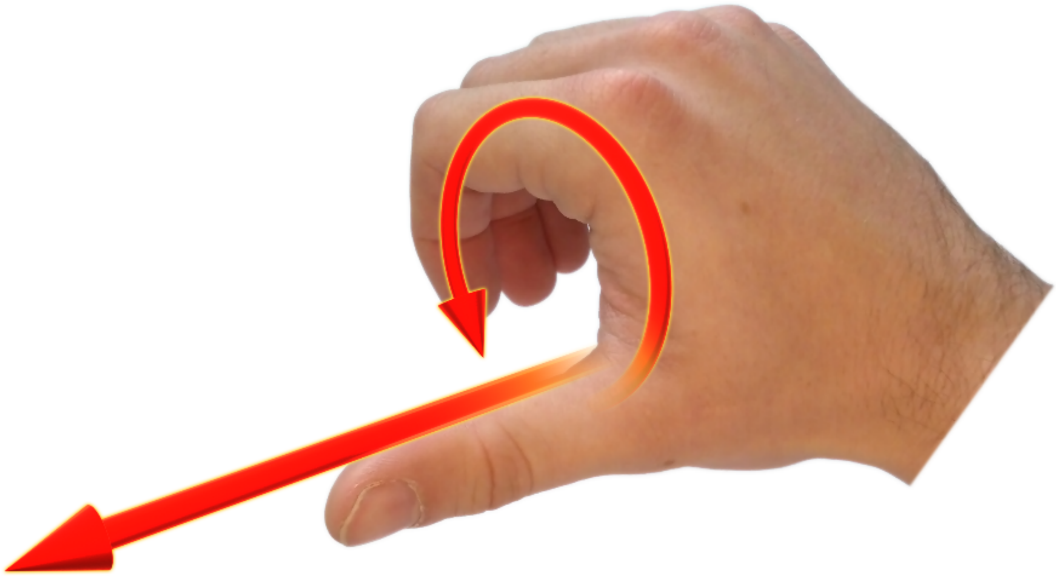

Figure 94: Second right Hand Rule

12.4.2 Rotation Order

When multiple axes are rotated, to imagine the final orientation the three rotations must be performed in the order heading first, then pitch and then roll. To deduce the final orientation the unit should first be considered level with the X axis pointing north and the Z axis pointing down. Heading is applied first, then pitch is applied and finally roll is applied to give the final orientation. This can be hard for some people to grasp at first and is often best learned experimentally by rotating GNSS Compass with your hand whilst watching the orientation plot in real time on the computer.

12.5 Geodetic Co-ordinate System

The geodetic co-ordinate system is the most popular way of describing an absolute position on the Earth. It is made up of two angles, latitude and longitude, combined with a height relative to an ellipsoid.

12.5.1 Latitude and Longitude

Latitude is the angle that specifies the north to south position of a point on the Earth's surface, reported as ± 90°. Longitude is the angle that specifies the east to west position of a point on the Earth's surface, reported as ± 180°. The line of zero latitude is the equator, and the line of zero longitude is the prime meridian. See **Figure 95: Latitude and longitude represented visually to describe a position on an ellipsoid**.

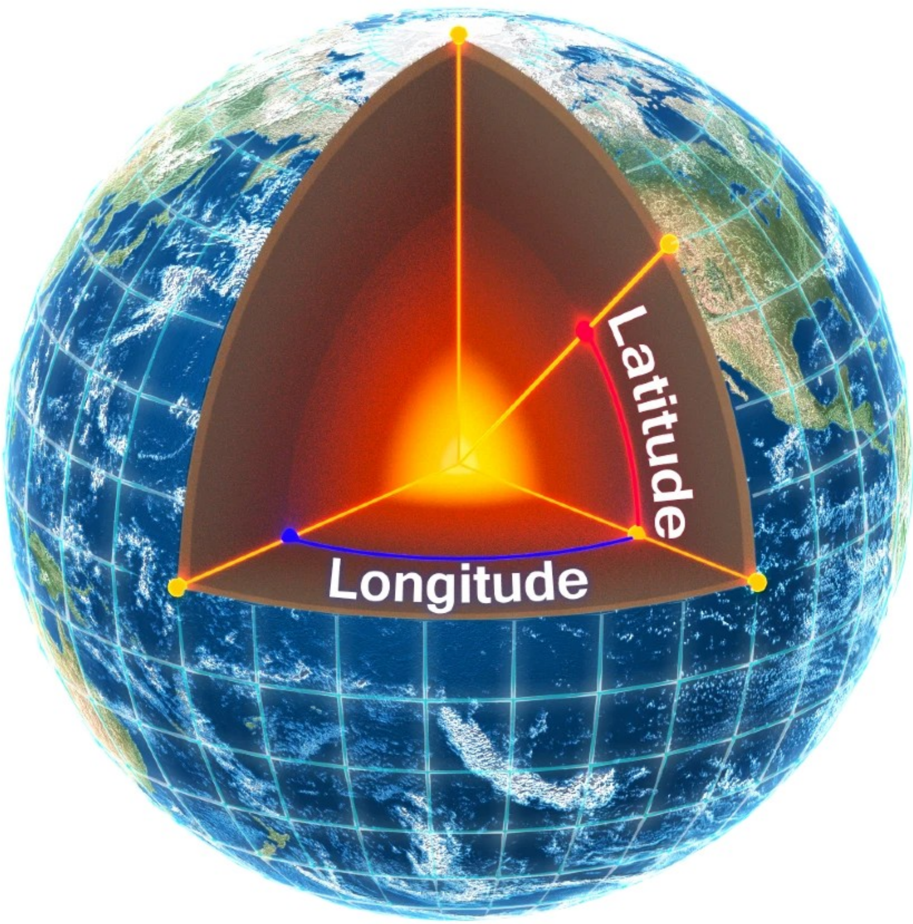

Figure 95: Latitude and longitude represented visually to describe a position on an ellipsoid

The figure below shows latitude and longitude on a map of the world, represented with a standard Mercator projection.

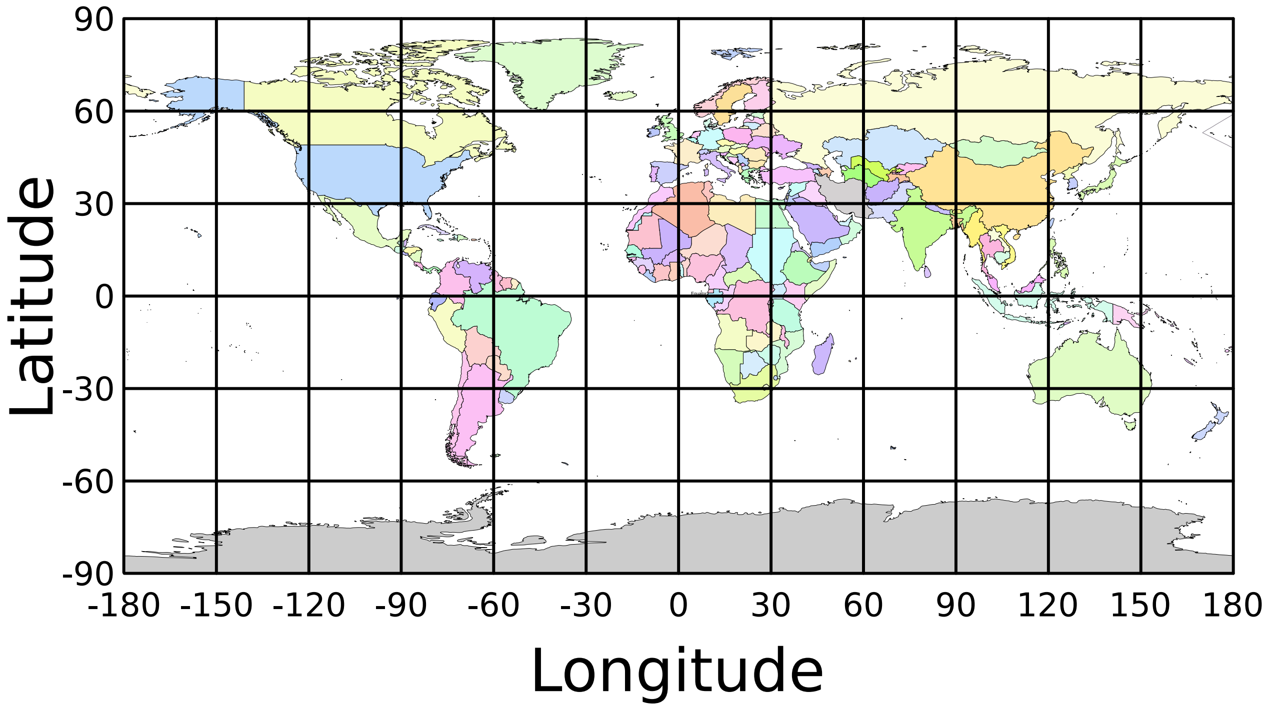

Figure 96: World map showing latitudes and longitudes

Latitude and longitude give the 2D point on the surface of the Earth. These are combined with height to give the 3D position on the Earth.

12.5.2 Height

Any height data output by Advanced Navigation devices is the height referenced the WGS84 reference ellipsoid. The WGS84 reference ellipsoid is a smooth mathematical model that approximates the form of the surface of the earth. The ellipsoid height (as used by GNSS) is not referenced to mean sea level; the height from the EGM96 geoid (orthometric height) approximates the height above mean sea level (MSL).

See **Figure 97: Orthometric, ellipsoid and geoid height diagram** below for a visual representation of geoid height, ellipsoid height and orthometric height (height above mean sea level).

Note:
Ellipsoid height refers to the height of a point of interest referenced to the WGS84 reference ellipsoid.
Geoid height refers to the height of the EGM96 geoid referenced to the WGS84 reference ellipsoid at a point of interest.
Orthometric height is the height at a point of interest referenced to the EGM96 geoid.

All heights can be either positive or negative dependant upon direction from the reference surface.

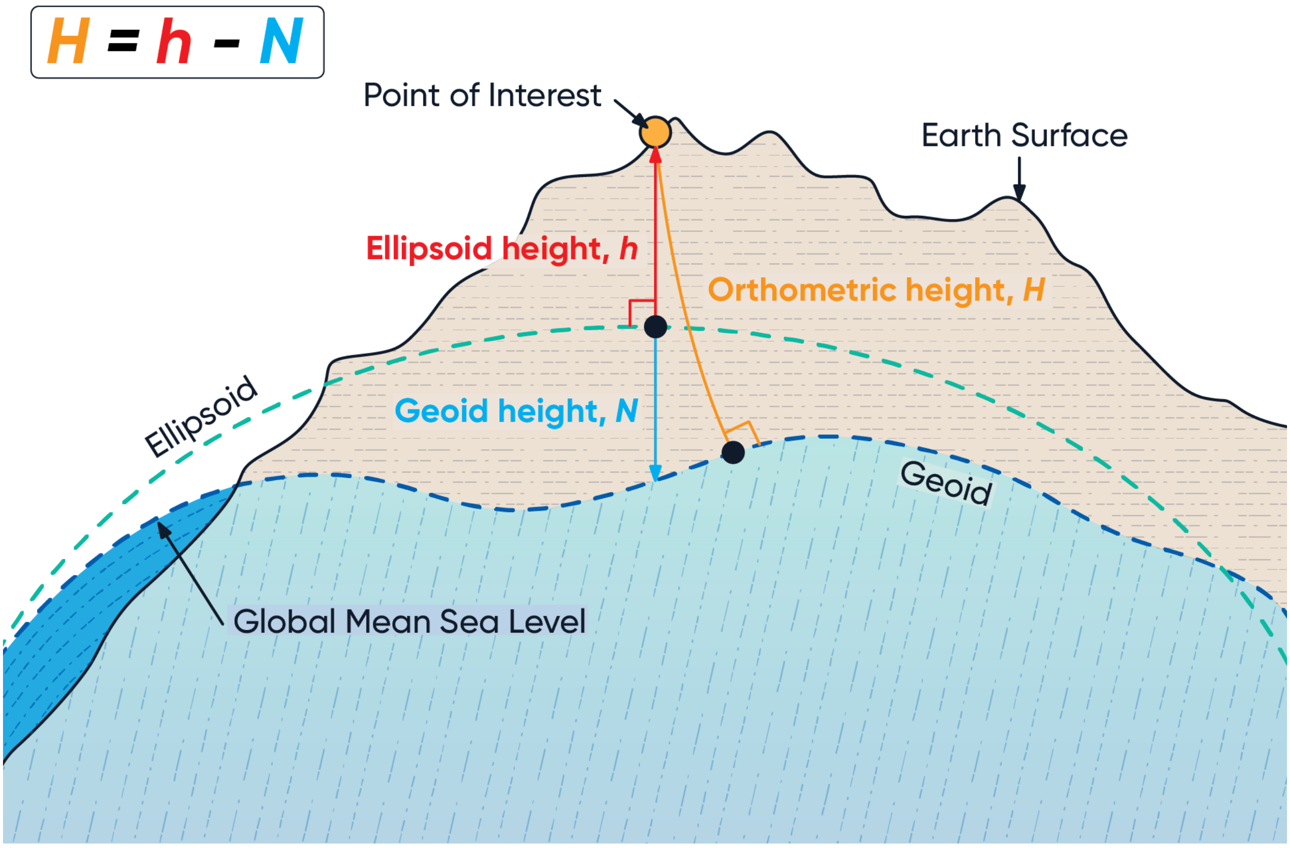

Figure 97: Orthometric, ellipsoid and geoid height diagram

The value required to convert the WGS84 ellipsoid height to orthometric height can be found in the geoid height packet, see **11.4.33 Geoid Height Packet**.

12.6 NED Co-ordinate Frame

The NED (North East Down) co-ordinate frame is used to express velocities and relative positions. The origin of the co-ordinate frame is the current position. From that origin, the north axis points true north and parallel to the line of latitude at that point. The east axis points perpendicular to the north axis and parallel to the line of longitude at that point. The down axis points directly down towards the centre of the Earth. See the figure below for a graphical representation of the NED co-ordinate frame at a position on the Earth.

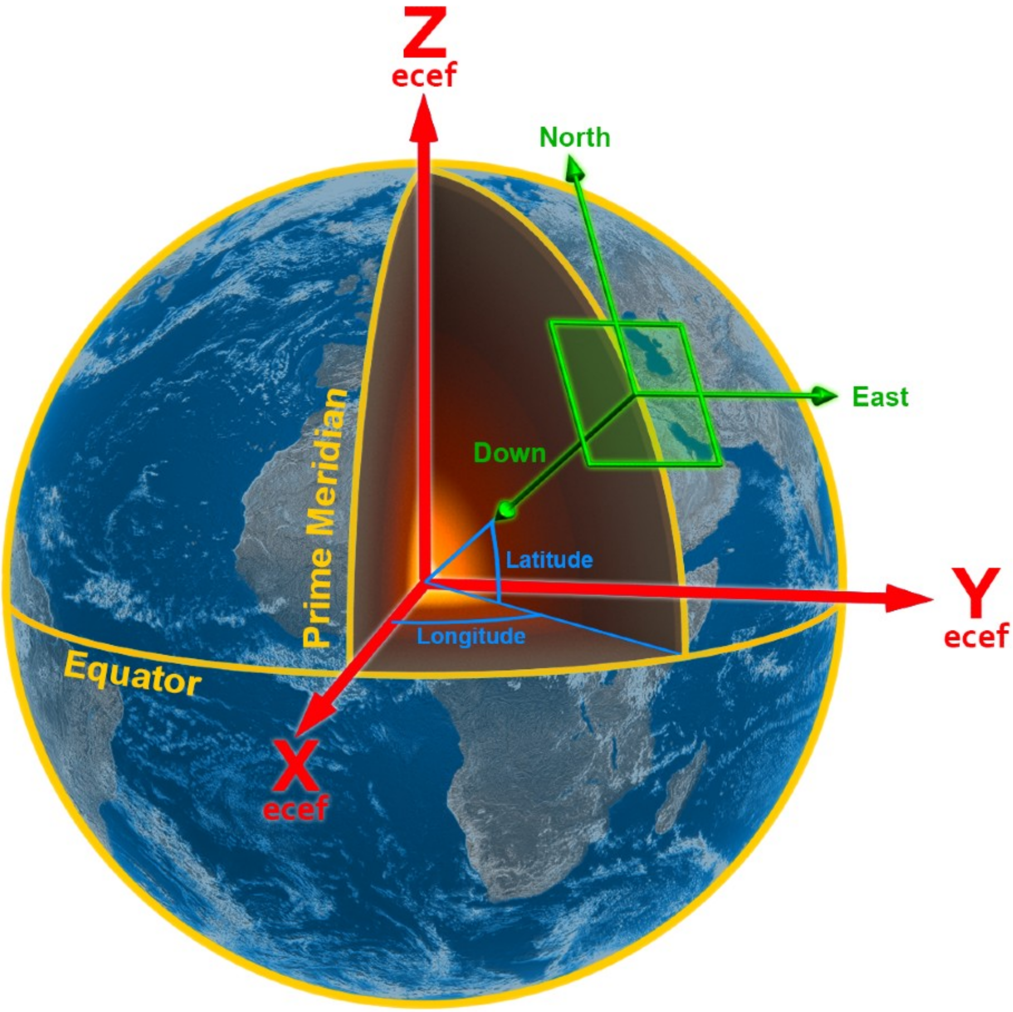

Figure 98: Graphic Showing Geodetic, NED and ECEF Co-ordinates

12.7 ECEF Co-ordinate Frame

The ECEF (Earth-centred earth-fixed) co-ordinate frame is a Cartesian co-ordinate frame used to represent absolute positions on the Earth. Its origin is at the centre of the Earth. ECEF is an alternative to the geodetic co-ordinate frame. It is represented by the three axes X, Y and Z which are presented graphically in **Figure 98: Graphic Showing Geodetic, NED and ECEF Co-ordinates**. ECEF positions can be retrieved from Advanced Navigation products, however the geodetic system is used as the default.