GNSS Compass Reference Manual

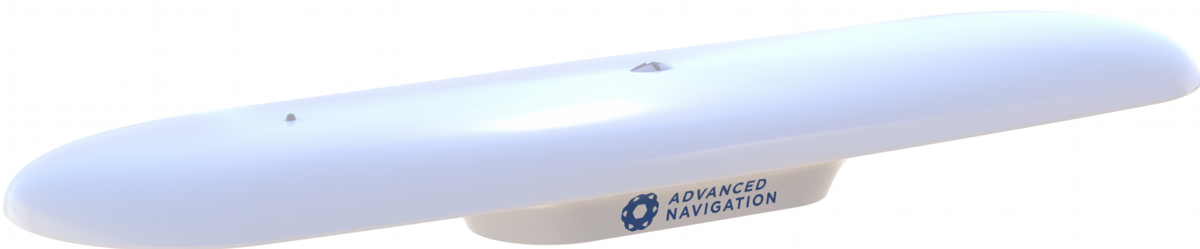

Table of Contents

1 Revision History

Version	Date	Changes
1.0	23/01/2018	Initial Release

Table 1: Revision history

2 Firmware Changelog

Version	Date	Changes
0.96	05/12/2017	Initial release firmware

Table 2: Firmware Changelog

3 Hardware Changelog

Version	Date	Changes
1.0	10/05/2017	Initial Release

Table 3: Hardware Changelog

4 Introduction

The 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 NMEA0183, NMEA2000 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.

If you have any questions, please contact support@advancednavigation.com.au.

5 Quick Start Guide

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 Illustration 1.

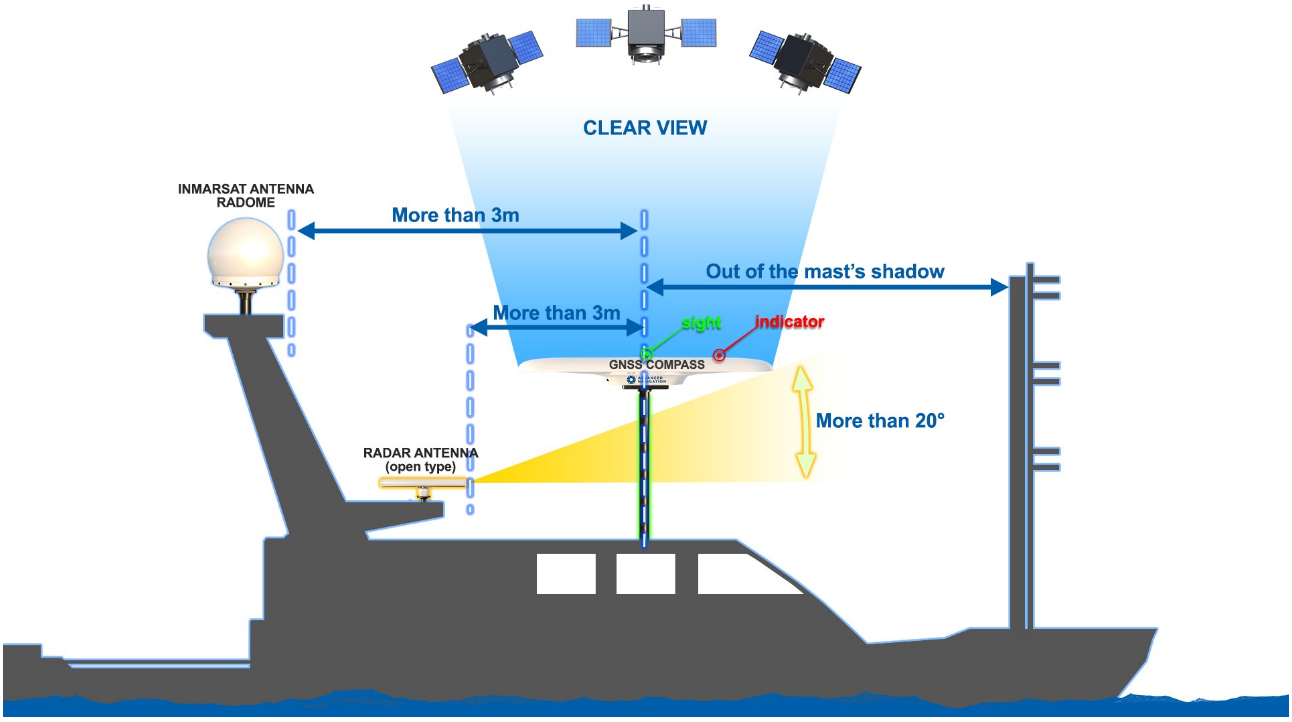

Illustration 1: GNSS Compass ideal mounting location diagram

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 Illustration 2.

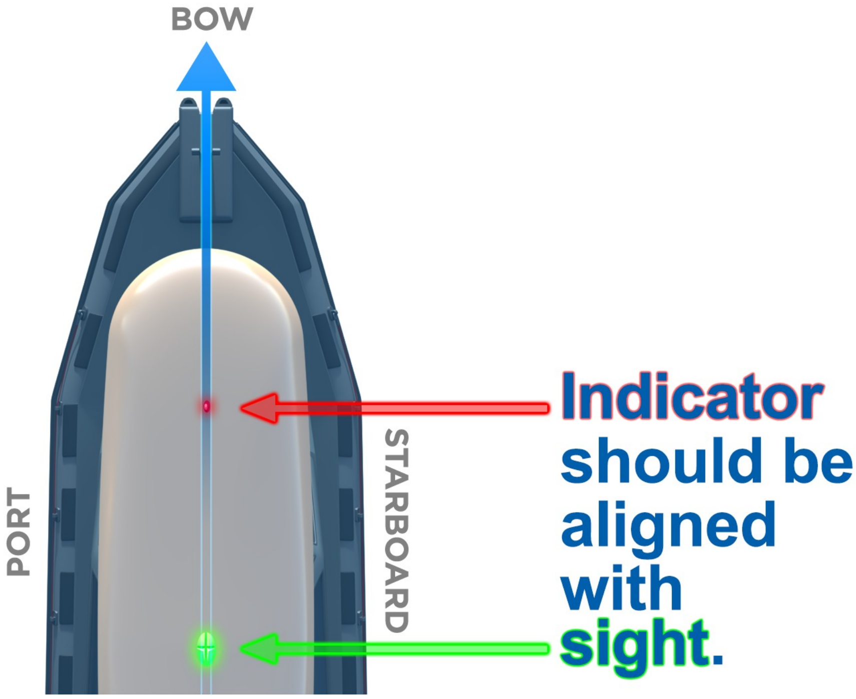

Illustration 2: GNSS Compass alignment

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

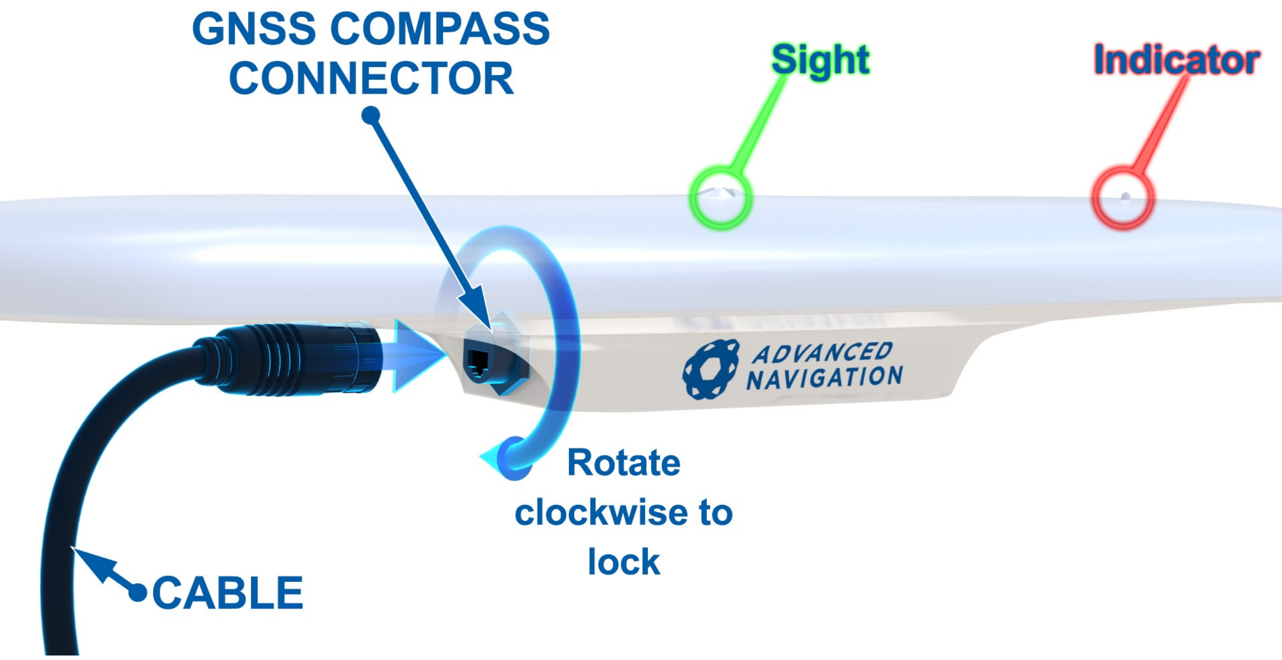

Illustration 3: GNSS Compass connector locking

5.1 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 section 7.8 for more information on the NMEA 2000 drop cable.

5.2 NMEA 0183 Connection

Plug a 9 to 36 volt power source into the DC jack and connect the secondary RS422 port to the receiving NMEA0183 device. Please see section 7.10 for further details on the pin-out of the serial breakout cable recommended for NMEA 0183 installations.

5.3 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.

6 Part Numbers and Ordering Options

6.1 Plug and Play Kits

Part Number	Description	Notes
GC-EK-SER-LC-CAN	GNSS Compass Low Cost NMEA 2000 Plug and Play Kit	NMEA 2000 plug and play kit Low cost serial variant GNSS Compass Comes with 6m NMEA 2000 cable, see section 7.8

6.2 Evaluation Kits

Part Number	Description	Notes
GC-EK-SER-LC-RS422	GNSS Compass Low Cost RS422 Evaluation Kit	NMEA 0183 plug and play Low cost serial variant GNSS Compass RS422/RS232 and CAN interfaces Comes with 100 to 240 V AC Power supply, USB to RS422 adaptor and 20 m serial breakout cable, see section 7.10
GC-EK-POE-LC	GNSS Compass Low Cost Ethernet Evaluation Kit	Low cost Ethernet variant GNSS Compass Power over Ethernet interface Comes with 100 to 240 V AC Power over Ethernet injector and 20 m Ethernet cable, see section 7.9
GC-EK-POE-HA	GNSS Compass High Accuracy Ethernet Evaluation Kit	High accuracy Ethernet variant GNSS Compass Power over Ethernet interface Comes with 100 to 240 V AC power over Ethernet injector and 20 m Ethernet cable, see section 7.9
GC-EK-SER-HA-RS422	GNSS Compass High Accuracy RS422 Evaluation Kit	NMEA 0183 plug and play High accuracy serial variant GNSS Compass RS422/RS232 and CAN interfaces Comes with USB to RS422 cable, 100 to 240 V AC power supply and 20 m serial breakout cable, see section 7.10

Table 4: Evaluation kit part numbers

6.3 Standalone Unit

Part Number	Description	Notes
GC-SER-LC	GNSS Compass Low Cost Serial	GNSS Compass Low Cost Serial Variant RS422/RS232 and CAN interfaces

Part Number	Description	Notes
	Variant	L1 only GNSS receiver Supports DGPS Supports post-processing (PPK) Does not support RTK Does not support L band No cables included
GC-POE-LC	GNSS Compass Low Cost Ethernet Variant	GNSS Compass Low Cost Ethernet Variant Power over Ethernet interface L1 only GNSS receiver Supports DGPS Supports post-processing (PPK) Does not support RTK Does not support L band No cables included
GC-POE-HA	GNSS Compass High Accuracy Ethernet Variant	GNSS Compass High Accuracy Ethernet Variant Power over Ethernet interface L1/L2 RTK GNSS receiver Supports DGPS Supports post-processing PPK Supports RTK Supports L band (Trimble RTX) No cables included
GC-SER-HA	GNSS Compass High Accuracy Serial Variant	GNSS Compass High Accuracy Serial Variant RS422/RS232 and CAN interfaces L1/L2 RTK GNSS receiver Supports DGPS Supports post-processing PPK Supports RTK Supports L band (Trimble RTX) No cables included

Table 5: Standalone unit part numbers

6.4 Accessories

Part Number	Description	Notes
GC-NMEA2000-CABLE-6M	6m NMEA 2000 drop cable for GNSS Compass	6m NMEA 2000 drop cable Compatible with serial units only (GC-SER-LC and GC-SER-HA) See section 7.8 for full details IP67 environmentally sealed connector

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 (GC-POE-LC and GC-POE-HA) See section 7.9 for full details IP67 environmentally sealed connector
GC-SER-BREAK-20M	20m serial breakout cable for GNSS Compass	20m cable to DB9 connectors Compatible with serial units only (GC-SER-LC and GC-SER-HA) See section 7.10 for full details IP67 environmentally sealed connector
GC-SER-CABLE-20M	20m serial cable for GNSS Compass	20m unterminated cable Compatible with serial units only (GC-SER-LC and GC-SER-HA) See section 7.11 for full details IP67 environmentally sealed connector
POE-INJECTOR	AC POE Injector	100 to 240 V AC PoE Injector
CABLE-FTDI-DSUB-422	FTDI USB to RS422 Adapter	1 metre FTDI USB to RS422 Adapter
CABLE-FTDI-DSUB-232	FTDI USB to RS232 Adapter	1 metre FTDI USB to RS232 Adapter
SUPPLY-24V	24V DC Power Supply	100-240V AC Mains (IEC socket) to 24V DC Power Supply (DC jack)
CAR12VPWR	Car cigarette lighter power supply	Car cigarette lighter to 2.1 x 5.5mm DC jack power supply
MOUNT-SUCT	Suction Cup Antenna Mount	Suction cup GNSS Compass mount for easy temporary installation of GNSS Compass on vehicles
ILU	Interface and Logging Unit	Interface and logging unit provides a convenient option for logging and applications that require multiple NMEA outputs

Table 6: Accessories part numbers

7 Specifications

7.1 Mechanical Drawings

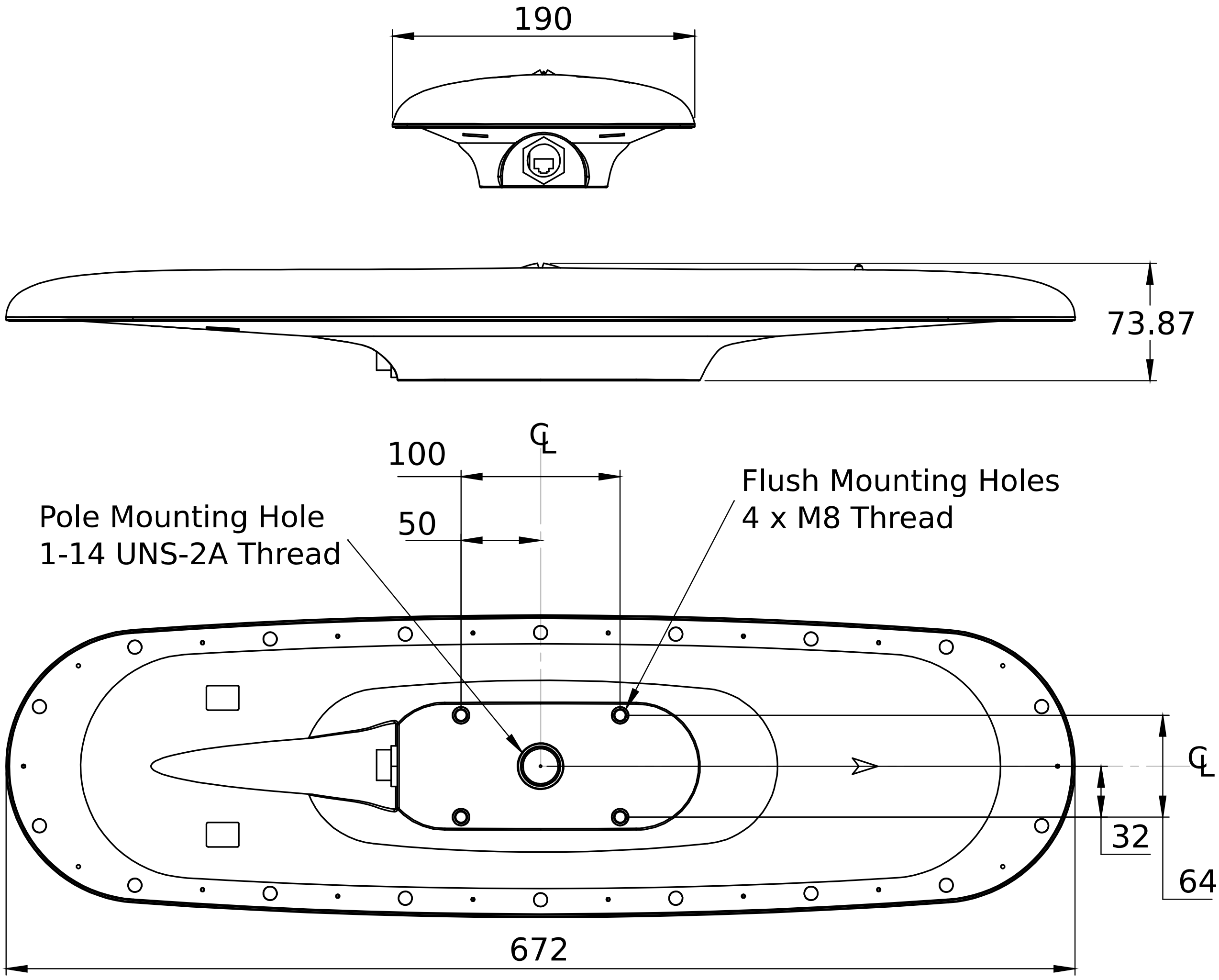

Illustration 4: Mechanical drawings of GNSS Compass

7.2 Axes

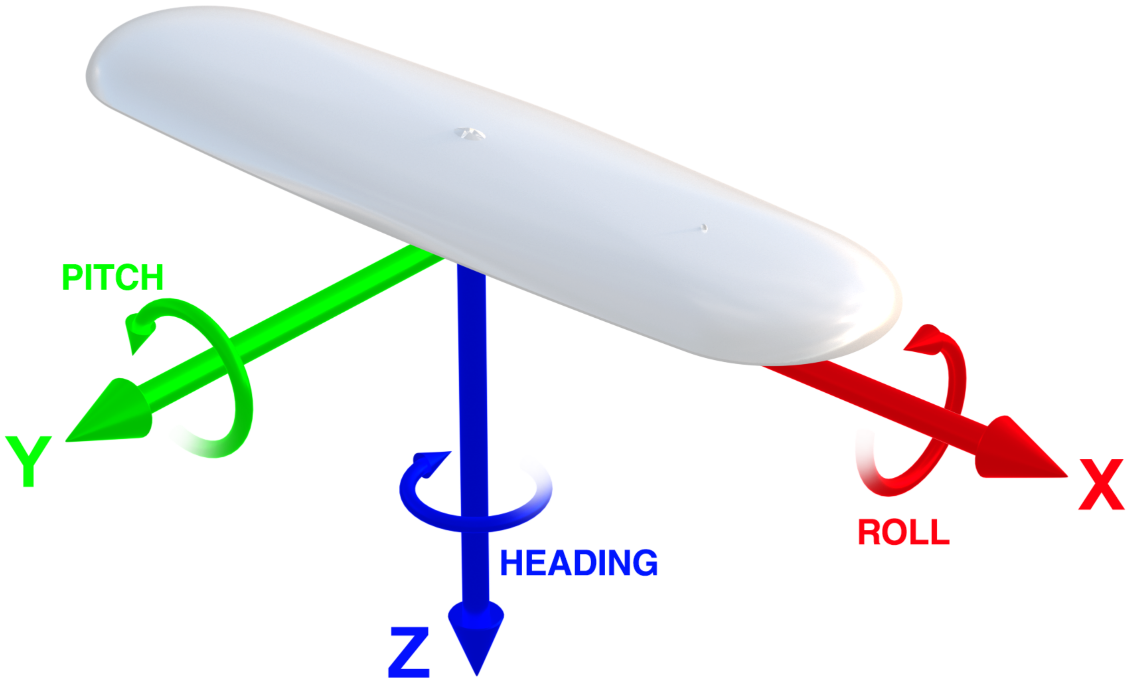

Illustration 5: GNSS Compass axes with arrows showing positive direction

7.3 Navigation Specifications

7.3.1 Low Cost Variant

Parameter	Value
Horizontal Position Accuracy	2.0 m
Vertical Position Accuracy	3.0 m
Horizontal Position Accuracy (DGNSS)	0.6 m
Vertical Position Accuracy (DGNSS)	1.0 m
Horizontal Position Accuracy (Kinematica Post Processing)	0.01 m
Vertical Position Accuracy (Kinematica Post Processing)	0.02 m
Velocity Accuracy	0.05 m/s
Roll & Pitch Accuracy	0.4 °
Heading Accuracy	0.2 °
Roll & Pitch Accuracy (Kinematica Post Processing)	0.13 °
Heading Accuracy (Kinematica Post Processing)	0.09 °
Heave Accuracy	5 % or 0.05 m
Orientation Range	Unlimited
Hot Start Time	500 ms
Internal Filter Rate	200 Hz
Output Data Rate	Up to 200 Hz

Table 7: Low cost variant navigation specifications

7.3.2 High Accuracy Variant

Parameter	Value
Horizontal Position Accuracy	0.8 m
Vertical Position Accuracy	1.5 m
Horizontal Position Accuracy (with RTK or Kinematica Post Processing)	0.008 m
Vertical Position Accuracy (with RTK or Kinematica Post Processing)	0.015 m
Velocity Accuracy	0.02 m/s
Roll & Pitch Accuracy	0.4 °
Heading Accuracy	0.2 °
Roll & Pitch Accuracy (Kinematica Post Processing)	0.13 °
Heading Accuracy (Kinematica Post Processing)	0.09 °
Heave Accuracy	5 % or 0.05 m
Orientation Range	Unlimited
Hot Start Time	500 ms
Internal Filter Rate	200 Hz
Output Data Rate	Up to 200 Hz

Table 8: High accuracy variant navigation specifications

7.4 GNSS Specifications

7.4.1 Low Cost Variant

Parameter	Value
Model	2 x u-blox M8T
Supported Navigation Systems	GPS L1 GLONASS G1 (disabled by default) GALILEO E1 BeiDou B1
Supported SBAS Systems	WAAS EGNOS MSAS GAGAN QZSS
Update Rate	10 Hz
Hot Start First Fix	1 s
Cold Start First Fix	30 s

Table 9: GNSS specifications low cost variant

7.4.2 High Accuracy Variant

Parameter	Value
Model	Trimble MB-Two
Supported Navigation Systems	GPS L1, L2 GLONASS G1, G2 GALILEO E1, E5b BeiDou B1, B2 (disabled by default)
Supported SBAS Systems	WAAS EGNOS MSAS GAGAN QZSS
Update Rate	20 Hz
Hot Start First Fix	3 s
Cold Start First Fix	30 s

Table 10: GNSS specifications high accuracy variant

7.5 Communication Specifications

7.5.1 Ethernet Variant

Parameter	Value
Interface	Ethernet
Speed	10/100 Mbit
Protocols	AN Packet Protocol NMEA 0183 TSS1 Simrad
Timing	PTP Server NTP Server
Timing Accuracy (PTP)	50 ns
Timing Accuracy (NTP)	1 ms

Table 11: Ethernet variant communication specifications

7.5.2 Serial Variant

Parameter	Value
Interface	RS422 (default) RS232 (software selectable) CAN
Speed	2400 to 1M baud
Protocols	AN Packet Protocol NMEA 0183 NMEA 2000 TSS1 Simrad
Timing	1PPS Output
Timing Accuracy	20 ns
Additional Interfaces	Secondary RS422/RS232 1PPS Output Alarm Output

Table 12: Serial variant communication specifications

7.6 Hardware

7.6.1 Ethernet Variant

Parameter	Value
Operating Voltage	Power over Ethernet (PoE) 802.3af or 802.3at
Power Consumption (Low Cost Variant)	1.1 Watts
Power Consumption (High Accuracy Variant)	2.4 Watts
Hot Start Battery Capacity	> 24 hrs
Hot Start Battery Charge Time	30 mins
Hot Start Battery Endurance	> 10 years
Operating Temperature	-40 °C to 85 °C
Environmental Sealing	IP68 MIL-STD-810G
Shock Limit	75 g
Dimensions	672 x 190 x 73.9 mm
Weight (Low Cost Variant)	1460 grams
Weight (High Accuracy Variant)	1530 grams

Table 13: Ethernet variant hardware specifications

7.6.2 Serial Variant

Parameter	Value
Operating Voltage	9 to 36 V
Input Protection	-40 to 60 V
Power Consumption (Low Cost Variant)	1.2 Watts
Power Consumption (High Accuracy Variant)	2.64 Watts
Hot Start Battery Capacity	> 24 hrs
Hot Start Battery Charge Time	30 mins
Hot Start Battery Endurance	> 10 years
Operating Temperature	-40 °C to 85 °C
Environmental Sealing	IP68 MIL-STD-810G
Shock Limit	75 g
Dimensions	672 x 190 x 73.9 mm
Weight (Low Cost Variant)	1480 grams
Weight (High Accuracy Variant)	1550 grams

Table 14: Serial variant hardware specifications

7.7 Electrical Isolation

The GNSS Compass's power supply circuit is galvanically isolated from the communication lines. Additionally the plastic enclosure isolates the electronics mechanically from the vessel, addressing the issue of vessel hull electrolysis.

7.8 NMEA 2000 Drop Cable

The NMEA 2000 cable is only compatible with GNSS Compass part numbers GC-SER-LC and GC-SER-HA. It has part number GC-NMEA2000-CABLE-6M.

The NMEA 2000 cable is used to connect serial variant GNSS Compasses to an NMEA 2000 network. 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.

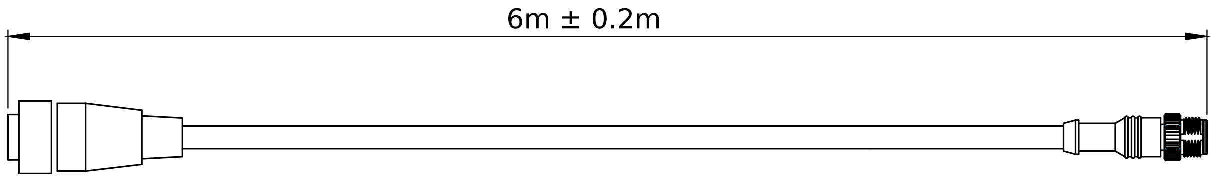

Illustration 6: NMEA 2000 Drop Cable

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 Illustration 7.

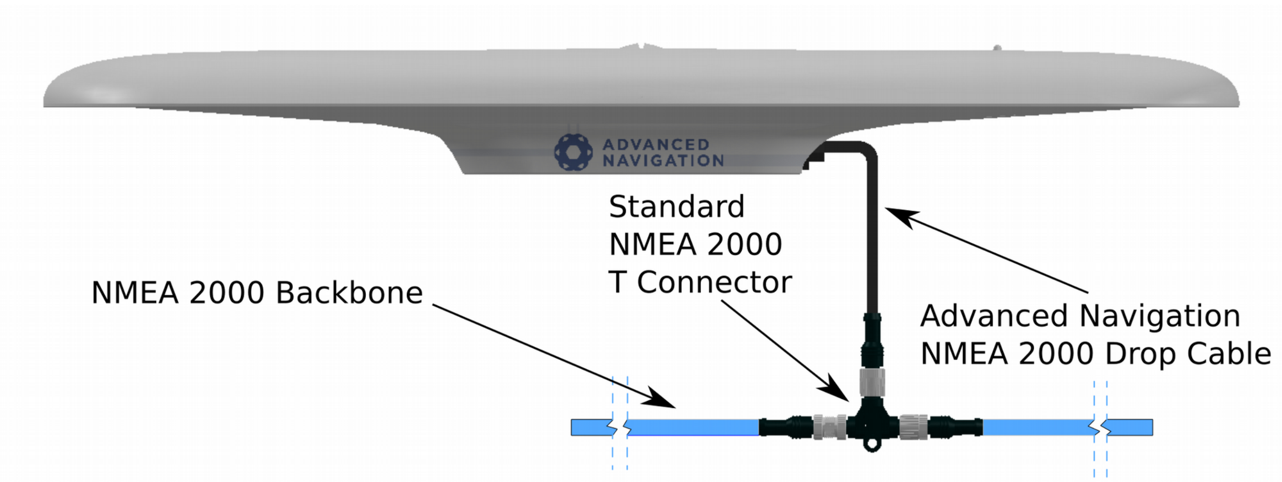

Illustration 7: GNSS Compass NMEA 2000 Connection

7.9 Ethernet Cable

The Ethernet cable is only compatible with GNSS Compass part numbers GC-POE-LC and GC-POE-HA. It has part number GC-POE-CABLE-20M.

Connection to 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 models GC-POE-LC and GC-POE-HA, however it will not be environmentally sealed so is not recommended for outdoor use. Additionally most standard Ethernet cable is not UV stable and will break down in sunlight.

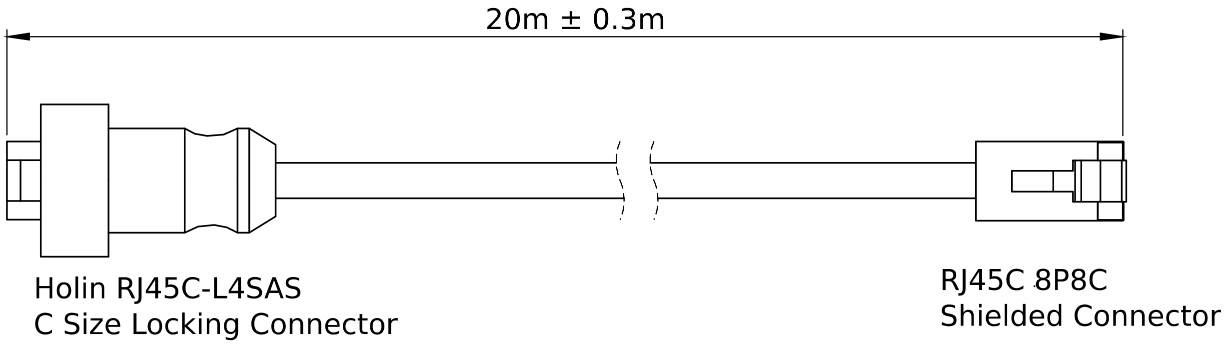

Illustration 8: Ethernet cable

7.10 Serial Breakout Cable

The serial breakout cable is only compatible with GNSS Compass part numbers GC-SER-LC and GC-SER-HA. It has part number GC-SER-BREAK-20M.

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. The opposite end of the cable contains 4 female DB9 connectors and a 2.1 x 5.5mm DC connector, these connectors are not environmentally sealed. The cable assembly is supplied with 20 metres of UV stable shielded cable. Each individual wire is colour coded 26AWG wire.

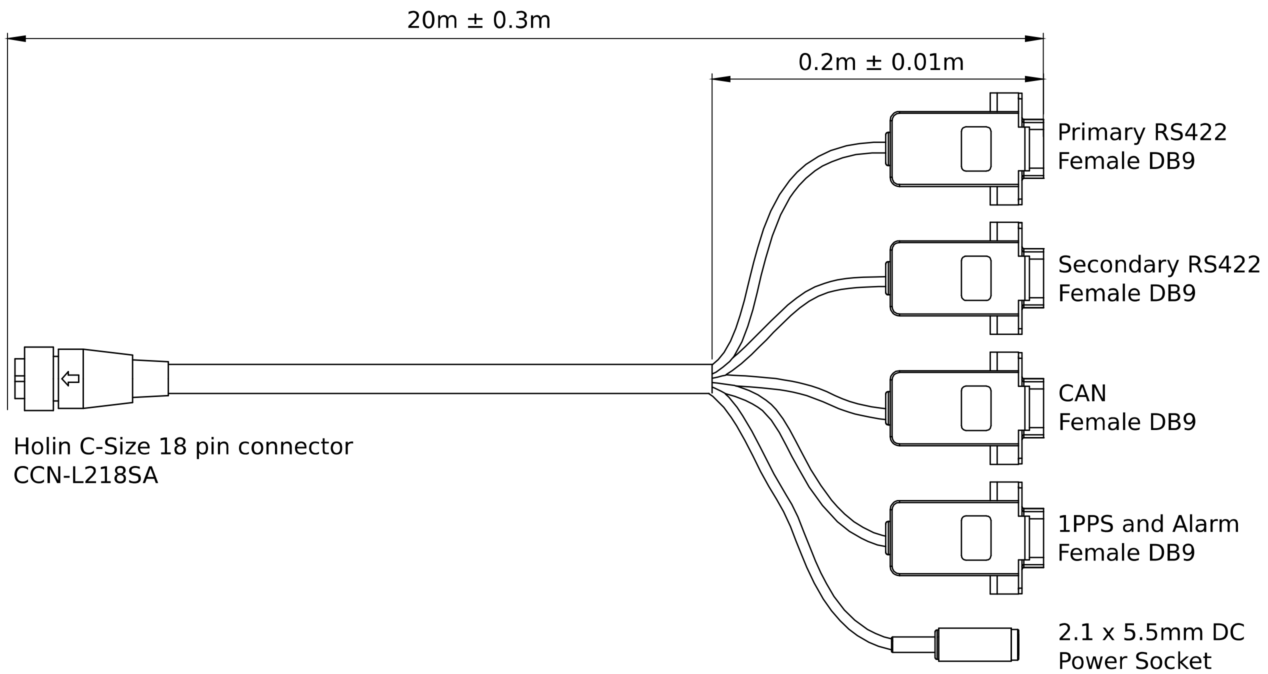

Illustration 9: Serial breakout cable

Colour	Function	Primary	Secondary	CAN	1PPS	Power
Red	Power Supply					Tip
Black	Power Ground					Ring
Green	Primary RS422 Tx(+) / RS232 Tx	2				
Green/White	Primary RS422 Tx(-)	8				
Purple	Primary RS422 Rx(+) / RS232 Rx	3				
Purple/White	Primary RS422 Rx(-)	7				
Brown	Secondary RS422 Tx(+) / RS232 Tx		2			
Brown/White	Secondary RS422 Tx(-)		8			
Pink	Secondary RS422 Rx(+) / RS232 Rx		3			
Pink/White	Secondary RS422 Rx(-)		7			
Grey	Signal Ground	5	5			
White	CAN Hi			7		
Blue	CAN Lo			2		
Orange	Alarm Hi				9	
Orange/White	Alarm Lo				1	
Yellow	1PPS Out				2	
Grey/White	Signal Ground			6	5	
Bare	Drain Wire					Ring

Table 16: Serial breakout cable pin allocation table

See Table 17 to match wire colour to pin number of the Holin connector.

7.11 Unterminated Serial Cable

The unterminated serial cable is only compatible with GNSS Compass part numbers GC-SER-LC and GC-SER-HA. It has part number GC-SER-CABLE-20M.

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. 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.

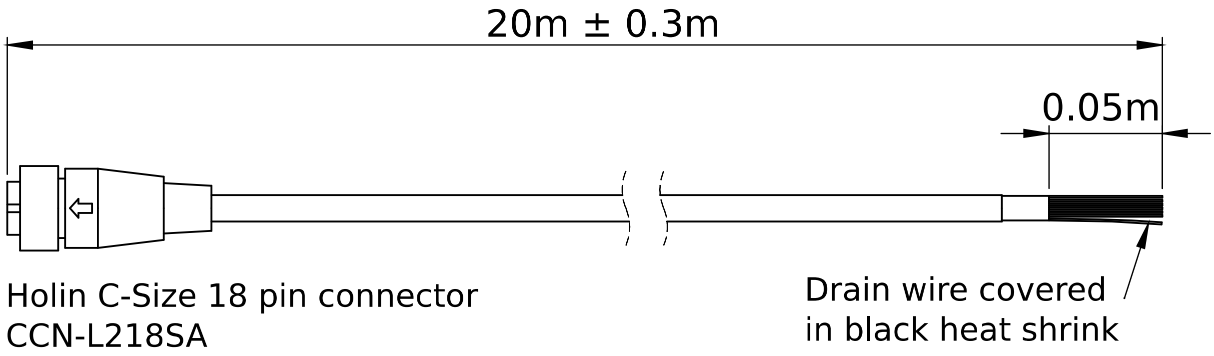

Illustration 10: Unterminated serial cable

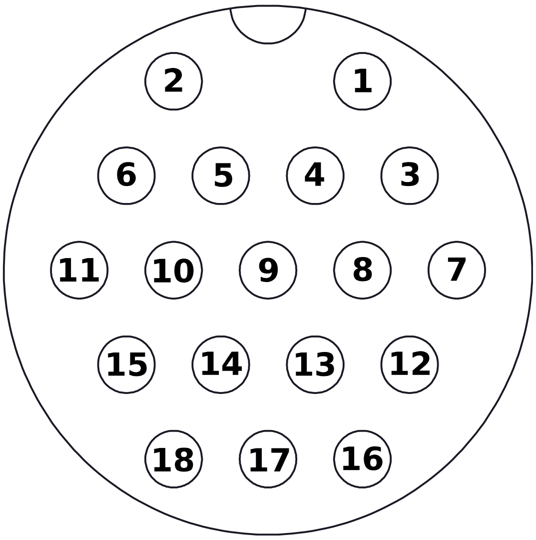

Illustration 11: Connector pin assignment viewed from the front

Pin	Colour	Function
1	Red	Power Supply
2	Black	Power Ground
3	Green	Primary RS422 Tx(+) / RS232 Tx
4	Green/White	Primary RS422 Tx(-)
5	Purple	Primary RS422 Rx(+) / RS232 Rx
6	Purple/White	Primary RS422 Rx(-)
7	Brown	Secondary RS422 Tx(+) / RS232 Tx
8	Brown/White	Secondary RS422 Tx(-)
9	Pink	Secondary RS422 Rx(+) / RS232 Rx
10	Pink/White	Secondary 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 (attach to power ground)

Table 17: Unterminated serial cable pin allocation table

7.12 Certification

The GNSS Compass is IMO wheelmarked 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.

Models GC-SER-LC and GC-SER-HA are certified 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 GC-SER-LC and GC-SER-HA

Models GC-POE-LC and GC-POE-HA are certified 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 61162-480 ed4.0 (2010-11)
	IEC 62288 Ed. 2.0 (2014-07)

Table 19: Standards for GC-POE-LC and GC-POE-HA

8 Installation

8.1 Mounting Location

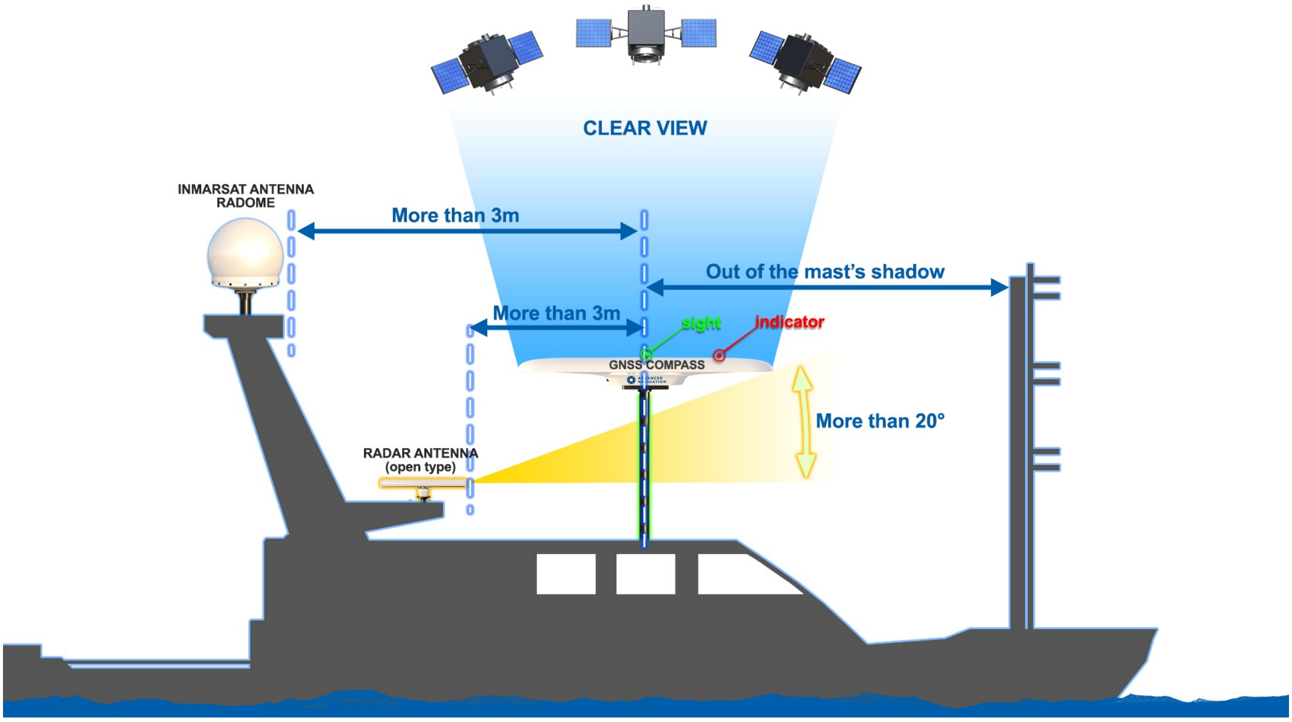

Illustration 12: GNSS Compass ideal mounting location diagram

The GNSS Compass needs to be mounted in an area with a clear and unobstructed view of the sky for best results. It should be mounted away from transmitting devices where possible. Please see Illustration 12 above for ideal mounting location.

8.2 Alignment

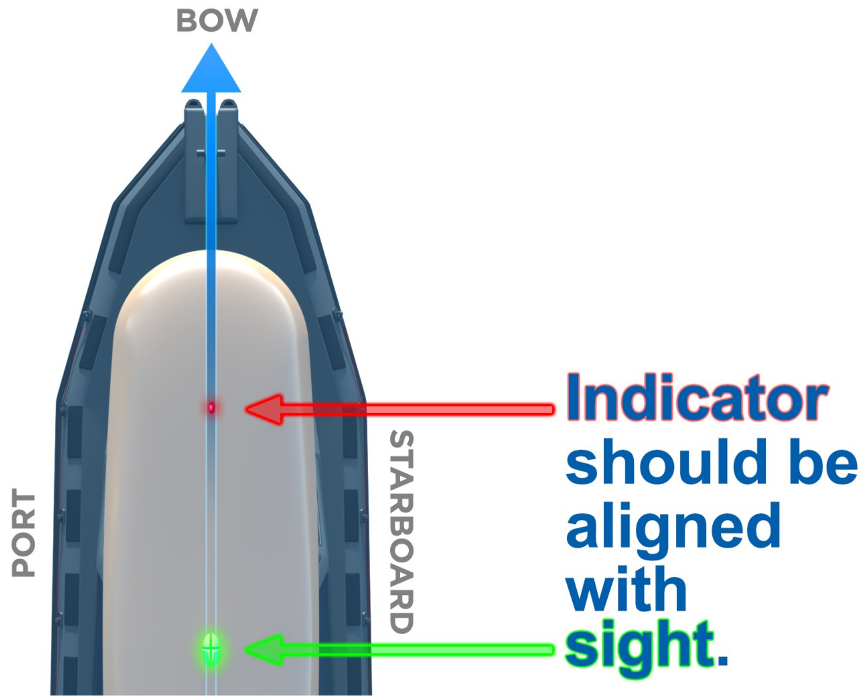

Illustration 13: GNSS Compass alignment with front of the vehicle

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 Illustration 13. The sight can be used to visually align the indicator for best results. See Illustration 14 for example mounting on a boat and Illustration 15 for example mounting on a car.

In the event that it is not feasible to mount the GNSS Compass in the standard orientation, it is possible to mount it with a known offset and configure the unit with this offset. The offset should be entered into the heading offset field in the alignment configuration dialogue.

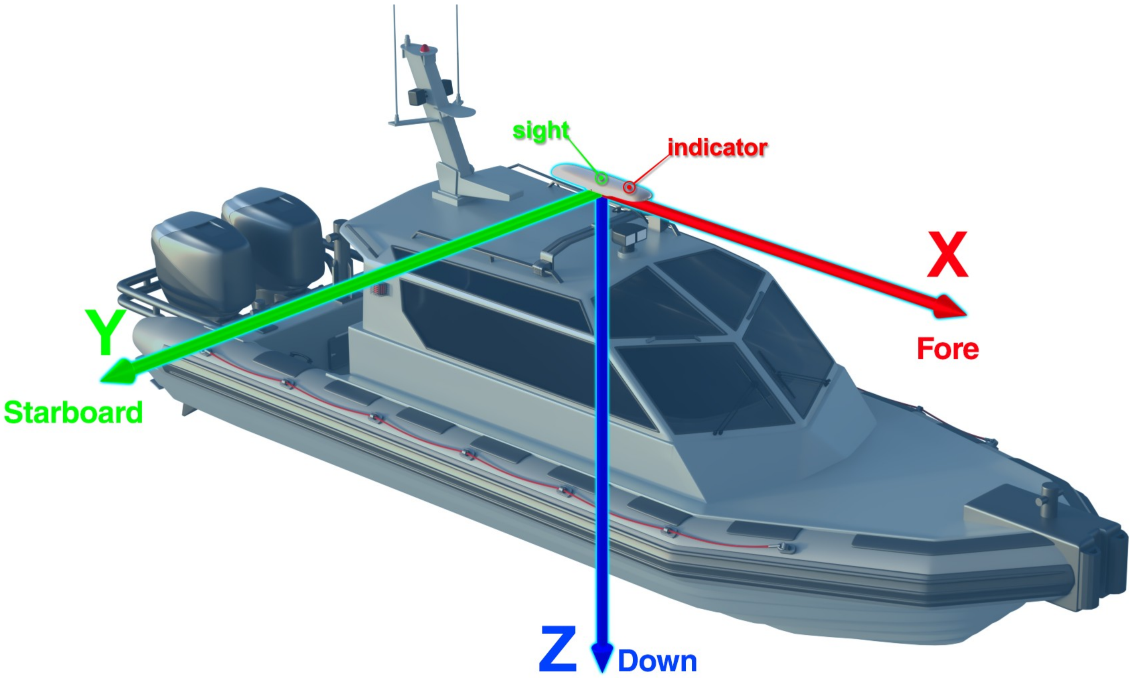

Illustration 14: GNSS Compass alignment on a boat

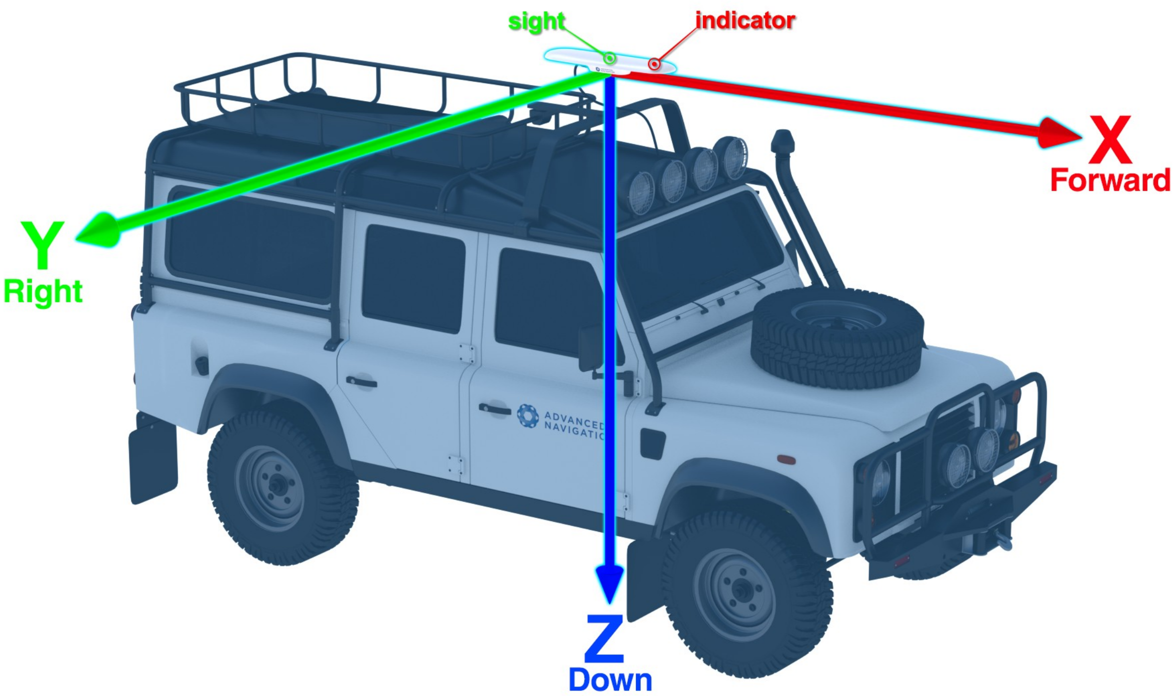

Illustration 15: GNSS Compass alignment on a car

8.3 Connection

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 Illustration 16.

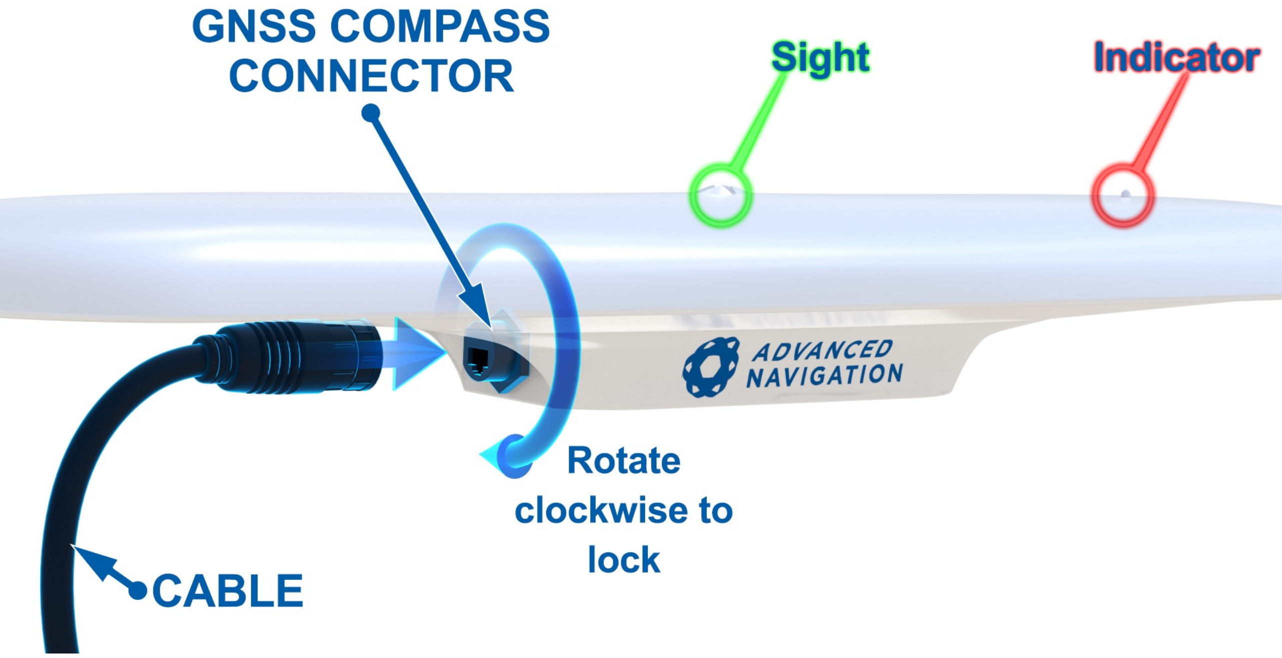

Illustration 16: GNSS Compass connector locking

8.3.1 NMEA 2000

For connection to an NMEA 2000 network the NMEA 2000 Drop Cable is required (part number GC-NMEA2000-CABLE-6M). 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.

8.3.2 NMEA 0183

For connection to an NMEA 0183 network the Advanced Navigation Serial Breakout Cable is required (part number GC-SER-BREAK-20M). The secondary 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.

8.3.3 Ethernet

For connection to an Ethernet network the Advanced Navigation Ethernet Cable 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) or 802.3af or 802.3at compliant PoE switch. The PoE injector or switch is then connected to a router.

8.3.4 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.

8.4 Configuration

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

8.4.1 Serial Variants

1. Connect a USB to serial adaptor to the primary port of the GNSS Compass Serial Breakout Cable.
2. Install Java from the link below.

   http://www.java.com/
3. Download GNSS Compass Manager from the link below.

   https://www.advancednavigation.com.au/product/gnss-compass#software
4. Run GNSS Compass Manager by double clicking on the file.
5. Select the port, set the baud rate to 115,200 and click Connect.
6. 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.

8.4.2 Ethernet Variants

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. 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.

9 Operation

9.1 Initialisation

After power is applied to the GNSS Compass, it will take some time to initialise position, velocity, time, roll, pitch and heading. This time will depend upon the status of the GNSS satellite constellations but can be approximated using Table 20 below.

Model	Power Up Type	Position Initialisation	Heading Initialisation
Low Cost	Hot Start	1 second	40 seconds
High Accuracy	Hot Start	3 seconds	120 seconds
Low Cost	Cold Start	30 seconds	60 seconds
High Accuracy	Cold Start	30 seconds	180 seconds

Table 20: GNSS Compass typical initialisation time

9.1.1 Hot Start

If the GNSS Compass has been powered off for more than 24 hours, when it is powered on it will initialise with a cold start. If the GNSS Compass has been powered off for less than 24 hours it will initialise with a hot start which is much faster.

9.2 Dual Antenna GNSS Heading

In the past most AHRS have relied upon magnetic heading. Magnetic heading has some downsides in that it requires calibration and is prone to interference from ferrous metals.

GNSS Compass uses a new technique to determine heading by measuring phase differences between two GNSS antennas mounted at a known separation inside the enclosure of the GNSS Compass. The benefit of this technique is that it is not subject to magnetic interference and provides more accurate heading than magnetic systems.

Dual antenna GNSS heading does require a clear view of the sky and sufficient spacing from RF transmitters operating close to GNSS bands.

9.3 GNSS Outages

When the GNSS Compass has an obstructed view of the sky there may be loss of a heading fix, loss of a position fix or both. This can occur when travelling under bridges, through tunnels or between buildings.

During a loss of heading fix the GNSS Compass will continue to provide accurate heading for up to 10 minutes using its gyroscopes. A heading error will slowly accumulate during this period at a rate of approximately 15 degrees/hour.

During a loss of position fix the GNSS Compass will continue to provide accurate position and velocity for up to 2 minutes using its inertial sensors.

10 NMEA 2000

The GNSS Compass outputs the NMEA 2000 messages listed in Table 21 below.

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

11 NMEA 0183

The GNSS Compass supports outputting the NMEA 0183 messages listed in Table 22 below. It is compliant with NMEA 0183 version 4.10. The maximum output rate for any of the messages below is 100Hz.

Sentence	Default	Description
$GPGGA	No	Time, latitude, longitude, height and HDOP
$GPGLL	No	Latitude and longitude
$GPGNS	No	Time, latitude, longitude, height and HDOP
$GPGSA	No	GNSS DOP and satellites used in solution
$GPGSV	No	GNSS satellites in view
$GPHBT	No	Heartbeat supervision sentence
$GPHDG	Yes (10Hz)	Magnetic deviation and variation
$GPHDM	No	Magnetic Heading
$GPHDT	No	True heading
$GPHEV	No	Heave
$GPRMC	Yes (10Hz)	Time, date, latitude, longitude and 2D velocity
$GPROT	No	Rate of turn
$GPVBW	No	Dual ground/water speed
$GPVLW	No	Dual ground/water distance
$GPVTG	No	Course over ground and ground speed
$GPZDA	No	Time and date
$PASHR	No	Time, orientation and orientation error
$TSS1	No	Heave, pitch and roll
$PFEC,GPatt	No	Attitude and heading
$PFEC,GPhve	No	Heave

Table 22: NMEA 0183 output messages supported

12 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. It is used across all existing and future Advanced Navigation products.

12.1 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 23: Data type abbreviations used in the ANPP

12.2 Packet Structure

The ANPP packet structure is shown in Table 24 and the header format is shown in Table 25. Example code can be downloaded from the software section.

Header				
Header LRC	Packet ID	Packet Length	CRC16	Packet Data

Table 24: ANPP Packet Structure

ANPP Header Format				
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Header LRC, see section 12.2.1
2	1	u8	1	Packet ID, see section 12.2.2
3	2	u8	1	Packet Length, see section 12.2.3
4	3	u16	2	CRC16, see section 12.2.4

Table 25: ANPP header format

12.2.1 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. The LRC can be found using the following:

LRC = ((packet_id + packet_length + crc[0] + crc[1])^0xFF) + 1

12.2.2 Packet ID

The packet ID is used to distinguish the contents of the packet. Packet IDs range from 0 to 255.

Within this range there are three different sub-ranges, these are system packets, state packets and configuration packets.

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.

12.2.3 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.

12.2.4 CRC

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

12.3 Packet Requests

Any of the state and configuration packets can be requested at any time using the request packet. See section 12.9.2.

12.4 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. For details on the acknowledgement packet, see section 12.9.1.

12.5 Packet Rates

The packet rates can be configured either the web interface for Ethernet variants, GNSS Compass Manager for serial variants or through the Packets Period Packet. By default GNSS Compass is configured to output the System State Packet at 20Hz.

12.6 Baud Rate

This section applies to the serial variant only and can be ignored for the Ethernet variant.

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 the packet length add five to account for the packet overhead. For example to output the system state packet at 20Hz the calculation would be:

Data throughput = (100 (packet length) + 5 (fixed packet overhead)) * 20 (rate)

Data throughput = 2100 bytes per second

Minimum baud rate = data throughput x 11 = 23,100 Baud

Closest standard baud rate = 38,400 Baud

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

12.7 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 System State Packet, the Unix Time Packet or the Formatted Time Packet. For example if the Unix Time Packet, Status Packet and 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 Unix Time Packet providing the time of validity for the other two packets.

12.8 Packet Summary

Packet ID	Length	R/W	Name
System Packets			
0	4	R	Acknowledge Packet

Packet ID	Length	R/W	Name
1	-	W	Request Packet
2	1	R/W	Boot Mode Packet
3	24	R	Device Information Packet
4	4	W	Restore Factory Settings Packet
5	4	W	Reset Packet
10	-	R/W	Serial Port Pass-through Packet
State Packets			
20	100	R	System State Packet
21	8	R	Unix Time Packet
22	14	R	Formatted Time Packet
23	4	R	Status Packet
24	12	R	Position Standard Deviation Packet
25	12	R	Velocity Standard Deviation Packet
26	12	R	Euler Orientation Standard Deviation Packet
27	16	R	Quaternion Orientation Standard Deviation Packet
28	48	R	Raw Sensors Packet
29	74	R	Raw GNSS Packet
30	13	R	Satellites Packet
31	-	R	Detailed Satellites Packet
32	24	R	Geodetic Position Packet
33	24	R	ECEF Position Packet
34	25	R	UTM Position Packet
35	12	R	NED Velocity Packet
36	12	R	Body Velocity Packet
37	12	R	Acceleration Packet
38	16	R	Body Acceleration Packet
39	12	R	Euler Orientation Packet
40	16	R	Quaternion Orientation Packet
41	36	R	DCM Orientation Packet
42	12	R	Angular Velocity Packet
43	12	R	Angular Acceleration Packet
44	60	R/W	External Position & Velocity Packet
45	36	R/W	External Position Packet
46	24	R/W	External Velocity Packet

Packet ID	Length	R/W	Name
47	16	R/W	External Body Velocity Packet
48	8	R/W	External Heading Packet
49	8	R	Running Time Packet
50	12	R	Local Magnetic Field Packet
52	8	R/W	External Time Packet
54	4	R	Geoid Height Packet
55	-	W	RTCM Corrections Packet
58	16	R	Heave Packet
60	-	R	Raw Satellite Data Packet
61	-	R	Raw Satellite Ephemeris Packet
69	48	R	GNSS Receiver Information Packet
73	24	R	Automotive Packet
Configuration Packets			
181	-	R/W	Packets Period Packet
182	17	R/W	Baud Rates Packet
184	4	R/W	Sensor Ranges Packet
185	73	R/W	Installation Alignment Packet
186	17	R/W	Filter Options Packet
187	-	R/W	Advanced Filter Parameters Packet
188	13	R/W	Port Function Configuration Packet
193	5	W	Set Zero Orientation Alignment Packet
194	49	R/W	Reference Point Offsets Packet
195	33	R/W	Port Output Configuration Packet
198	64	R/W	User Data Packet

Table 26: Packet summary

12.9 System Packets

12.9.1 Acknowledge Packet

Acknowledgement Packet				
Packet ID				0
Length				4
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	Acknowledge Result, see section 12.9.1.1

Table 27: Acknowledge packet

12.9.1.1 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 28: Acknowledge result

12.9.2 Request Packet

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

Table 29: Request packet

12.9.3 Boot Mode Packet

Boot Mode Packet				
Packet ID				2
Length				1
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Boot mode, see section 12.9.3.1

Table 30: Boot mode packet

12.9.3.1 Boot Mode Types

Value	Description
0	Bootloader
1	Main Program

Table 31: Boot mode types

12.9.4 Device Information Packet

Device Information Packet				
Packet ID				3
Length				24
Field #	Bytes Offset	Data Type	Size	Description
1	0	u32	4	Software version
2	4	u32	4	Device ID
3	8	u32	4	Hardware revision
4	12	u32	4	Serial number part 1
5	16	u32	4	Serial number part 2
6	20	u32	4	Serial number part 3

Table 32: Device information packet

12.9.5 Restore Factory Settings Packet

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

Table 33: Restore factory settings packet

12.9.6 Reset Packet

Reset Packet				
Packet ID				5
Length				4
Field #	Bytes Offset	Data Type	Size	Description
1	0	u32	4	Verification sequence, see section 12.9.6.1

Table 34: Reset packet

12.9.6.1 Verification Sequence Values

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

Table 35: Verification sequence values

12.9.7 Serial Port Pass-through Packet

Serial Port Pass-through Packet				
Packet ID				10
Length				Variable, up to 255 bytes
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Pass-through Route, see section 12.9.7.1
2	1			Pass-through data

Table 36: Serial port pass-through packet

12.9.7.1 Pass-through Routes

Value	Description
1	Reserved
2	Secondary RS232

Table 37: Pass-through routes

12.10 State Packets

GNSS Compass supports a large number of packets providing extensive functionality. However for the majority of users the easiest approach is to configure GNSS Compass using the GNSS Compass Manager software and then support only the single system state packet shown below in section 12.10.1. Advanced functionality can be added as required through the other packets.

12.10.1 System State Packet

System State Packet				
Packet ID				20
Length				100
Field #	Bytes Offset	Data Type	Size	Description
1	0	u16	2	System status, see section 12.10.1.1
2	2	u16	2	Filter status, see section 12.10.1.2
3	4	u32	4	Unix time stamp (seconds), see section 12.10.1.4
4	8	u32	4	Microseconds, see section 12.10.1.5
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 38: System state packet

12.10.1.1 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.

Bit	Description
0	System Failure
1	Accelerometer Sensor Failure
2	Gyroscope Sensor Failure
3	Magnetometer Sensor Failure
4	Secondary GNSS Failure
5	Primary GNSS Failure
6	Accelerometer Over Range
7	Gyroscope Over Range
8	Magnetometer Over Range
9	Reserved
10	Minimum Temperature Alarm
11	Maximum Temperature Alarm
12	Low Voltage Alarm
13	High Voltage Alarm
14	GNSS Antenna Fault
15	Data Output Overflow Alarm

Table 39: System status

12.10.1.2 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	GNSS Fix Status, see section 12.10.1.3
5	
6	
7	Event 1 Occurred
8	Event 2 Occurred
9	Internal GNSS Enabled
10	Dual Antenna Heading Active
11	Velocity Heading Enabled
12	Dual Antenna Heading Outage for over 60 Seconds
13	External Position Active
14	External Velocity Active
15	External Heading Active

Table 40: Filter Status

12.10.1.3 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	Omnistar GNSS fix
6	1	1	0	RTK Float GNSS fix
7	1	1	1	RTK Fixed GNSS fix

Table 41: GNSS fix status

12.10.1.4 Unix Time Seconds

This field provides UTC time in seconds since January 1, 1970, including leap seconds.

12.10.1.5 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.

12.10.2 Unix Time Packet

Unix Time Packet				
Packet ID				21
Length				8
Field #	Bytes Offset	Data Type	Size	Description
1	0	u32	4	Unix time stamp (seconds), see section 12.10.1.4
2	4	u32	4	Microseconds, see section 12.10.1.5

Table 42: Unix time packet

12.10.3 Formatted Time Packet

Formatted Time Packet				
Packet ID				22
Length				14
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 43: Formatted time packet

12.10.4 Status Packet

Status Packet				
Packet ID				23
Length				4
Field #	Bytes Offset	Data Type	Size	Description
1	0	u16	2	System status, see section 12.10.1.1
2	2	u16	2	Filter status, see section 12.10.1.2

Table 44: Status packet

12.10.5 Position Standard Deviation Packet

Position Standard Deviation Packet				
Packet ID				24
Length				12
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 45: Position standard deviation packet

12.10.6 Velocity Standard Deviation Packet

Velocity Standard Deviation Packet				
Packet ID				25
Length				12
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 46: Velocity standard deviation packet

12.10.7 Euler Orientation Standard Deviation Packet

Euler Orientation Standard Deviation Packet				
Packet ID				26
Length				12
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 47: Euler orientation standard deviation packet

12.10.8 Quaternion Orientation Standard Deviation Packet

Quaternion Orientation Standard Deviation Packet				
Packet ID				27
Length				16
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 48: Quaternion orientation standard deviation packet

12.10.9 Raw Sensors Packet

Raw Sensors Packet				
Packet ID				28
Length				48
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		8	Reserved

Table 49: Raw sensors packet

12.10.10 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
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)
7	36	fp32	4	Velocity east (m)
8	40	fp32	4	Velocity down (m)
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 section 12.10.10.1

Table 50: Raw GNSS packet

12.10.10.1 Raw GNSS Status

Bit	Description
0	GNSS Fix Status, see section 12.10.1.3
1	
2	
3	Doppler velocity valid
4	Time valid
5	External GNSS
6	Tilt valid
7	Heading valid
8	Floating ambiguity heading
9-15	Reserved (set to zero)

Table 51: Raw GNSS status

12.10.11 Satellites Packet

Satellites Packet				
Packet ID				30
Length				13
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 52: Satellites packet

12.10.12 Detailed Satellites Packet

Detailed Satellites Packet				
Packet ID				31
Length				7 x number of satellites
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Satellite system, see section 12.10.12.1
2	1	u8	1	Satellite number (PRN)
3	2	s8	1	Satellite frequencies, see section 12.10.12.2
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 53: Detailed satellites packet

12.10.12.1 Satellite Systems

Value	System
0	Unknown
1	GPS
2	GLONASS
3	BeiDou
4	GALILEO
5	SBAS
6	QZSS
7	Starfire
8	Omnistar
9	IMES

Table 54: Satellite systems

12.10.12.2 Satellite Frequencies

Bit	Description
0	L1 C/A
1	L1 C
2	L1 P
3	L1 M
4	L2 C
5	L2 P
6	L2 M
7	L5

Table 55: Satellite frequencies

12.10.13 Geodetic Position Packet

Geodetic Position Packet				
Packet ID				32
Length				24
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 56: Geodetic position packet

12.10.14 ECEF Position Packet

ECEF Position Packet				
Packet ID				33
Length				24
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 57: ECEF position packet

12.10.15 UTM Position Packet

UTM Position Packet				
Packet ID				34
Length				26
Field #	Bytes Offset	Data Type	Size	Description
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 58: UTM position packet

12.10.16 NED Velocity Packet

NED Velocity Packet				
Packet ID				35
Length				12
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 59: NED velocity packet

12.10.17 Body Velocity Packet

Body Velocity Packet				
Packet ID				36
Length				12
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 60: Body velocity packet

12.10.18 Acceleration Packet

This packet includes the acceleration due to gravity.

Acceleration Packet				
Packet ID				37
Length				12
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 61: Acceleration packet

12.10.19 Body Acceleration Packet

This packet does not include the acceleration due to gravity.

Body Acceleration Packet				
Packet ID				38
Length				16
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 62: Body acceleration packet

12.10.20 Euler Orientation Packet

Euler Orientation Packet				
Packet ID				39
Length				12
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 63: Euler orientation packet

12.10.21 Quaternion Orientation Packet

Quaternion Orientation Packet				
Packet ID				40
Length				16
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 64: Quaternion orientation packet

12.10.22 DCM Orientation Packet

DCM Orientation Packet				
Packet ID				41
Length				36
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 65: DCM orientation packet

12.10.23 Angular Velocity Packet

Angular Velocity Packet				
Packet ID				42
Length				12
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 66: Angular velocity packet

12.10.24 Angular Acceleration Packet

Angular Acceleration Packet				
Packet ID				43
Length				12
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 67: Angular acceleration packet

12.10.25 External Position & Velocity Packet

External Position & Velocity Packet				
Packet ID				44
Length				60
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 68: External position & velocity packet

12.10.26 External Position Packet

External Position Packet				
Packet ID				45
Length				36
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)
5	28	fp32	4	Longitude standard deviation (m)
6	32	fp32	4	Height standard deviation (m)

Table 69: External position packet

12.10.27 External Velocity Packet

External Velocity Packet				
Packet ID				46
Length				24
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 70: External velocity packet

12.10.28 External Body Velocity Packet

External Body Velocity Packet				
Packet ID				47
Length				16
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 standard deviation (m/s)

Table 71: External body velocity packet

12.10.29 External Heading Packet

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

Table 72: External heading packet

12.10.30 Running Time Packet

Running Time Packet				
Packet ID				49
Length				8
Field #	Bytes Offset	Data Type	Size	Description
1	0	u32	4	Running time seconds
2	4	u32	4	Microseconds

Table 73: Running time packet

12.10.31 Local Magnetic Field Packet

Local Magnetic Field Packet				
Packet ID				50
Length				12
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 74: Local magnetic field packet

12.10.32 External Time Packet

External Time Packet				
Packet ID				52
Length				8
Field #	Bytes Offset	Data Type	Size	Description
1	0	u32	4	Unix time seconds, see section 12.10.1.4
2	4	u32	4	Microseconds, see section 12.10.1.5

Table 75: External time packet

12.10.33 Geoid Height Packet

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

Mean Sea Level Height = Height – Geoid Height

Depth = Geoid Height – Height

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

Table 76: Geoid height packet

12.10.34 RTCM Corrections Packet

This packet is used to encapsulate RTCM v2, RTCM v3 or CMR correction data to be sent to GNSS Compass's internal GNSS receiver for differential or RTK GNSS functionality.

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

Table 77: RTCM corrections packet

12.10.35 Heave Packet

Heave Packet				
Packet ID				58
Length				16
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 78: Heave packet

12.10.36 Raw Satellite Data Packet

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

Raw Satellite Data Packet				
Packet ID				60
Length				16 + Satellites * (6 + Frequencies * 26)
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
6	14	u8	1	Total packets
7	15	u8	1	Number of satellites
For each satellite				
8	16	u8	1	Satellite system, see section 12.10.12.1
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				
13	22	u8	1	Satellite frequency, see section 12.10.36.1
14	23	u8	1	Tracking status, see 12.10.36.2
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 79: Raw satellite data packet

12.10.36.1 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
9			E5 b			
10			E5 a+b			

Table 80: Satellite frequencies

12.10.36.2 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 81: Tracking status

12.10.37 Raw Satellite Ephemeris Packet

GNSS Compass Manager will automatically convert this packet to RINEX 3.02 format. This packet has been left out of the reference manual due to it's length. If you need the format of this packet, please contact Advanced Navigation support.

12.10.38 GNSS Receiver Information Packet

GNSS Receiver Information Packet				
Packet ID				69
Length				48
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	GNSS manufacturer ID, see section 12.10.38.1
2	1	u8	1	GNSS receiver model, see section 12.10.38.2
3	2	s8[10]	10	GNSS serial number in ASCII character string
4	12	u32	4	Firmware version
5	16	u32[3]	12	Software license code
6	28	u32	4	Omnistar serial number
7	32	u32	4	Omnistar subscription start unix time
8	36	u32	4	Omnistar subscription expiry unix time
9	40	u8	1	Omnistar engine mode, see section 12.10.38.4
10	41	u8	1	RTK software license accuracy, see section 12.10.38.5
11	42		6	Reserved (set to zero)

Table 82: GNSS receiver information packet

12.10.38.1 GNSS Manufacturer IDs

Value	Description
0	GNSS Manufacturer Unknown
1	Trimble
2	u-blox

Table 83: GNSS manufacturer IDs

12.10.38.2 GNSS Receiver Models (Trimble)

Value	Description
0	GNSS Receiver Model Unknown
1	Trimble BD920
2	Trimble BD930
3	Trimble BD982
4	Trimble MB-One
5	Trimble MB-Two

Table 84: Trimble GNSS receiver models

12.10.38.3 GNSS Receiver Models (u-blox)

Value	Description
0	GNSS Receiver Model Unknown
1	u-blox M8
2	u-blox M8T
3	u-blox M8P

Table 85: u-blox GNSS receiver models

12.10.38.4 Omnistar Engine Modes

Value	Description
0	Omnistar engine not active
1	HP
2	XP
3	G2
4	HP+G2
5	HP+XP

Table 86: Omnistar engine modes

12.10.38.5 RTK Software License Accuracy

Value	Description
0	RTK accuracy unknown
1	0.3m horizontal, 0.3m vertical
2	0.07m horizontal, 0.07m vertical
3	0.07m horizontal, 0.02m vertical
4	0.008m horizontal, 0.07m vertical
5	0.008m horizontal, 0.02m vertical

Table 87: RTK software license accuracies

12.10.39 Automotive Packet

Automotive Packet				
Packet ID				73
Length				24
Field #	Bytes Offset	Data Type	Size	Description
1	0	fp32	4	Virtual odometer distance (m)
2	4	fp32	4	Slip Angle (rad)
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 88: Automotive packet

12.11 Configuration Packets

Configuration packets can be both read from and written to the device. 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).

12.11.1 Packets Period Packet

Packets Period Packet				
Packet ID				181
Length				2 + (5 x number of packet periods)
Field #	Bytes Offset	Data Type	Size	Description
1	0	u16	1	Flags, see section 12.11.1.1
2	2	u8	1	Packet ID
3	3	u32	4	Packet period, see section 12.11.1.3
+				Fields 2-34 repeat for additional packet periods

Table 89: Packets period packet

12.11.1.1 Flags

Bit	Description
0	Permanent
1-3	Port
4	Port field valid
5-7	Reserved
8	Clear existing packet periods, see section 12.11.1.2
9-15	Reserved

Table 90: Packet periods flags

12.11.1.2 Clear Existing Packets

This is a boolean field, when set to one it deletes any existing packet rates. When set to zero existing packet rates remain. Only one packet rate can exist per packet ID, so new packet rates will overwrite existing packet rates for the same packet ID.

12.11.1.3 Packet Period

This indicates the period in milliseconds. The packet rate can be calculated as follows.

Packet Rate = 1000/(Packet Period) Hz

For example setting packet ID 20 with a packet period of 50 will give the following.

Packet 20 Rate = 1000/(50)

Packet 20 Rate = 20 Hz

12.11.2 Baud Rates Packet

Baud Rates Packet				
Packet ID				182
Length				17
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Permanent
2	1	u32	4	Primary serial port baud rate (1200 to 1000000)
3	5	u32	4	Secondary serial port Baud Rate (1200 to 1000000)
4	9		8	Reserved (set to zero)

Table 91: Baud rates packet

12.11.3 Sensor Ranges Packet

Sensor Ranges Packet				
Packet ID				184
Length				4
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Permanent
2	1	u8	1	Accelerometers range, see section 12.11.3.1
3	2	u8	1	Gyroscopes range, see section 12.11.3.2
4	3	u8	1	Magnetometers range, see section 12.11.3.3

Table 92: Sensor ranges packet

12.11.3.1 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 93: Accelerometers range

12.11.3.2 Gyroscopes Range

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

Table 94: Gyroscopes range

12.11.3.3 Magnetometers Range

Value	**Description**
0	2 Gauss
1	4 Gauss
2	8 Gauss

Table 95: Magnetometers range

12.11.4 Installation Alignment Packet

Installation Alignment Packet				
Packet ID				185
Length				73
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]
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	Odometer offset X (m)
15	53	fp32	4	Odometer offset Y (m)
16	57	fp32	4	Odometer offset Z (m)
17	61	fp32	4	External data offset X (m)
18	65	fp32	4	External data offset Y (m)
19	69	fp32	4	External data offset Z (m)

Table 96: Installation alignment packet

12.11.4.1 Alignment DCM

The alignment DCM (direction cosine matrix) is used to represent an alignment offset of GNSS Compass from it's standard alignment. A DCM is used rather than euler angles for accuracy reasons. To convert euler angles to DCM please 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)

12.11.5 Filter Options Packet

Filter Options Packet				
Packet ID				186
Length				17
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Permanent
2	1	u8	1	Vehicle type, see section 12.11.5.1
3	2	u8	1	Internal GNSS enabled (boolean)
4	3	u8	1	Reserved (set to zero)
5	4	u8	1	Atmospheric altitude enabled (boolean)
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		9	Reserved (set to zero)

Table 97: Filter options packet

12.11.5.1 Vehicle Types

Value	Description
0	Unconstrained
1	Bicycle or Motorcycle
2	Car
3	Hovercraft
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 98: Vehicle types

12.11.6 Advanced Filter Parameters Packet

Please contact Advanced Navigation support.

12.11.7 Port Function Configuration Packet

Port Function Configuration Packet				
Packet ID				188
Length				13
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Permanent
2	1	u8	1	Port 1 transmit function see sections 12.11.7.1 and 12.11.7.2
3	2	u8	1	Port 1 receive function see sections 12.11.7.1 and 12.11.7.3
4	3	u8	1	Port 2 transmit function see sections 12.11.7.1 and12.11.7.2
5	4	u8	1	Port 2 receive function see sections 12.11.7.1 and 12.11.7.3
6	5	u8	1	Port 3 transmit function see sections 12.11.7.1 and 12.11.7.2
7	6	u8	1	Port 3 receive function see sections 12.11.7.1 and 12.11.7.3
8	7	u8	1	Port 4 transmit function see sections 12.11.7.1 and 12.11.7.2
9	8	u8	1	Port 4 receive function see sections 12.11.7.1 and 12.11.7.3
10	9		4	Reserved (set to zero)

Table 99: Port function configuration packet

12.11.7.1 Ports

Port	Ethernet Model	Serial Model
1	Port 1 function (default TCP 16718)	Reserved (set to zero)
2	Port 2 function (default TCP 16719)	Secondary 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 100: Ports mapping for the two models of GNSS Compass

12.11.7.2 Transmit Functions

Value	Description
0	Inactive
7	NMEA Output (default)
12	ANPP Output
39	TSS1 Output
40	Simrad 1000 Output
41	Simrad 3000 Output
42	Serial Port Pass-through

Table 101: Port transmit functions

12.11.7.3 Receive Functions

Value	Description
0	Inactive
6	NMEA Input
11	ANPP Input
19	RTCM Differential Corrections Input (default)
42	Serial Port Pass-through

Table 102: Port receive functions

12.11.8 Set Zero Orientation Alignment Packet

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

Table 103: Set zero orientation alignment packet

12.11.9 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. The primary reference point offset applies to all data output including NMEA etc as well as heave point 1. The other heave point offsets apply only to heave points 2-4 in the Heave Packet.

Reference Point Offsets Packet				
Packet ID				194
Length				49
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Permanent
2	1	fp32	4	Primary reference point offset X (m)
3	5	fp32	4	Primary reference point offset Y (m)
4	9	fp32	4	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 104: Reference point offsets packet

12.11.10 Port Output Configuration Packet

Port Output Configuration Packet				
Packet ID				195
Length				33
Field #	Bytes Offset	Data Type	Size	Description
1	0	u8	1	Permanent
2	1	u8	1	NMEA fix behaviour, see section 12.11.10.1
3	2	u16	2	GPZDA Rates, see section 12.11.10.2
4	4	u16	2	GPGGA Rates, see section 12.11.10.2
5	6	u16	2	GPVTG Rates, see section 12.11.10.2
6	8	u16	2	GPRMC Rates, see section 12.11.10.2
7	10	u16	2	GPHDT Rates, see section 12.11.10.2
8	12	u16	2	GPGLL Rates, see section 12.11.10.2
9	14	u16	2	PASHR Rates, see section 12.11.10.2
10	16	u16	2	TSS1 Rates, see section 12.11.10.2
11	18	u16	2	Simrad Rates, see section 12.11.10.2
12	20		13	Reserved (set to zero)

Table 105: GPIO output configuration packet

12.11.10.1 NMEA Fix Behaviour

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

Table 106: NMEA fix behaviour

12.11.10.2 Port Output Rates

Bit	Ethernet Model	Serial Model
0-3	Port 1 rate (default TCP 16718) see section 12.11.10.3	Reserved (set to zero)
4-7	Port 2 rate (default TCP 16719) see section 12.11.10.3	Secondary serial port rate see section 12.11.10.3
8-11	Port 3 rate (default TCP 16720) see section 12.11.10.3	Reserved (set to zero)
12-15	Port 4 rate (default TCP 16721) see section 12.11.10.3	Reserved (set to zero)

Table 107: Serial output rates

12.11.10.3 GPIO 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

Table 108: Serial output rates index

12.11.11 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
Field #	Bytes Offset	Data Type	Size	Description
1	0		64	User Data

Table 109: User data packet