SIMRAD

HS80A/MX575D GPS Compass

User Manual

ENGLISH



navico.com/commercial

Preface

Disclaimer

As Navico is continuously improving this product, we retain the right to make changes to the product at any time which may not be reflected in this version of the manual. Please contact your nearest distributor if you require any further assistance.

It is the owner's sole responsibility to install and use the equipment in a manner that will not cause accidents, personal injury or property damage. The user of this product is solely responsible for observing safe boating practices.

NAVICO HOLDING AS AND ITS SUBSIDIARIES, BRANCHES AND AFFILIATES DISCLAIM ALL LIABILITY FOR ANY USE OF THIS PRODUCT IN A WAY THAT MAY CAUSE ACCIDENTS, DAMAGE OR THAT MAY VIOLATE THE LAW.

Governing Language: This statement, any instruction manuals, user guides and other information relating to the product (Documentation) may be translated to, or has been translated from, another language (Translation). In the event of any conflict between any Translation of the Documentation, the English language version of the Documentation will be the official version of the Documentation.

This manual represents the product as at the time of printing. Navico Holding AS and its subsidiaries, branches and affiliates reserve the right to make changes to specifications without notice.

Compliance statements

Navico declare under our sole responsibility that the MX575D/HS80A conforms with the requirements of the European Council Directive 2014/90/EU on Marine Equipment modified by Commission Implementing Regulation MED (EU) 2018/773 - Wheelmark.

All compliance documents are available on the product's section on the following website:

www.navico.com/commercial

Copyright

Copyright © 2019 Navico Holding AS.

Warranty

The warranty card is supplied as a separate document.

In case of any queries, refer to the our website:
www.navico.com/commercial

About this manual

This manual is a reference guide for installing and using the HS80A/MX575D GPS compass systems.

The latest available manual version can be downloaded from our web sites.

Important text that requires special attention from the reader is emphasized as follows:

➔ ***Note:*** Used to draw the reader's attention to a comment or some important information.

> ⚠ **Warning:** Used when it is necessary to warn personnel that they should proceed carefully to prevent risk of injury and/or damage to equipment/ personnel.

Contents

5 Introduction
5 Overview
6 Parts list

7 Installation
7 Mounting location
8 Mounting orientation
10 Mounting options
15 Ports
19 Powering the Smart GPS compass
20 Connecting the Smart GPS compass to external devices
22 Default parameters

23 Operation
23 GPS overview
23 GLONASS overview
24 Smart GPS compass overview
27 Common commands and messages

32 Technical specifications
32 Specifications
33 Certifications
33 Proprietary Input data messages

40 Troubleshooting
42 List of abbreviations

43 Wiring diagrams
43 1PPS output
44 PC to GPS compass interface diagram
44 HS80A connection via the NMEA 2000 network

Introduction

Overview

The HS80A GPS compass and the MX575D DGPS compass are based upon a new generation GPS engine technology.



Figure 1-1: HS80A/MX575D side view

➔ ***Note:*** When referring to both the HS80A GPS compass and the MX575D DGPS compass this manual uses the term smart GPS compass. When referring to either product, this manual uses either HS80A or MX575D, respectively.

The smart GPS compass is a complete GPS heading and positioning system in a single enclosure that requires only one power/data cable connection. With its NMEA 2000/NMEA 0183 support and ease of installation, it is the perfect solution for marine applications.

The HS80A/MX575D is an integrated system that houses the following:

- New GPS + GLONASS engine technology
- Two Dual-Frequency GPS/GLONASS antennas
- Beacon receiver and H-field beacon antenna (MX575D only)
- Power supply
- Single axis gyro
- Tilt sensor on each axis (X and Y axes)

The gyro and tilt sensors are present in all models to improve system performance and to provide backup heading information in the event that GPS heading is not available due to signal blockage.

➔ ***Note:*** The HS80A GPS compass is identical to the MX575D DGPS compass with the exception that it does not contain a DGPS beacon receiver and H-field antenna. If you purchased the HS80A GPS compass, disregard the sections of this manual that discuss the beacon signal, receiver operation, and implications to installation relating to the beacon signal.

The new GPS engine technology supports multiple RF front ends - enabling tighter coupling of measurements from separate antennas for use in heading-based products. Users will achieve excellent accuracy and stability due to the more accurate code phase measurements, improved multipath mitigation, and fewer components.

The two smart GPS antennas are separated by 50 cm between their phase centers, resulting in +/- 0.5° RMS heading performance. The smart GPS compass provides heading and positioning updates of up to 25 Hz and delivers positioning accuracy of less than 1.0 m 95% of the time when using differential GPS corrections from beacon (MX575D only) or from Satellite Based Augmentation Systems (SBAS).

The smart GPS compass also features the GPS' exclusive COAST™ technology that enables the GPS receivers to utilize old differential GPS correction data for 40 minutes or more without significantly affecting the positioning quality. The MX575D is less likely to be affected by differential signal outages due to signal blockages, weak signals, or interference when using COAST.

Parts list

➔ ***Note:*** The HS80A/MX575D's parts comply with IEC 60945 Section 4.4: "exposed to the weather."

The sections below list parts included in your HS80A kit and the MX575D kit.

HS80A Parts list

Part Name	Qty	Part number
HS80A GPS compass	1	000-11643-001
Serial-to-NMEA 2000 adapter	1	000-10941-001
Manual	1	988-10221-002
Kit containing the following:		
• Clamp	1	
• Screw	1	
• Washer	1	
• Pole mount bracket with screws	1	
Optional items		
15 meter Power/data cable		000-10939-001
30 meter antenna cable		000-10940-001

MX575D Parts list

Part Name	Qty	Part number
MX575D DGPS compass	1	000-11644-001
Power/data cable, 15 m	1	000-10939-001
Manual	1	988-10221-002
Kit containing the following:		
• Clamp	1	
• Screw	1	
• Washer	1	
• Pole mount bracket with screws	1	
Optional items		
Serial-to-NMEA 2000 adapter		000-10941-001
30 meter antenna cable		000-10940-001

2 Installation

Mounting location

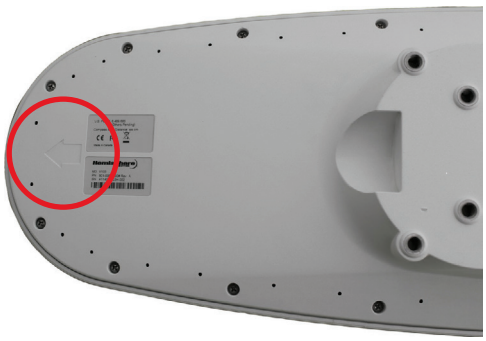
This section provides information on determining the best location for the Smart GPS compass.

- Mount the Smart GPS compass 10 meters (min.) forward of main mast.
- Mount the Smart GPS compass at least 10 meters away from and out of the transmitting beam of radar, INMARSAT and other high-power transmitters.
- Mount the Smart GPS compass 3 meters away from VHF antennas.
- Maintain a distance of min. 1 meter between two Smart GPS compasses and other GPS antennas.

GPS reception

When considering where to mount the Smart GPS compass, consider the following GPS reception recommendations:

- Consider GPS reception, ensuring there is a clear view of the sky available to the Smart GPS compass so the GPS satellites are not masked by obstructions that may reduce system performance
- Since the Smart GPS compass computes a position based on the internal primary GPS antenna element, mount the Smart GPS compass where you desire a position with respect to the primary GPS antenna (located at the end opposite the recessed heading arrow on the underside of the enclosure).



- Locate any transmitting antennas away from the GPS compass by at least a few meters to ensure tracking performance is not compromised, giving you the best performance possible
- Make sure there is enough cable length to route into the vessel to reach a breakout box or terminal strip
- Do not locate the antenna where environmental conditions exceed those specified in "Environmental" on page 33.

Beacon reception

When using the MX575D internal beacon receiver as the correction source, consider the possible mounting locations from the perspective of ambient noise within the beacon band (300 KHz).

Keep the following in mind when deciding upon a location with respect to maximizing beacon performance:

- Ensure that the antenna is as far as possible from all other equipment that emits electromagnetic interference (EMI) such as DC motors, alternators, solenoids, radio transmitters, power cables, display units, and other electronic devices.
- If you are installing the antenna on a vessel, mount the MX575D considering maintenance and accessibility. In addition, ensure that the antenna is not obscured by the metal mast, guy wires or metal railings on the vessel.
- If radar(s) or INMARSAT system is present, mount the GPS compass antenna outside the path of the transmission beam.

The MX575D's internal beacon receiver calculates a signal-to-noise ratio (SNR), measured in

decibels (dB) that indicates the receiver's performance. The SNR is the level of the signal above the noise floor: the higher the SNR, the better your beacon receiver demodulates the signal. The optimum antenna location will be a position where your average SNR is highest. You should turn on all accessories that you intend to use during normal operation when locating the best position for the antenna. By monitoring the SNR, you can determine the optimum location with respect to beacon reception. The SNR is available in the Satellite/DGPS display.

Environmental considerations

The Smart GPS compass is designed to withstand harsh environmental conditions, however, adhere to the following limits when storing and using the GPS compass:

- Operating temperature: -30°C to +70°C (-22°F to +158°F)
- Storage temperature: -40°C to +85°C (-40°F to +185°F)
- Humidity: 95% non-condensing

Interference

VHF interference from such devices as cellular phones and radio transmitters may interfere with GPS operation. For example, if installing the Smart GPS compass near marine radios consider the following:

- VHF marine radio working frequencies (Channels 1 to 28 and 84 to 88) range from 156.05 to 157.40 MHz. The GPS working center frequency is 1575.42 MHz. The bandwidth is +/- 2 MHz to +/- 10 MHz, which is dependent on the GPS antenna and receiver design.
- VHF marine radios emit strong harmonics. The 10th harmonic of VHF radio, in some channels, falls into the GPS working frequency band, which may cause the SNR of GPS to degrade significantly.
- The radiated harmonic signal strength of different brands/models varies.
- Follow VHF radio manufacturers' recommendations on how to mount their radios and what devices to keep a safe distance away.
- Handheld 5 W VHF radios may not provide suitable filtering and may interfere with the Smart GPS compass's operation if too close.

→ ***Note:*** Powerful Xenon-Arc search lights emit electromagnetic radiation, which may interfere with communication and navigation systems on board. The preferred location for the GPS antenna is at least 3 meters above the search light.

Before installing the Smart GPS compass ensure there are no nearby devices that may cause VHF interference.

Mounting orientation

The smart GPS compass outputs heading, pitch, and roll readings regardless of the orientation of the antennas. However, the relation of the antennas to the boat's axis determines whether you will need to enter a heading, pitch, or roll bias. The primary antenna is used for positioning and the primary and secondary antennas, working in conjunction, output heading, pitch, and roll values.

→ ***Note:*** Regardless of which mounting orientation you use, the Smart GPS compass provides the ability to output the heave of the vessel. This output is available via the $GPHEV message.

Parallel orientation

The most common installation is to orient the Smart GPS compass parallel to, and along the centerline of the axis of the boat. This provides a true heading. In this orientation:

- If you use a gyrocompass, you can enter a heading bias in the Smart GPS compass to calibrate the physical heading to the true heading of the vessel.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Smart GPS compass is not installed in a horizontal plane.

Perpendicular orientation

You can also install the antennas so they are oriented perpendicular to the centerline of the boat's axis. In this orientation:

- You will need to enter a heading bias of +90° if the primary antenna is on the starboard side of the boat and -90° if the primary antenna is on the port side of the boat.
- You will need to configure the receiver to specify the GPS antennas are measuring the roll axis using $JATT,ROLL,YES.
- You will need to enter a roll bias to properly output the pitch and roll values.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.

Figure 2-2 and Figure 2-3 provide mounting orientation examples.

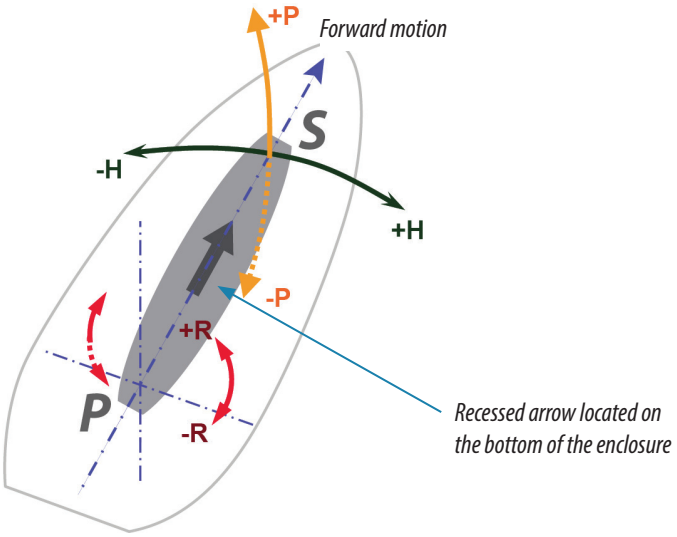


Figure 2-2: Recommended orientation and resulting signs of HPR values

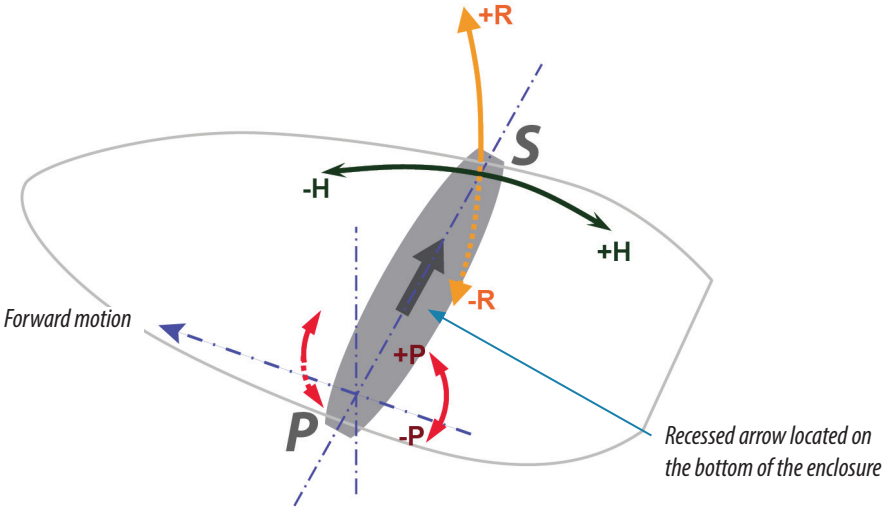


Figure 2-3: Alternate orientation and resulting signs of HPR values

Smart GPS compass alignment

The top of the Smart GPS compass enclosure incorporates sight design features to help you align the enclosure with respect to an important feature on your vessel.

To use the sights, center the small post on the opposite side of the enclosure from you, within the channel made in the medallion located in the center of the enclosure top as shown in Figure 2-4 and Figure 2-5. Alignment accuracy when looking through the long site (Figure 2-4) is approximately +/- 1°, while alignment through the short site (Figure 2-5) is approximately +/- 2.5°.



Figure 2-4: Long sight alignment



Figure 2-5: Short sight alignment

If you have another accurate source of heading data on your vessel, such as a gyrocompass, you may use its data to correct for a bias in Smart GPS compass alignment within the Smart GPS compass software configuration. Alternatively, you can physically adjust the heading of the Smart GPS compass so that it renders the correct heading measurement, however, adding a software offset is an easier process.

Mounting options

The Smart GPS compass allows for two different mounting options: flush mount and pole mount.

- Flush mount - The bottom of the Smart GPS compass contains eight M8-1.25 holes for flush mounting the unit to a flat surface (see Figure 2-6). The eight holes comprise two sets of four holes. The inner four holes are in the same location as the HS70, allowing you to use the Smart GPS compass as a drop-in replacement. The outer four holes provide a wider mounting option.
- Pole mount - Attach the included pole mount bracket to the bottom of the Smart GPS compass with the included screws. Hand tighten until snug (do not over tighten). The set screws on the long sides of the base (see middle drawing in Figure 2-6) allow you to secure the Smart GPS compass in place (3/16" Allen wrench not included).

Smart GPS compass dimensions

Figure 2-6 illustrates the physical dimensions of the Smart GPS compass.

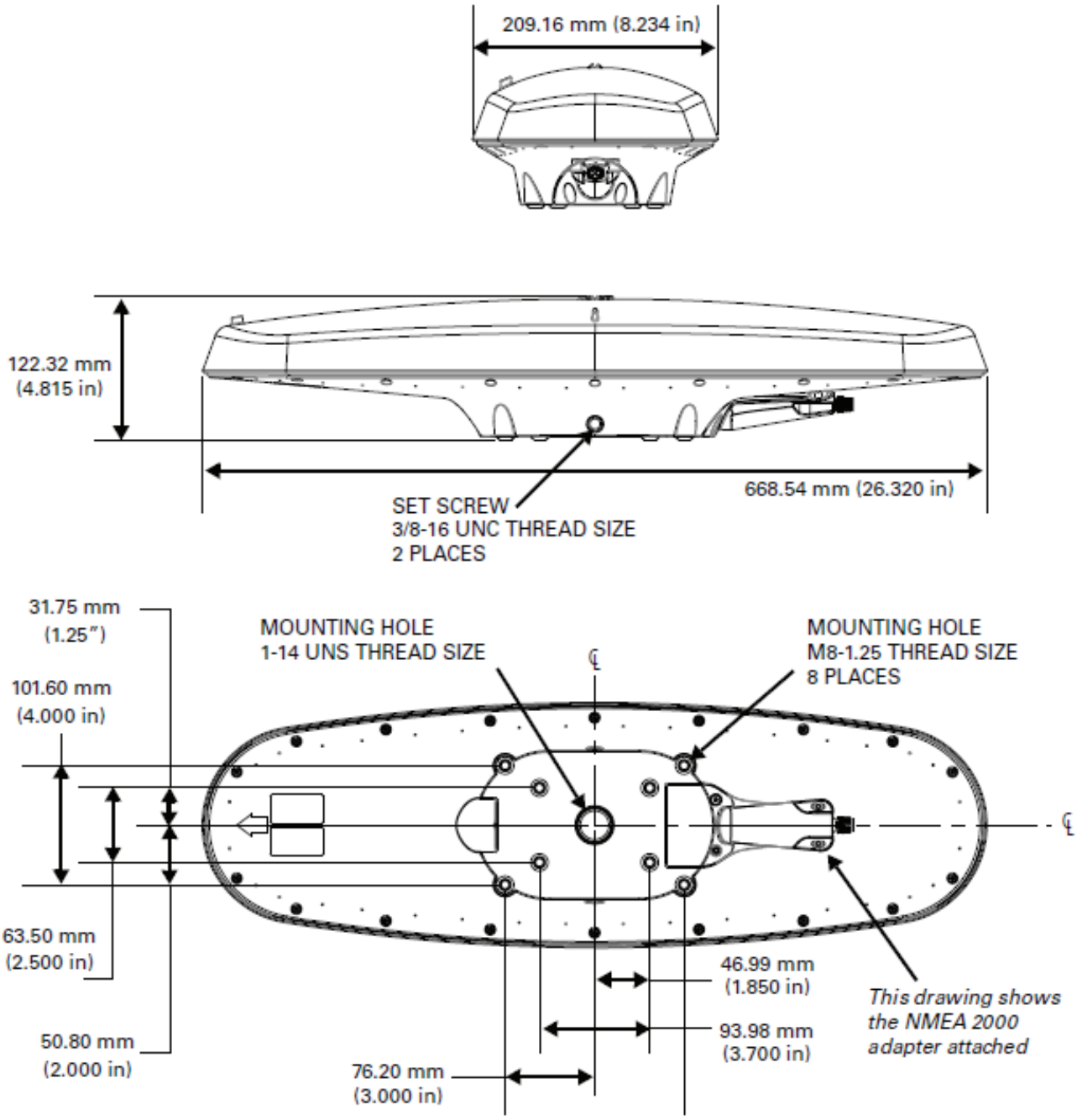


Figure 2-6: HS80A/MX575D Smart GPS compass dimensions

Power/Data cable considerations

Before mounting the Smart GPS compass consider the following regarding power/data cable routing:

- Cable must reach an appropriate power source.
- Cable may connect to a data storage device, computer, or other device that accepts GPS data.
- Avoid running the cable in areas of excessive heat.
- Keep cable away from corrosive chemicals.
- Do not run the cable through door or window jams.
- Keep cable away from rotating machinery.
- Do not crimp or excessively bend the cable.
- Avoid placing tension on the cable.
- Remove unwanted slack from the cable at the Smart GPS compass end.
- Secure along the cable route using cable ties.

> ⚠ **Warning:** Improperly installed cable near machinery can be dangerous.

Mounting the Smart GPS compass

This section describes how to flush mount or pole mount the Smart GPS compass. Keep the following in mind when planning your installation:

- SIMRAD does not supply mounting surface hardware or a mounting pole. You must supply the appropriate hardware or mounting pole required to complete Smart GPS compass installation.
- You do not necessarily need to orient the antenna precisely as you can enter a software offset to accommodate for a heading measurement bias due to installation.

Flush mounting the Smart GPS compass

The bottom of the Smart GPS compass contains eight holes (two sets of four holes) for flush mounting the unit to a flat surface (Figure 2-7). The flat surface may be something you fabricate per your installation, an off-the-shelf item (such as a radar mounting plate), or an existing surface on your vessel.

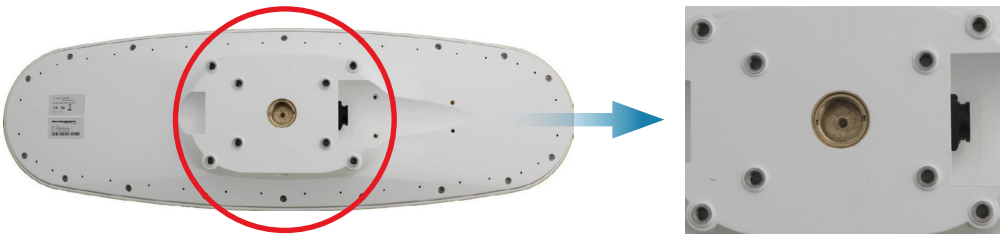


Figure 2-7: Flush mounting holes on bottom of Smart GPS compass

Complete the following steps to flush mount the Smart GPS compass:

1. Determine the desired location and proper orientation for the Smart GPS compass. See "Mounting orientation" on page 8 for information on determining the desired orientation.
2. Use the supplied template or photocopy the section of the Smart GPS compass that contains the eight mounting holes (see Figure 2-7) for use as a template to plan the mounting hole locations. Use the inner four holes or the outer four holes per your installation.

   If using a photocopy make sure it is scaled one-to-one with the mounting holes on the bottom of the Smart GPS compass.
3. Mark the mounting hole centers on the mounting surface.
4. Place the Smart GPS compass over the marks to ensure the planned hole centers align with the true hole centers (adjusting as necessary).

5. Use a center punch to mark the hole centers.
6. Drill the mounting holes with a 9 mm bit appropriate for the surface.
7. Place the Smart GPS compass over the mounting holes and insert the mounting screws through the bottom of the mounting surface and into the Smart GPS compass.

> ⚠ **Warning:** When installing the Smart GPS compass, hand tighten only. Damage resulting from over tightening is not covered by the warranty.

Pole mounting the Smart GPS compass

If you need the GPS-assisted roll measurement, install the Smart GPS compass perpendicular to the vessel's axis. If you do not need this measurement, install the Smart GPS compass parallel with the vessel's axis. For more information refer to "Figure 2-2: Recommended orientation and resulting signs of HPR values" on page 9 and "Figure 2-3: Alternate orientation and resulting signs of HPR values" on page 9.

Complete the following steps to pole mount the Smart GPS compass:

1. Attach the pole mount bracket to the bottom of the GPS compass using the four (4) M8 screws and washers included in the package.
2. Hand tighten the Smart GPS compass on the pole until snug (unit is stable on pole) while ensuring correct orientation.
3. Determine the desired location and proper orientation for the Smart GPS compass. See "Mounting orientation" on page 8 for information on determining the desired orientation.

> ⚠ **Warning:** Hand tighten only. Damage resulting from over tightening is not covered by the warranty.

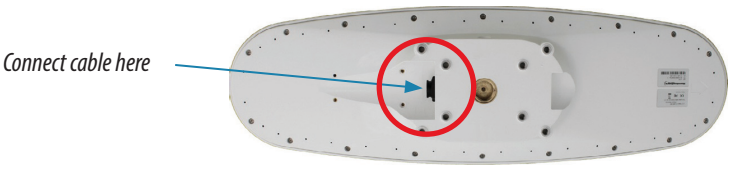
4. Use the set screws on the long sides of the base (see "Figure 2-6: HS80A/MX575D Smart GPS compass dimensions" on page 11) to secure the Smart GPS compass in place (3/16" Allen wrench not included).

Connecting the serial cable or Serial-to-NMEA 2000 adapter to the Smart GPS compass

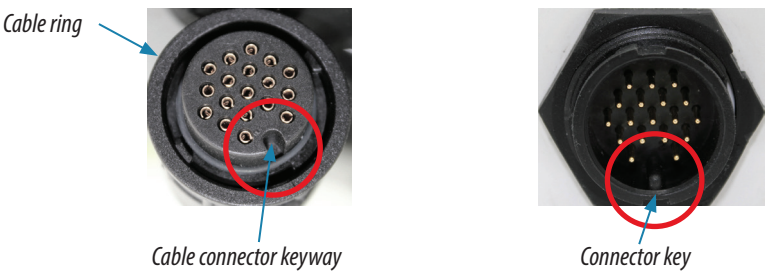
After you mount the Smart GPS compass, connect either the serial power/data cable or the serial-to-NMEA 2000 adapter to the Smart GPS compass.

Connecting the serial Power/Data cable

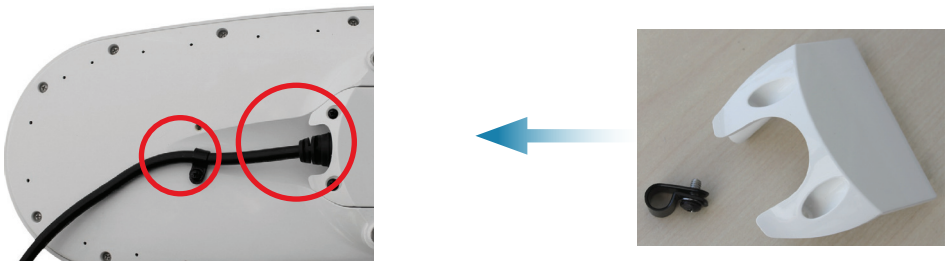
1. Align the cable connector keyway with the Smart GPS compass connector key



2. Rotate the cable ring clockwise until it locks. The Locking action is firm; you will feel a positive "click" when it has locked.



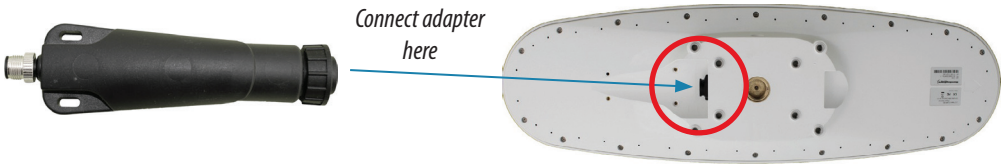
3. Attach the power/data cable to the cable clamp.
4. Fasten the clamp to the bottom of the Smart GPS compass using the screw and washer.
5. Attach the cable cover.



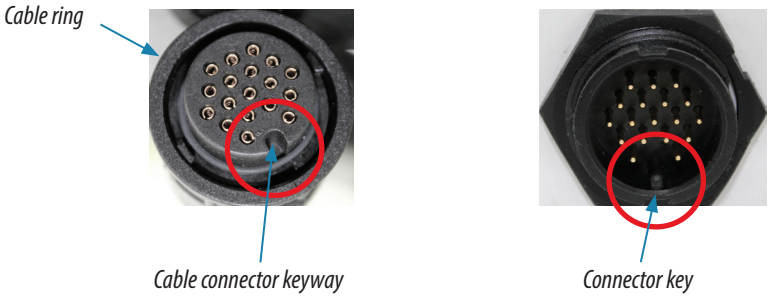
Connecting the Serial-to-NMEA 2000 adapter

For more information on the serial-to-NMEA 2000 adapter see "NMEA 2000 port" on page 16. This adapter is an optional item for the MX575D model.

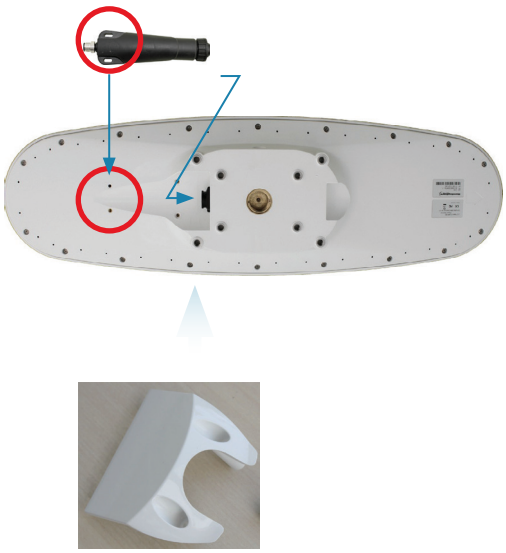
1. Align the adapter connector keyway with the Smart GPS compass connector key.



2. Rotate the cable ring clockwise until it locks. The locking action is firm; you will feel a positive "click" when it has locked.



3. Fasten the adapter to the body of the Smart GPS compass using the provided screws and the two slots in the adapter.
4. Attach the cable cover.



Ports

The Smart GPS compass offers either NMEA 0183 serial port or NMEA 2000 port functionality.

Serial ports

The Smart GPS compass has three ports (Port A, Port B, and Port C), where:

- Port A can be both full-duplex RS-232 and half-duplex RS-422 (transmit only)
- Port B is full-duplex RS-422
- Port C is for NMEA 2000 and only available via serial-to-NMEA 2000 adapter

You can receive external differential corrections via either Port A (full-duplex RS-232) or Port B (full-duplex RS-422). You can connect up to three devices at one time using two ports. One device can receive data via Port A (RS-422 transmit only) while two devices can transmit and receive data via Ports A and B (one connected to Port A RS-232 and one connected to Port B).

➔ ***Notes:***

1. Port A (RS-422) or Port B is required for communicating to an IMO type-approved device.
2. You can update firmware via Port A (RS-232) or Port B.

➔ ***Note:*** The MX575D has maximum baud rate of 38400. Higher baud rates may impair beacon signal tracking.

Serial port configuration

You may configure Port A or Port B of the GPS receiver to output any combination of data. Port A can have a different configuration from Port B in terms of data message output, data rates, and the baud rate of the port. This allows you to configure the ports independently based upon your needs.

For example, if you want one generalized port and one heading-only port, you can configure the ports as follows:

- Port A to have GPGGA, GPVTG, GPGSV, GPZDA, and GPHDT all output at 1 Hz over a 9600 baud rate.
- Port B for GPHDT and GPROT message output at their maximum rate of 25 Hz over a 19200 baud rate.

The messages you configure each port to output and the rate of the port will be the same for both RS-232 and RS-422 interface levels. For example, the RS-232 Port A and RS-422 Port A output the same data messages at the same baud rate. If the baud rate or messages for the RS-422 port need to be changed, this needs to be commanded through the RS-232 port.

Both RS-232 and RS-422 output signals may be used simultaneously.

➔ ***Note:*** When the smart GPS compass is connected to Port 3 & 4 of the CDU or junction box, a command signal that configures the smart GPS compass will be sent to set it to 19,200 baud and turn on only the required NMEA sentences.

Selecting baud rates and message types

When selecting your baud rate and message types use the following formula to calculate the bits/sec for each message and then sum the results to determine the baud rate for your required data throughput.

Message output rate * Message length (bytes) * bits in byte = Bits/second

(1 character = 1 byte, 8 bits = 1 byte, use 10 bits/byte to account for overhead)

See "Common commands and messages" on page 27 for an example of this calculation.

Recommendations for connecting to other devices

When interfacing to other devices, ensure the transmit data output from the Smart GPS compass is connected to the data input of the other device. The signal grounds must also be connected.

Since RS-422 is a balanced signal with positive and negative signals referenced to ground, ensure you maintain the correct polarity. For example, when connecting the transmit data output positive signal to the receive line of the other device, it should be connected to the receive positive terminal. The negative transmit data signal from the Smart GPS compass is then connected to the receive data negative input of the other device.

There is likely little reason to connect the receive data input of the Smart GPS compass to another device unless it is able to send configuration commands to the Smart GPS compass. Since the Smart GPS compass uses proprietary NMEA 0183 commands for control over its configuration, the vast majority of electronics will not be able to configure its settings unless the other device has a terminal setting where you can manually issue commands.

NMEA 2000 port

To use the HS80A for NMEA 2000 interface, you need to use the Serial-to-NMEA 2000 adapter (P/N 710-0113-000#, see Figure 2-8). This adapter is optional item for the MX575D model. Insert the 18-pin connector of the adapter into the male end of the 18-pin connector on the HS80A by aligning the keys. You can then attach the adapter to the unit using the supplied screws (machine, 8-32, ½", PPHC, SS) and washer (washer, flat, #8, SS). The 5-pin male Micro-C connector connects to your NMEA 2000 drop cable.



Figure 2-8: Serial-to-NMEA 2000 adapter

The MX575D DGPS compass model is supplied with 15 meter interface cable for NMEA 0183 interface connection. An optional 30 meter NMEA 0183 interface cable can be ordered separately. The NMEA 2000 interface adapter is another option for the MX575D.

➔ ***Note:*** The serial-to-NMEA 2000 adapter is not an IMO requirement and may not be used in such an application.

Received messages based on a request

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
059392	ISO Acknowledgement Used to acknowledge the status of certain requests addressed to a specific ECU.	B	On Request	On Request
059904	ISO Request Request the transmission of a specific PGN, addressed or broadcast.	B	On Request	On Request
060928	ISO Address Claim Used to identify to other ECUs the address claimed by an ECU.	B	On Request	On Request
126996	Product Information NMEA 2000 database version supported, manufacturer's product code, NMEA 2000 certification level, Load Equivalency number, and other product- specific information.	B	On Request	On Request
126464	Receive/Transmit PGNs group function The Transmit / Receive PGN List Group type of function is defined by first field. The message will be a Transmit or Receive PGN List group function.	B	On Request	On Request
129538	GNSS Control Status GNSS common satellite receiver parameter status.	B	On Request	On Request
129545	GNSS RAIM Output Used to provide the output from a GNSS receiver's Receiver Autonomous Integrity Monitoring (RAIM) process. The Integrity field value is based on the parameters set in PGN 129546 GNSS RAIM Settings.	B	On Request	On Request
129546	GNSS RAIM Settings Used to report the control parameters for a GNSS Receiver Autonomous Integrity Monitoring (RAIM) process.	B	On Request	On Request

Transmitted messages

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
126992	System Time The purpose of this PGN is twofold: To provide a regular transmission of UTC time and date. To provide synchronism for measurement data.	B	1000	1
127250	Vessel Heading Heading sensor value with a flag for True or Magnetic. If the sensor value is Magnetic, the deviation field can be used to produce a Magnetic heading, and the variation field can be used to correct the Magnetic heading to produce a True heading.	B	100	10
127251	Rate of Turn Rate of change of the Heading.	B	100	10
127257	Attitude Provides a single transmission that describes the position of a vessel relative to both horizontal and vertical planes. This would typically be used for vessel stabilization, vessel control and onboard platform stabilization.	B	1000	1
127258	Magnetic Variation Message for transmitting variation. The message contains a sequence number to allow synchronization of other messages such as Heading or Course over Ground. The quality of service and age of service are provided to enable recipients to determine an appropriate level of service if multiple transmissions exist.		1000	1
129025	Position, Rapid Update Provides latitude and longitude referenced to WGS84. Being defined as single frame message, as opposed to other PGNs that include latitude and longitude and are defined as fast or multi- packet, this PGN lends itself to being transmitted more frequently without using up excessive bandwidth on the bus for the benefit of receiving equipment that may require rapid position updates.	B	100	10
129026	COG & SOG, Rapid Update Single frame PGN that provides Course Over Ground (COG) and Speed Over Ground (SOG).	B	250	4
129027	Position Delta, High Precision Rapid Update The "Position Delta, High Precision Rapid Update" Parameter Group is intended for applications where very high precision and very fast update rates are needed for position data. This PGN can provide delta position changes down to 1 mm with a delta time period accurate to 5 msec.	B	100	10

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
129028	Altitude Delta, High Precision Rapid Update The "Altitude Delta, High Precision Rapid Update" Parameter Group is intended for applications where very high precision and very fast update rates are needed for altitude and course over ground data. This PG can provide delta altitude changes down to 1 millimeter, a change in direction as small as 0.0057°, and with a delta time period accurate to 5 msec.	B	100	10
129029	GNSS Position Data Conveys a comprehensive set of Global Navigation Satellite System (GNSS) parameters, including position information.	B	1000	1
129033	Time & Date Single transmission that provides UTC time, UTC Date, and Local Offset.	B	1000	1
129539	GNSS DOPs Provides a single transmission containing GNSS status and dilution of precision components (DOP) that indicate the contribution of satellite geometry to the overall positioning error. There are three DOP parameters reported: horizontal (HDOP), Vertical (VDOP), and time (TDOP).	B	1000	1
129540	GNSS Sats in View GNSS information on current satellites in view tagged by sequence ID. Information includes PRN, elevation, azimuth, SNR, defines the number of satellites; defines the satellite number and the information.	B	1000	1

Powering the Smart GPS compass

Power considerations

For best performance use a clean and continuous 12-24 VDC power supply. The Smart GPS compass power supply circuit features reverse polarity protection, but will not operate with reverse polarity.

See "Power" on page 33 for complete power specifications.

Connecting to a power source

➔ ***Note:*** This section refers to powering the MX575D unit via the serial cable connection. The HS80A power is taken from the NMEA 2000 main buss. Follow the standard procedure for powering up via NMEA 2000.

Before you power up the Smart GPS compass you must terminate the wires of the power cable as required. There are a variety of power connectors and terminals on the market from which to choose from, depending on your specific requirements.

> ⚠ **Warning:** Do not apply voltage higher than 36 VDC. This will damage the receiver and void the warranty.

To interface the Smart GPS compass power cable to the power source:

- Connect the red wire of the cable's power input to DC positive (+)
- Connect the black wire of the cable's power input to DC negative (-)

The Smart GPS compass will start when an acceptable voltage is applied to the power leads of the extension cable.

Electrical isolation

The Smart GPS compass's power supply circuit is isolated from the communication lines and the PC-ABS plastic enclosure isolates the electronics mechanically from the vessel (addressing the issue of vessel hull electrolysis).

Connecting the Smart GPS compass to external devices

➔ ***Note:*** This section refers to a serial connection. For connecting external NMEA 2000 devices, plug the serial-to-NMEA 2000 adapter into the HS80A and then attach a standard NMEA 2000 drop line cable to the adapter.

➔ ***Note:*** The NMEA (N2K) adapter is not included as standard accessory of the MX575D model.

Power/Data cable considerations

The MX575D uses a single 15 m (49 ft) or optional 30 m (98 ft) cable for power and data input/output. This cable is optional for HS80A

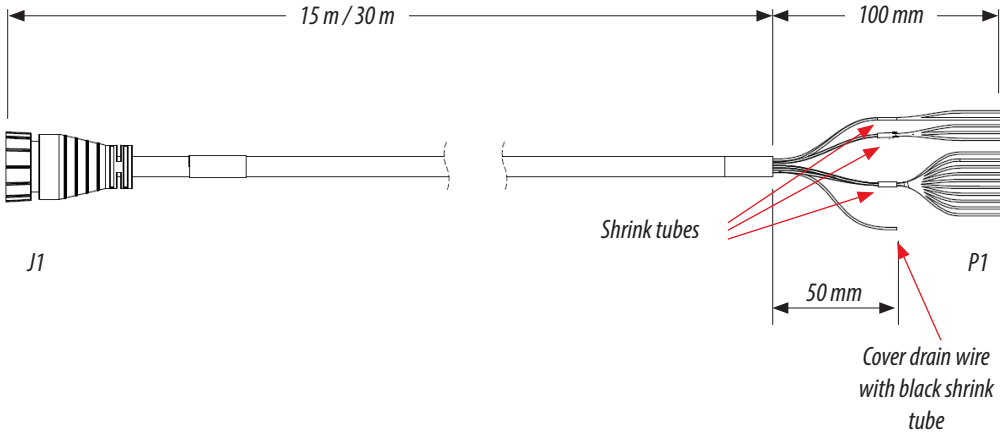


Figure 2-9: Power/Data cable, 15m or 30m

The receiver end of the cable is terminated with an environmentally sealed 18-pin connector while the opposite end is not terminated and requires field stripping and tinning.

Depending on the application and installation needs, you may need to shorten this cable. However, if you require a longer cable run than 30 m, you can bring the cable into a break-out box that incorporates terminal strips.

When lengthening the cable keep the following in mind:

- To lengthen the serial lines inside the vessel, use 0.5 mm^2/20-gauge twisted pairs and minimize the additional wire length.
- When lengthening the power input leads to the Smart GPS compass, ensure the additional voltage drop is small enough that your power system can continue to power the system above the minimum voltage of the system. Wires of 0.75 mm^2/18-gauge or larger should also be used.
- Minimize RS-232 cable length to ensure reliable communication.
- Use similar color-coded wires whenever possible.

Power/Data cable pin out specifications

Figure 2-10 shows the power/data cable pin out, and the table shows the cable's pin out specifications.

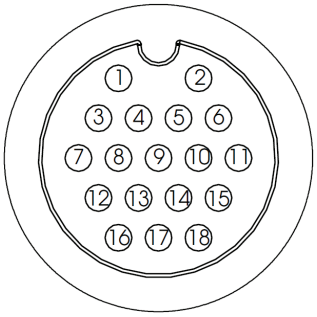


Figure 2-10: Power/data cable pin assignment

Pin	Function	Wire Color
1	Power (+)	Red
2	Power (-)	Black
3	Port A Tx of RS-232	Blue
4	Port A Rx of RS-232	Black/blue stripe
5	Reserved	
6	Port A Tx of RS-422 (+)*	Green
7	Port B Rx of RS-422 (+), control input	Brown
8	Port B Rx of RS-422 (-), control input	Black/brown stripe
9	Reserved	
10	Drain	Bare wire
11	Port A Tx of RS-422 (-)*	Green/black stripe
12	Signal ground	Grey
13	Alarm, relay contact	White
14	Alarm, relay contact	White/red stripe
15	1 PPS (+)	Orange
16	Port B Tx of RS-422 (+)**	Yellow
17	Port B Tx of RS-422 (-)**	Yellow/black stripe
18	1 PPS (-)	Orange/black stripe

➔ ***Notes:***

* Port A is normally used for beacon status or fast heading output.
** Port B is normally used for GPS and heading data output.

Default parameters

The table below provides details on certain default parameters. Contact your dealer for default port settings for your unit.

➔ ***Note:*** Use the $JSAVE command to save changes you make to the Smart GPS compass's configuration for the changes to be present in subsequent power cycles.

Unit	Parameter	Specification
HS80A and MX575D	Max DGPS age (correction age)	2700 seconds
	Elevation mask	5°
	Differential mode	HS80A: SBAS MX575D: Beacon and SBAS
MX575D (internal beacon parameters)	Frequency selection	Automatic
	MSK rate selection	Automatic

3 Operation

GPS overview

When referring to the two D/GPS compass models, HS80A and MX575D, this manual uses the general term "smart GPS compass". Specific model number will be called when describing a particular feature or operation that is unique to that model. The HS80A is GPS + GLONASS only, while the MX575D is GPS + GLONASS + beacon differential.

When the smart GPS compass is powered for the first time, it performs a 'cold start' that involves acquiring the available GPS satellites in view and the land-based beacon DGPS service for the MX575D. External source of RTCM SC-104 differential corrections can also be used in lieu of the built-in beacon receiver. If you use an external source of correction data, it must support an eight data bit, no parity, one stop bit configuration (8-N-1).

GPS operation

The GPS receiver is always operating, regardless of the DGPS operation mode. The following sections describe general operation of the Smart GPS compass's internal GPS receiver.

→ ***Note:*** Differential source and status have no impact on heading, pitch, or roll. They only have an impact on positioning and heave.

GLONASS overview

GLONASS is a global satellite navigation system developed by the Soviet Union, providing real-time position and velocity determination for military and civilian users. The GLONASS satellites are located in orbits at 25,510 km altitude with a 64.8 degree inclination. GLONASS' orbit makes it especially suited for use in high latitudes (north or south), where getting a GPS signal can be problematic. The constellation operates in three orbital planes, with 8 evenly spaced satellites on each plane. A fully operational constellation with global coverage consists of 24 satellites. To get a position fix the receiver must be in the range of at least four satellites.

Combining the GPS and GLONASS systems provides the following advantages:

- Better signal acquisition times.
- Better position and time accuracy.
- Reduces the risk of losing signals when passing under bridges or tall constructions.
- Better satellite geometry resulting in better HDOP.

Automatic tracking

The Smart GPS compass receiver automatically searches for GPS (and GLONASS) satellites, acquires the signals, and manages the navigation information required for positioning and tracking.

Receiver performance

The Smart GPS compass works by finding four or more GPS satellites in the visible sky. It uses information from these satellites to compute a position within 4.0 m. Since there is some error in the GPS data calculations, the Smart GPS compass also tracks a differential correction. The Smart GPS compass uses these corrections to improve its position accuracy to better than 1.0 m.

The two main aspects of GPS receiver performance are:

1. Satellite acquisition, and
2. Positioning and heading calculation.

The satellites transmit coded information to the Smart GPS compass antennas on a specific frequency. This allows the receiver to calculate a range to each satellite from both antennas. GPS/GLONASS is essentially a timing system. The ranges are calculated by timing how long it takes for the signal to reach the antenna. The GPS receiver uses a complex algorithm incorporating satellite locations and ranges to each satellite to calculate the geographic location and heading. Reception of any four or more GPS signals allows the receiver to

compute three-dimensional coordinates and a valid heading.

Differential operation

The purpose of differential GPS (DGPS) is to remove the effects of selective availability (SA), atmospheric errors, timing errors, and satellite orbit errors, while enhancing system integrity. Autonomous positioning capabilities of the Smart GPS compass will result in positioning accuracies of 4.0 m 95% of the time. In order to improve positioning quality to better than 1.0 m 95%, the Smart GPS compass is able to use differential corrections received through the internal beacon receiver (for MX575D), SBAS demodulator or through externally-supplied RTCM corrections.

SBAS tracking

The HS80A can scan and track SBAS signals without the need to tune the receiver. The HS80A features two-channel tracking that provides an enhanced ability to maintain a lock on an SBAS satellite when more than one satellite is in view. This redundant tracking approach results in more consistent tracking of an SBAS signal in areas where signal blockage of a satellite is possible. The MX575D is configured to receive beacon DGPS corrections. However, it can also be configured to receive SBAS or external RTCM corrections from the SIMRAD-MX CDU.

Beacon operation

Many marine authorities have installed networks of radio beacon stations that broadcast DGPS corrections to users of this system. With the increasing utility of these networks for terrestrial applications, there is an increasing trend toward densification of these networks inland. The dual channel beacon receiver in the MX575D can operate in manual or automatic tuning mode, or, using database mode, which will select the closest station in compliance with IEC 61108-4 standards. The MX575D is configured to receive DGPS corrections from beacon stations by default.

Smart GPS compass overview

The Smart GPS compass provides accurate and reliable heading and position information at high update rates. To accomplish this task, the Smart GPS compass uses a high performance GPS receiver and two antennas for GPS signal processing. One antenna is designated as the primary GPS antenna and the other is the secondary GPS antenna. Positions computed by the Smart GPS compass are referenced to the phase center of the primary GPS antenna. Heading data references the vector formed from the primary GPS antenna phase center to the secondary GPS antenna phase center.

The heading arrow located on the bottom of the Smart GPS compass enclosure defines system orientation. The arrow points in the direction the heading measurement is computed (when the antenna is installed parallel to the fore-aft line of the vessel). The secondary antenna is directly above the arrow.

Fixed baseline moving base station RTK

The Smart GPS compass's internal GPS receiver uses both the L1 GPS C/A code and carrier phase data to compute the location of the secondary GPS antenna in relation to the primary GPS antenna with a very high sub-centimeter level of precision. The technique of computing the location of the secondary GPS antenna with respect to the primary antenna, when the primary antenna is moving, is often referred to as moving base station Real Time Kinematic (or moving base station RTK).

Generally, RTK technology is very sophisticated and requires a significant number of possible solutions to be analyzed where various combinations of integer numbers of L1 wavelengths to each satellite intersect within a certain search volume. The integer number of wavelengths is often referred to as the "ambiguity" as they are initially ambiguous at the start of the RTK solution.

The Smart GPS compass restricts the RTK solution. It does this knowing that the secondary GPS antenna is 50 cm from the primary GPS antenna. This is called a fixed baseline and it defines the search volume of the secondary antenna as the surface of a sphere with radius 50 cm centered on the location of the primary antenna (see Figure 3-1).

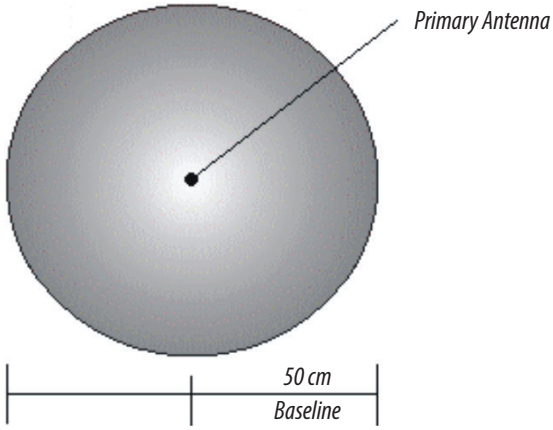


Figure 3-1: Secondary antenna's search volume

➔ ***Note:*** The Smart GPS compass moving base station algorithm only uses GPS to calculate heading. Differential corrections are not used in this calculation and will not affect heading accuracy.

Supplemental sensors

The Smart GPS compass has three supplemental sensors (gyro and two tilt sensors) that are integrated into the unit's main PCB. The supplemental sensors are enabled by default. You can enable/disable the gyro and both tilt sensors (you cannot enable/disable each tilt sensor separately).

The sensors act to reduce the RTK search volume, which improves heading startup and re-acquisition times. This improves the reliability and accuracy of selecting the correct heading solution by eliminating other possible, erroneous solutions.

Sensor operation summary

Feature	Normal Operation	Coasting (no GPS)
Heading	GPS	Gyro
Heave	GPS	None
Pitch	GPS	Inertial tilt sensor
Roll	Inertial sensor	Inertial tilt sensor

Tilt aiding

The Smart GPS compass's accelerometers (internal tilt sensors) are factory calibrated and enabled by default. This constrains the RTK heading solution beyond the volume associated with just a fixed antenna separation. This is because the Smart GPS compass knows the approximate inclination of the secondary antenna with respect to the primary antenna. The search space defined by the tilt sensor will be reduced to a horizontal ring on the sphere's surface by reducing the search volume.

This considerably decreases instances of incorrect headings as well as startup and reacquisition times (see Figure 3-2).

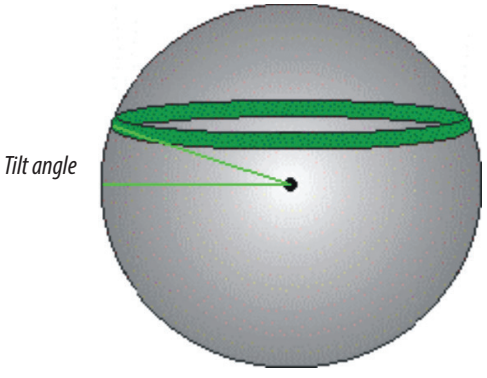


Figure 3-2: Smart GPS compass' tilt aiding

Gyro aiding

The Smart GPS compass's internal gyro offers several benefits. It reduces the sensor volume for an RTK solution. This shortens reacquisition times when a GPS heading is lost because the satellite signals were blocked. The gyro provides a relative change in angle since the last computed heading, and, when used in conjunction with the tilt sensor, defines the search space as a wedge-shaped location (see Figure 3-3).

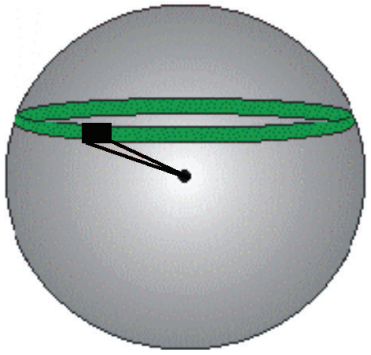


Figure 3-3: Smart GPS compass's gyro aiding

The gyro aiding accurately smooth the heading output and the rate of turn. It provides a substitute heading for a short period, accurate to within 1º per minute for up to three minutes, in times of GPS loss for either antenna. If the outage lasts longer than three minutes, the gyro will have drifted too far and the Smart GPS compass begins outputting null fields in the heading output messages. There is no user control over the timeout period of the gyro.

Calibration, which is set at the factory, is required for the gyro to remove latency from the heading solution as well as provide backup heading when GPS is blocked. The receiver will calibrate itself after running for a while, but it may be important to follow the manual calibration instructions, if you want to guarantee performance quickly after powering up the receiver.

The gyro initializes itself at power up and during initialization. There is no need for manual calibration. When the gyro is first initializing, it is important that the dynamics that the gyro experiences during this warm up period are similar to the regular operating dynamics. For example, if you use the Smart GPS compass on a high speed, maneuverable craft, it is recommended that when gyro aiding in the Smart GPS compass is first turned on, use it in an environment that has high dynamics for the first five to ten minutes instead of sitting stationary.

With the gyro enabled, the gyro is also used to update the post HTAU smoothed heading output from the moving base station RTK GPS heading computation. This means that if the HTAU value is increased while gyro aiding is enabled, there will be little to no lag in heading output due to vehicle maneuvers.

Time constants

The Smart GPS compass incorporates user-configurable time constants that can provide a degree of smoothing to the heading, pitch, rate of turn (ROT), course over ground (COG), and speed measurements. You can adjust these parameters depending on the expected dynamics of the vessel. For example, increasing the time is reasonable if the vessel is very large and is not able to turn quickly or would not pitch quickly. The resulting values would have reduced 'noise,' resulting in consistent values with time. However, if the vessel is quick and nimble, increasing this value can create a lag in measurements. The level of smoothing may be adjusted manually, but if you are unsure on how to set this value, it is best to be conservative and leave it at the default setting.

➔ ***Note:*** For heading and rate of turn there is no lag once the gyro is calibrated and enabled.

Heading time constant

Use the $JATT,HTAU command to adjust the level of responsiveness of the true heading measurement provided in the $GPHDT message. The default value of this constant is 10.0 seconds of smoothing when the gyro is enabled. The gyro is enabled by default, but can be

turned off. By turning the gyro off, the equivalent default value of the heading time constant would be 0.5 seconds of smoothing. This is not automatically done and therefore you must manually enter it. Increasing the time constant increases the level of heading smoothing and increases lag only if the gyro is disabled.

Pitch time constant

Use the $JATT,PTAU command to adjust the level of responsiveness of the pitch measurement provided in the $PSAT,HPR message. The default value of this constant is 0.5 seconds of smoothing. Increasing the time constant increases the level of pitch smoothing and increases lag.

Rate of Turn (ROT) time constant

Use the $JATT,HRTAU command to adjust the level of responsiveness of the ROT measurement provided in the $GPROT message. The default value of this constant is 2.0 seconds of smoothing. Increasing the time constant increases the level of ROT smoothing.

Course Over Ground (COG) time constant

Use the $JATT,COGTAU command to adjust the level of responsiveness of the COG measurement provided in the $GPVTG message. The default value of this constant is 0.0 seconds of smoothing. Increasing the time constant increases the level of COG smoothing. COG is computed using only the primary GPS antenna and its accuracy depends upon the speed of the vessel (noise is proportional to 1/speed). This value is invalid when the vessel is stationary, as tiny movements due to calculation inaccuracies are not representative of a vessel's movement.

Speed time constant

Use the $JATT,SPDTAU command to adjust the level of responsiveness of the speed measurement provided in the $GPVTG message. The default value of this constant is 0.0 seconds of smoothing. Increasing the time constant increases the level of speed measurement smoothing.

Alarm functionality

➔ ***Note:*** Alarm functionality is only valid for serial communication.

A relay is located on the Smart GPS compass' circuit board. The relay contacts are isolated from all circuitry. When heading is valid, the relay contacts remain closed, completing the circuit as an indication that the Smart GPS compass is operational. If the unit loses power or heading, the coil voltage is lost and the relay opens and activates the notification method employed by the user.

➔ ***Note:*** Alarm pins must be connected to an IMO type-approved device.

Alarm signal

There are two wires (24 AWG multi-strands) on the output cable that are used for the external alarm function. The color codes for the two wires are white and white/red stripe and are the output of a relay. When this relay closes, the connection is complete on the user-defined external notification device.

Watchdog

The watchdog is a timer that is controlled by the software that monitors if the heading is lost. The watchdog software is compliant with IEC 60495.

Common commands and messages

➔ ***Note:*** When selecting your baud rate and message types, use the following formula and example to calculate the bits/sec for each message and then sum the results to determine the baud rate for your required data throughput. Transmitting the commands listed in "Commands" on page 28 and monitoring the messages in "NMEA 0183 and other messages" on page 29 requires that the PC serial communication port be connected to the RS-232 interface wires of the 18-Pin antenna cable of the MX575D (see "PC to GPS compass interface diagram" on page 44). The HS80A requires this optional cable.

Message output rate * Message length (bytes) * bits in byte = Bits/second
(1 character = 1 byte, 8 bits = 1 byte, use 10 bits/byte to account for overhead)

Example:

Message	Rate	Bytes	Bits in byte	Bits/sec
GPHDT	10	20	10	2000
GPROT	5	18	10	900
GPHDG	1	33	10	330
GPGGA	1	83	10	830
GPZDA	1	38	10	380
			Total	**4440**

The next sections provides brief descriptions of common commands and messages for the Smart GPS compass.

Commands

Command	Description
$GPMSK	Tune beacon to specific frequency
$JAGE	Specify maximum DGPS (COAST) correction age (6 to 8100 seconds)
$JAPP	Query or specify receiver application firmware
$JASC	Specify ASCII messages to output to specific ports (see ASCII messages in Table 3-3)
$JBAUD	Specify RS-232, RS-422 (output) communication rate
$JBIN	Specify binary messages to output to specific ports (see Table 3-4)
$JDIFF	Query or specify differential correction mode
$JGEO	Query or specify SBAS for current location and SBAS satellites
$JI	Query unit's serial number and firmware versions
$JOFF	Turn off all data messages
$JQUERY,GUIDE	Query accuracy suitability for navigation
$JRESET	Reset unit's configuration to firmware defaults → ***Note:*** $JRESET clears all parameters. For the Smart GPS compass you will have to issue the $JATT, FLIPBRD, YES command to properly redefine the circuitry orientation inside the product once the receiver has reset. Failure to do so will cause radical heading behavior. You can also issue the $JRESET command with an optional field as follows: • $JRESET,ALL does everything $JRESET does, plus it clears almanacs • $JRESET,BOOT does everything $JRESET,ALL does, plus clears use of the real-time clock at startup, clears use of backed-up ephemeris and almanacs, and reboots the receiver when done
$JSAVE	Save session's configuration changes

In Table 3-3 the Info Type value is one of the following:

- P = Position
- V = Velocity, Time
- H = Heading, Attitude
- S = Sats, Stats, Quality

NMEA 0183 and other messages

Message	Info Type	Max Output Rate	Description	IEC Approved Message
$GPDTM	P	1 Hz	Datum reference	Yes
$GPGGA	P	25 Hz	GPS position and fix data	Yes
$GPGLL	P	25 Hz	Geographic position - lat/long	Yes
$GPGNS	P	25 Hz	GNSS position and fix data	Yes
$GPGRS	S	1 Hz	GNSS range residual (RAIM)	Yes
$GPGSA	S	1 Hz	GNSS DOP and active satellites	Yes
$GPGST	S	1 Hz	GNSS pseudo range error statistics and position accuracy	Yes
$GPGSV	S	1 Hz	GNSS satellites in view	Yes
*$GPHDG	H	25 Hz	Provides magnetic deviation and variation for calculating magnetic or true heading *see last bullet in Note at end of this table	Yes
*$GPHDM	H	25 Hz	Magnetic heading (based on GPS-derived heading and magnetic declination) *see last bullet in Note at end of this table	No
*$GPHDT	H	25 Hz	GPS-derived true heading *see last bullet in Note at end of this table	Yes
$GPHEV	H	25 Hz	Heave value (in meters)	Yes
$GPRMC	P	25 Hz	Recommended minimum specific GNSS data	Yes
*$GPROT	H	25 Hz	GPS-derived rate of turn (ROT) *see last bullet in Note at end of this table	Yes
$GPRRE	S	1 Hz	Range residual and estimated position error	Yes
$GPVTG	V	25 Hz	COG and ground speed	Yes
$GPZDA	V	25 Hz	Time and date	Yes
$PASHR	H	25 Hz	Time, heading, roll, and pitch data in one message	No
$PSAT,GBS	S	1 Hz	Satellite fault detection (RAIM)	Yes
$PSAT,HPR	H	25 Hz	Proprietary NMEA message that provides heading, pitch, roll, and time in single message	No
$PSAT,INTLT	H	1 Hz	Proprietary NMEA message that provides the pitch and roll measurements from the internal inclinometers (in degrees)	Yes
$RD1	S	1 Hz	SBAS diagnostic information	Yes
$TSS1	H	25 Hz	Heading, pitch, roll, and heave message in the commonly used TSS1 message format	No

→ ***Notes:***

- The "GP" of the message is the talker ID.
- GPGRS, GPGSA, GPGST, and GPGSV support external integrity checking. They are to be

synchronized with corresponding fix data (GPGGA or GPGNS).

- You can change the message header for the HDG, HDM, HDT, and ROT messages to either GP or HE using the $JATT,NMEAHE command.
  - To preface these messages with GP, issue the following command: $JATT,NMEAHE,0<CR><LF>
  - To preface these messages with HE, issue the following command: $JATT,NMEAHE,1<CR><LF>

Binary messages

$JBIN Message	Description
1	GPS position
2	GPS DOPs
80	SBAS
93	SBAS ephemeris data
94	Ionosphere and UTC conversion parameters
95	Satellite ephemeris data
96	Code and carrier phase
97	Processor statistics
98	Satellites and almanac
99	GPS diagnostics

Parameters specific to $JATT command

Parameter	Description	Query	Specify
COGTAU	Set/query COG time constant (0.0 to 3600.0 sec)	X	X
CSEP	Query antenna separation	X	
EXACT	Enable/disable internal filter reliance on the entered antenna separation	X	X
FLIPBRD	Turn the flip feature on/off. Default is Yes (On). If performing a factory reset verify this is on.	X	X
GYROAID	Enable/disable gyro	X	X
HBIAS	Set/query heading bias (-180.0º to 180.0º)	X	X
HELP	Show the available commands for GPS heading operation and status	X	
HIGHMP	Set/query the high multipath setting for use in poor		
GPS environments	X	X	
HRTAU	Set/query ROT time constant (0.0 to 3600.0 sec)	X	X
HTAU	Set/query heading time constant (0.0 to 3600.0 sec)	X	X
LEVEL	Enable/disable level operation	X	X
MSEP	Manually set or query antenna separation	X	X
NEGTILT	Enable/disable negative tilt	X	X
NMEAHE	Change the HDG, HDM, HDT, and ROT message headers between GP and HE	X	X
PBIAS	Set/query pitch/roll bias (-15.0º to 15.0º)	X	X
PTAU	Set/query pitch time constant (0.0 to 3600.0 sec)	X	X
ROLL	Configure for roll or pitch GPS orientation	X	X
SEARCH	Force a new GPS heading search		X

SPDTAU	Set/query speed time constant (0.0 to 3600.0 sec)	X	X
SUMMARY	Display current Crescent Vector settings summary	X	
TILTAID	Enable/disable accelerometer, pre-calibrated		X
TILTCAL	Calibrate accelerometers		X

4 Technical specifications

Specifications

GPS sensor

Item	Specification
Model#	**HS80A/MX575D**
Receiver type	L1 GPS and GLONASS C/A code
Channels	Two 270-channel, parallel tracking
SBAS tracking	2-channel, parallel tracking
Update rate	25 Hz (heading)
Horizontal accuracy	< 1.0 m 95% confidence (DGPS) < 4.0 m 95% confidence (autonomous, no SA)
Heading accuracy	< 0.5° RMS Normal operation: GPS Coasting (no GPS): Gyro
Heave accuracy	< 30 cm RMS Normal operation: GPS Coasting (no GPS): None
Pitch accuracy	< 1° RMS Normal operation: GPS Coasting (no GPS): Inertial sensor
Roll accuracy	< 1° RMS using accelerometer Normal operation: Inertial sensor Coasting (no GPS): Inertial sensor
Rate of turn	90°/s maximum
Cold start	< 60 s typical (no almanac or RTC)
Warm start	< 20 s typical (almanac and RTC)
Hot start	< 10 s typical (almanac, RTC, and position)
Heading fix	< 10 s typical (valid position)
Compass safe distance	75 cm (29.5 in)4
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288 m (60,000 ft)
Timing (1PPS) Accuracy	50 ns

Communication

Item	Specification
	HS80A/MX575D
Serial ports	1 RS-232 (full-duplex) 2 RS-422 (1 full duplex, 1 half duplex)
Baud rates	HS80A/ MX575D: 4800, 9600, 19200, 38400
Correction I/O protocol	RTCM SC-104
Data I/O protocol	NMEA 0183, NMEA 2000

Power

Item	Specification	
	HS80A/MX575D	
Input voltage	6 to 36 VDC	
Power consumption	3 W nominal	
Current consumption	HS80A	MX575D
	320 mA @ 9 V DC	350 mA @ 9 V DC
	240 mA @ 12 V DC	265 mA @ 12 V DC
	180 mA @ 16 V DC	200 mA @ 16 V DC
Power isolation	Isolated to enclosure	
Reverse polarity protection	Yes	

Mechanical

Item	Specification	
Enclosure	UV resistant, white plastic, AES HW 600G, non-corrosive, self-extinguishing	
Dimensions	668.54 L x 209.16 W x 122.32 H (mm) 26.320 L x 8.234 W x 4.815 H (in)	
Weight	HS80A 2.131 kg (4.70 lb)	MX575D 2.44 kg (5.38 lb)

Environmental

Item	Specification
Operating temperature	-30°C to +70°C (-22°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing
Vibration	IEC 60945
EMC	FCC Part 15, Subpart B; CISPR22; IEC 60945 (CE)

Certifications

Navico declare under our sole responsibility that this product conforms with the requirements of the European Council Directive 2014/90/EU on Marine Equipment modified by Commission Implementing Regulation MED (EU) 2018/773 - Wheelmark.

All compliance documents are available on the product's section on the following website:
www.navico.com/commercial

Proprietary Input data messages

The table below gives a list of the available proprietary input messages and their description:

Message type	Description
$PMVXG,303	RESET CONTROL
$PMVXG,026	NMEA MESSAGE SCHEDULE
$PMVXG,200	SET PORT CONFIGURATION
$PCSI	BEACON PCB CONTROL
$GPMSK,305	BEACON AUTO/MANUAL CONTROL

$JSAVE	SAVES ALL CHANGED PARAMETERS
$JDIFF	CONTROLS THE DIFFERENTIAL BEACON RECEIVER
$JSHOW	SHOWS ALL GPS AND BEACON PARAMETERS

Sentence type - $PMVXG,303

Description: Reset Control

This message allows the user to command various types of resets to the Smart GPS compass.

Flow: Input

$PMVXG,303 – Reset Control				
Field	Description	Units	Format	Range
1	Reset Control		Int	**0.** No Action **1.** Reset Serial I/O to Factory Default Settings. **2.** Resets GPS Parameters to Factory Default settings, User I/O Settings Remain **3.** Resets GPS Parameters to Factory Default Settings, I/O Settings Return to Factory Defaults. **4.** Reset All Parameters Except the Oscillator Model
2	NULL			

Example:

$PMVXG,303,3*57

$PMVXG,303,4*50

Sentence type - $PMVXG,026

Description: NMEA Message Schedule

This message enables/disables output of the specified sentence to the NMEA port and defines the output rate.

Flow: Input

$PMVXG,026 – NMEA Schedule				
Field	Description	Units	Format	Range
1	Equipment Port Output Block Example "GGA"		Char	Default = None
2	Clear Current List		Int	0 = NO 1 = YES Default = None
3	Add/Delete Sentence From List		Int	1 = Append Sentence to Output List 2 = Delete Sentence From Output List Default = None
4	Sentence Output Rate	Sec	Float	>0 = Output Period -1 = When new Data is Available
5	Position Precision (number of decimal units in position output)		Int	2-6 Default = 2
6	Null			

Example:

```
$PMVXG,026,HDT,0,1,1,,*
$PMVXG,026,ROT,0,1,1,,*
$PMVXG,026,VTG,0,1,5,5,*
```

Sentence type: $PMVXG,200

Description: Set Port Configuration

This message sets the transmission rate, number of data bits, and parity convention for each of the serial interface ports.

Flow: Input

$PMVXG,200 – PORT CONFIGURATION				
Field	Description	Units	Format	Range
1	Serial Port		Int	0 = Current Port 1 = Port 1 2 = Port 2 Default:
2	Baud Rate		Int	5 = 4800 6 = 9600 7 = 19200 Default:
3	Stop Bits		Int	1 = 1 Stop Bit 2 = 2 Stop Bits Default:
4	Pacing Mode		Int	0 = None 1 = XON/XOFF 2 = CTS/RTS Default:
5	Parity		Int	0 = No Parity 1 = Even Parity 2 = Odd Parity Default:
6	Serial Port Output Format		Int	0 = None 1 = MX LB2 2 = Auxiliary LB2 4 = RTCM Output 10 = Primary NMEA 11 = Auxiliary NMEA Default:
7	Serial Port Input Format		Int	1 = MX LB2 2 = Aux. LB2 4 = RTCM Input 10 = NMEA Input 11 = Aux NMEA Default:

Example:

```
$PMVXG,200,1,6,,,10,10*61
$PMVXG,200,1,7,,,,,*60
```

Sentence type: $GPMSK

Description: Beacon tune command

There are three main derivatives of this command that affects the method of beacon receiver tuning, and each are described in the following sections.

Full manual command ($GPMSK):

This command instructs the MX575D's internal beacon receiver to tune to a specified frequency and MSK Rate.

It has the following form:

$GPMSK,fff.f,M,ddd,M,n<CR><LF>

The internal SBX will reply with the following response:

$PCSI,ACK,GPMSK,fff.f,M,ddd,M,n<CR><LF>

When this message is acknowledged by the internal beacon receiver, it will immediately tune to the frequency specified and demodulate at the rate specified.

Field	Description
fff.f	Frequency in kHz (283.5 to 325)
M	Designates manual frequency selection
ddd	MSK bit rate (100 or 200 bps)
M	Designates manual MSK bit rate selection
n	Period of output of performance status message, 0 to 100 seconds ($CRMSS)

Example:

$GPMSK,305,M,,A,,,*

$GPMSK,305,,A,,A,,,*

Partial manual tune command ($GPMSK):

This command instructs the internal beacon receiver to tune to a specified frequency and automatically select the correct MSK rate.

It has the following form:

$GPMSK,fff.f,M,,A,n<CR><LF

The internal SBX will reply with the following response:

$PCSI,ACK,GPMSK,fff.f,M,,A,n<CR><LF>

When this message is acknowledged by the internal beacon receiver, it will immediately tune to the frequency specified and demodulate at the rate specified.

Field	Description
fff.f	Frequency in kHz (283.5 to 325)
M	Designates manual frequency selection
ddd	MSK bit rate (100 or 200 bps)
A	Designates Automatic MSK bit rate selection
n	Period of output of performance status message, 0 to 100 seconds ($CRMSS)

Automatic beacon search command ($GPMSK,305):

This command initiates the beacon receiver to automatic mode of operation in which the receiver operates without operator intervention, selecting the most appropriate beacon station.

This command has the following format:

```
$GPMSK,305,A,,A,,,<CR><LF>
```

The internal beacon receiver will reply with the following response:

```
$PCSI,ACK,GPMSK,,A,,A,n<CR><LF>
```

Field	Description
A1	Automatic Frequency selection Mode
A2	Designates Automatic rate selection
null	

The Smart GPS compass provides the above response to this variety of $GPMSK message, and immediately tunes to the optimum beacon station in automatic mode, provided a valid beacon almanac is present in receiver memory. Without a valid almanac, the beacon receiver will perform a Global Search to identify candidate stations in the area, followed by the acquisition phase of the initial search.

Beacon database search mode ($GPMSK,305):

This operating mode has been added to the MX575D beacon receiver in order to be compliant with the specification IEC 61108-4 for ship borne DGPS maritime radio beacon receiver equipment.

The basic operation is outlined below.

1. The receiver will determine the 10 closest beacon stations after the GPS receiver has calculated a valid position fix. The list can be accessed using the command $PCSI,3,2*.
2. The primary beacon channel tries to tune to the closest available station, using the frequency and bit rate specified in the station database.
3. The background channel tunes to the frequency of the closest station using an alternate bit rate.
4. The primary channel retunes to the alternate bit rate if lock is achieved on the background channel (with acceptable station health and WER).
5. The background channel continually searches for a closer station using the station database once a lock is achieved on the primary channel.
6. The primary channel will remain tuned to the same station unless one of the following occurs:
   - Word error rate (WER) drops below 10%
   - Station becomes unhealthy or unmonitored
   - Background channel finds a closer station
   - Position changes enough to affect station list.

This command has the following format:

```
$GPMSK,305,D,,D<CR><LF>
```

Sentence type: $JSHOW

Description: Command to show its current configuration.

This command is used to poll the Smart GPS compass receiver for its current configuration.

This command has the following structure.

```
$JSHOW[,subset] <CR><LF>
```

Using the $JSHOW command without the optional ',subset' field will provide a complete response from the receiver. An example of this response follows.

```
$>JSHOW,BAUD,9600 (1)
$>JSHOW,BAUD,9600,OTHER (2)
$>JSHOW,ASC,GPGGA,1.0,OTHER (3)
$>JSHOW,ASC,GPVTG,1.0,OTHER (4)
$>JSHOW,ASC,GPGSV,1.0,OTHER (5)
$>JSHOW,ASC,GPGST,1.0,OTHER (6)
$>JSHOW,ASC,D1,1,OTHER (7)
$>JSHOW,DIFF,WAAS (8)
$>JSHOW,ALT,NEVER (9)
$>JSHOW,LIMIT,10.0 (10)
$>JSHOW,MASK,5 (11)
$>JSHOW,POS,51.0,-114.0 (12)
$>JSHOW,AIR,AUTO,OFF (13)
$>JSHOW,FREQ,1575.4200,250 (14)
$>JSHOW,AGE,1800 (15)
```

This example response is summarized in the following table.

Line	Description
1	This line indicates that the current port is set to a baud rate of 9600
2	This line indicates that the other port is set to a baud rate of 9600
3	This line indicates that GPGGA is output at a rate of 1 Hz from the other port
4	This line indicates that GPVTG is output at a rate of 1 Hz from the other port
5	This line indicates that the GPGSV is output at a rate of 1 Hz from the other port
6	This line indicates that GPGST is output at a rate of 1 Hz from the other port
7	This line indicates that D1 is output at a rate of 1 Hz from the other port
8	This line indicates that the current differential mode is WAAS
9	This line indicates the status of the altitude aiding feature
10	This line indicates the threshold of estimated differential performance that allows the green DGPS LED to illuminate (on the Mini MAX only)
11	This line indicates the current elevation mask cutoff angle, in degrees
12	This line indicates the current seed position used for startup, in decimal degrees
13	This line indicates the current status of the AIR mode
14	This line indicates the current frequency of the L-band receiver
15	This line indicates the current maximum acceptable differential age in seconds

When issuing this command with the optional, 'subset' data field (without the square brackets), a one-line response is provided. The subset field maybe either CONF or GP.

When CONF is specified for 'subset', the following response is provided.

```
$>JSHOW,CONF,N,0.0,10.0,5,A,60W
```

This response is summarized in the following table.

Message Component	Description
$>JSHOW,CONF	Message header
N	N 'N' indicates no altitude aiding

0.0	'0.0' indicates the aiding value, if specified (either specified height or PDOP threshold)
10.0	Residual limit for the $JLIMIT command
5	Elevation mask cutoff angle, in degrees
A	AIR mode indication
60	Maximum acceptable age of correction data in seconds
W	Current differential mode, 'W' indicates WAAS mode

When GP is specified for 'subset', the following is an example response provided:

```
$>JSHOW,GP,GGA,1.0
```

This response will provide the >$JSHOW,GP message header, followed by each message currently being output through the current port and also the update rate for that message.

Sentence type: $JDIFF

Description: Beacon receiver differential mode

This command is used to change the differential mode of the receiver. The default differential mode is Auto/Database.

This command has the following structure.

```
$JDIFF,diff<CR><LF>
```

Where the differential mode variable, 'diff', has one of the following values:

```
$JDIFF,diff<CR><LF>
```

Values	Description
OTHER	Specifying OTHER instructs the receiver to use external corrections input through the opposite port from which you are communicating
BEACON	Specifying BEACON instructs the receiver to use corrections from the internal SBX beacon engine
WAAS	Specifying WAAS instructs the receiver to use SBAS corrections
LBAND	Specifying LBAND instructs the receiver to use OmniSTAR corrections.
AUTODIFF	Specifying AUTODIFF instructs the receiver to use eDif mode
NONE	In order for the receiver to operate in autonomous mode, the NONE argument may be specified in this command.

Example:

```
$JDIFF,BEACON*
$JDIFF,LBAND*
$JDIFF,WAAS*
```

5 Troubleshooting

Table A-1 provides troubleshooting for common problems.

Table A-1: Troubleshooting

Symptom	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connectors • Check power input voltage (6 to 36 VDC) • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from HS80A (N2K Network connection)	• Check N2K connectivity using the Device List from the CDU. • Check integrity and connectivity of power and data cable connections
No data from MX575D (NMEA -0183 connection)	• Check receiver power status to ensure the receiver is powered (an ammeter can be used for this) • Verify desired messages are activated (using the CDU or $JSHOW command in any terminal program) • Ensure the baud rate of the smart GPS compass matches that of the receiving device • Check integrity and connectivity of power and data cable connections
Random data from smart GPS compass	• Verify the RTCM or binary messages are not being output accidentally (send a $JSHOW command) • Ensure the baud rate of the smart GPS compass matches that of the remote device • Potentially, the volume of data requested to be output by the smart GPS compass could be higher than the current baud rate supports (try using 19200 as the baud rate for all devices or reduce the amount of data being output)
No GPS lock	• Verify the smart GPS compass has a clear view of the sky • Verify the lock status of GPS satellites (this can be done with using the MFD or CDU)
No SBAS lock	• Verify the smart GPS compass has a clear view of the sky • Verify the lock status of SBAS satellites (this can be done using the CDU) • Set SBAS mode to automatic with the $JWAASPRN,AUTO command → ***Note:*** SBAS lock is only possible if you are in an appropriate SBAS region; currently, there is limited SBAS availability in the southern hemisphere.

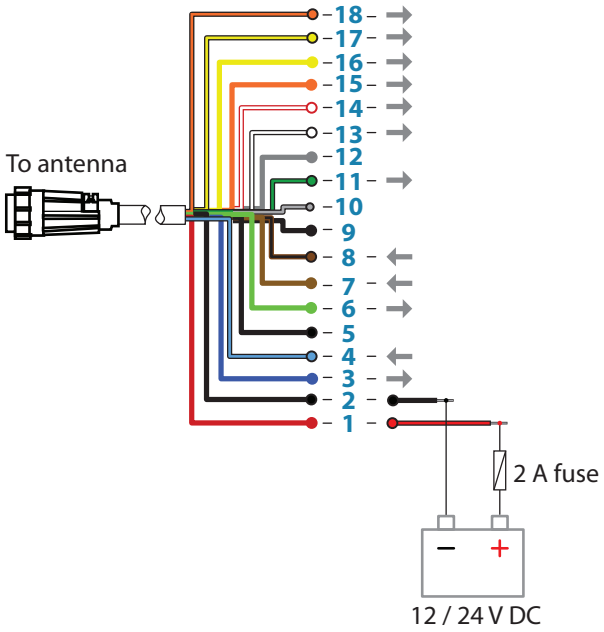
Symptom	Possible Solution
No heading or incorrect heading value	• Check CSEP value is fairly constant without varying more than 1 cm (0.39 in)—larger variations may indicate a high multipath environment and require moving the receiver location • Heading is from primary GPS antenna to secondary GPS antenna, so the arrow on the underside of the smart GPS compass should be directed to the bow side • $JATT,SEARCH command forces the smart GPS compass to acquire a new heading solution (unless gyro is enabled) • Enable GYROAID to provide heading for up to three minutes during GPS signal loss • Enable TILTAID to reduce heading search times • Monitor the number of satellites and SNR values for both antennas using the CDU—at least four satellites should have strong SNR values • Potentially, the volume of data requested to be output by the smart GPS compass could be higher than the current baud rate supports (try using 19200 as the baud rate for all devices or reduce the amount of data being output)
No DGPS position in external RTCM mode	• Verify the baud rate of the RTCM input port matches the baud rate of the external source • Verify the pinout between the RTCM source and the RTCM input port (transmit from the source must go to receive of the RTCM input port and grounds must be connected) • Ensure corrections are being transmitted to the correct port—using the $JDIFF,PORTB command on Port A will cause the receiver to expect the corrections to be input through Port B
No Beacon lock (MX575D only)	• Verify the MX575D has no obstructions from large metal objects and railings. • Verify the Beacon status in the Satellite/DGPS screen of the CDU. Select a known beacon station frequency using manual mode. → ***Note:*** Beacon lock is only possible if you are in areas where the land-based beacons cover. There are many areas of the world where beacon signal is not available.

List of abbreviations

CDU	Control and Display Unit
COG	Course Over Ground
DGPS	Differential Global Positioning System
GLONASS	Global Orbiting Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HDOP	Horizontal Dilution of Precision
IMO	International Maritime Organization
NMEA	National Marine Electronics Association
PDOP	Positional Dilution of Precision
RAIM	Receiver Autonomous Integrity Monitoring
ROT	Rate of Turn
RTK	Real Time Kinematic
SBAS	Satellite Based Augmentation System
SOG	Speed Over Ground
THD	Transmitting Heading Device
VDOP	Vertical Dilution of Precision

6 Wiring diagrams

1PPS output



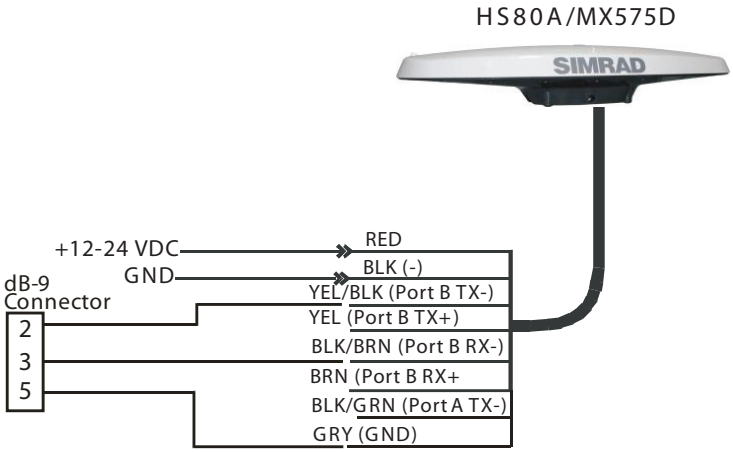
Pin	Function	Wire Color
1	Power (+)	Red
2	Power (-)	Black
3	Port A Tx of RS-232	Blue
4	Port A Rx of RS-232	Black/blue stripe
5	Reserved	
6	Port A Tx of RS-422 (+)*	Green
7	Port B Rx of RS-422 (+), control input	Brown
8	Port B Rx of RS-422 (-), control input	Black/brown stripe
9	Reserved	
10	Drain	Bare wire
11	Port A Tx of RS-422 (-)*	Green/black stripe
12	Signal ground	Grey
13	Alarm, relay contact	White
14	Alarm, relay contact	White/red stripe
15	1 PPS (+)	Orange
16	Port B Tx of RS-422 (+)**	Yellow
17	Port B Tx of RS-422 (-)**	Yellow/black stripe
18	1 PPS (-)	Orange/black stripe

➔ ***Notes:***

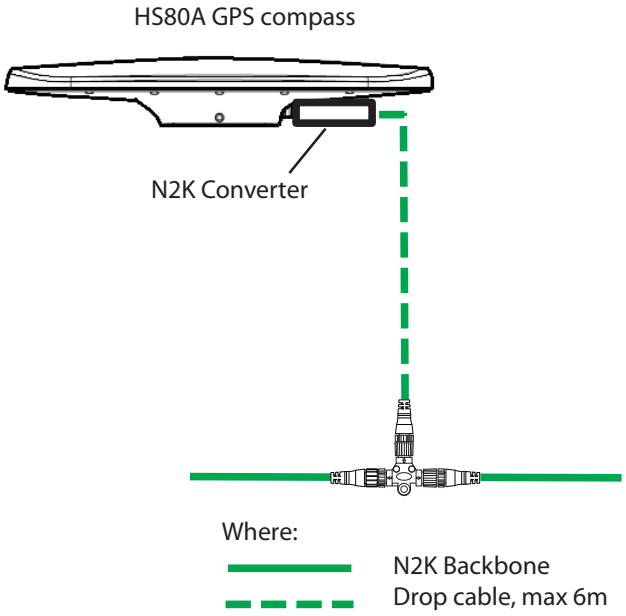
* Port A is normally used for beacon status or fast heading output.

** Port B is normally used for GPS and heading data output.

PC to GPS compass interface diagram



HS80A connection via the NMEA 2000 network



988-10221-004

SIMRAD