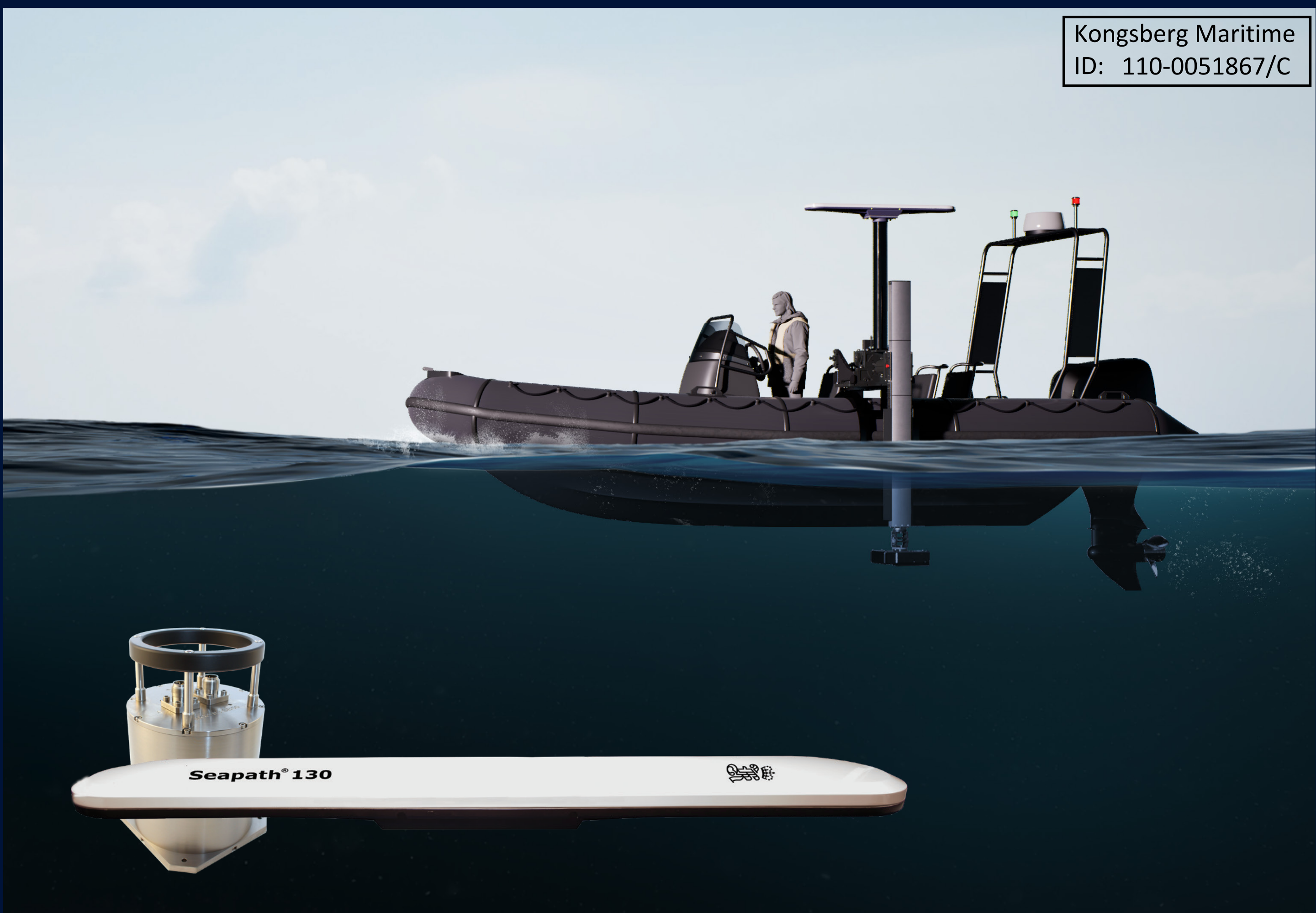
Installation Manual

Seapath® 130-R series

Compact GNSS aided Inertial Navigation System



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Seapath 130-R series Compact GNSS aided Inertial Navigation System

Installation manual

Kongsberg Maritime
ID: 110-0051867/C

M340-64/3.0

Document history

Document number: M340–64 / Revision 3.0		
Rev. 1.0	December 2018	First version.
Rev. 2.0	September 2023	Updated to correspond with Product sw version 2.01.00. Fugro Seastar DGNSS receiver connection diagrams included. Weight on Sensor Unit has been updated. Updated wiring schematic for DGNSS cable to PPU. Updated Sensor unit power specification. Included description of RS-232 and RS-422 connections.
Rev. 3.0	May 2024	Updated to correspond with Product sw version 2.02.00. Updated performance specifications.

Note

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Kongsberg Discovery AS endeavours to ensure that all information in this document is correct and fairly stated, but does not accept liability for any errors or omissions.

Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.

Kongsberg Discovery disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

Comments

To assist us in making improvements to the product and to this manual, we welcome comments and constructive criticism.

e-mail: kd.seatex@kd.kongsberg.com

Kongsberg Discovery AS

www.kongsberg.com

Table of contents

1 About this manual

Observe the general information about the Seapath 130 series in this manual. This manual applies to the Seapath 130–R2 and 130–R3 products.

Purpose of manual

The purpose of this installation manual is to provide the descriptions and procedures required to install and set up the Seapath 130 series of products on a vessel.

Target audience

This installation manual is intended as a reference manual for the personnel installing the system and it contains the necessary information to install and set up the Seapath equipment on a vessel.

Maintenance purposes

This manual is also intended as reference material for the maintenance personnel. Keep this manual for later use.

License information

Export of the MGC R2, MGC R3 or MGC R4 component requires an export license.

Registered trademarks

Seapath® is a registered trademark of Kongsberg Discovery AS in Norway and the People's Republic of China.

2 Seapath 130–R

2.1 Product description

The Seapath 130 is developed specifically for hydrographic surveying where high precision heading, position, roll, pitch, heave and timing are critical measurements. The product combines state-of-the-art dual frequency GNSS receivers (GPS/GLO/GAL/BDS), inertial technology and processing algorithms in a compact and portable package.

The main component is the sensor unit with the motherboard, GNSS antennas and receivers. The sensor unit is to be mounted on top of the vessel mast or pole. On top of the transducer, the inertial sensor of type MGC R2 and R3 is mounted within a subsea bottle. The Seapath operator software is installed on a connected PC for configuration and monitoring. All the components are connected through a spider cable with MGC connection, three configurable serial lines, DGNSS (Differential GNSS) correction input, 1PPS output, network communication and power inlet.

The latest Seapath software includes Automatic Online Calibration (AOC) that significantly improves the roll and pitch accuracy. With the AOC functionality recalibration of the IMU is now longer required if the vessel is in motion with heading changes (not stationary vessels).

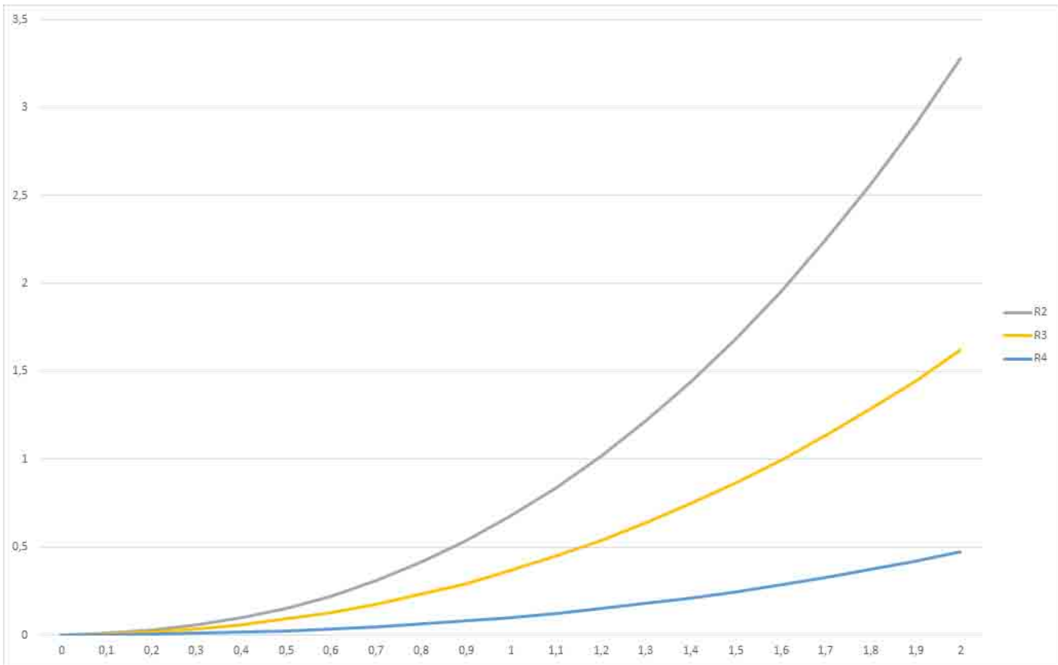
The Seapath 130–R series is delivered in the following and improved product range:

- **Seapath 130–R2** with MGC R2 to 0.008° roll and pitch accuracy
- **Seapath 130–R3** with MGC R3 to 0.007° roll and pitch accuracy

The advanced Seapath navigation algorithms integrate the RTK GNSS data with the inertial sensor data. This gives the Seapath 130 unique advantages compared to stand alone RTK products. The Seapath product's accurate roll, pitch and heading measurements allow the RTK antenna position to be referenced to any point on the vessel where accurate position and velocity are required. All the data from Seapath have the same time stamp and the output is in real-time. Subdecimetre position accuracy can be achieved through download of satellite orbit and clock data from internet and by post processing of satellite and IMU (Inertial Measurement Unit) data. The Seapath is robust against GNSS dropouts by using the inertial sensor for dead reckoning navigation in order to provide position, velocity and also heading measurements when GNSS is not available.

With latest Seapath software the typical position drift for MGC R2, MGC R3 and MGC R4 after GNSS droupout is shown in the plot below:

Figure 1 Typical position drift in meters after GNSS dropout in minutes

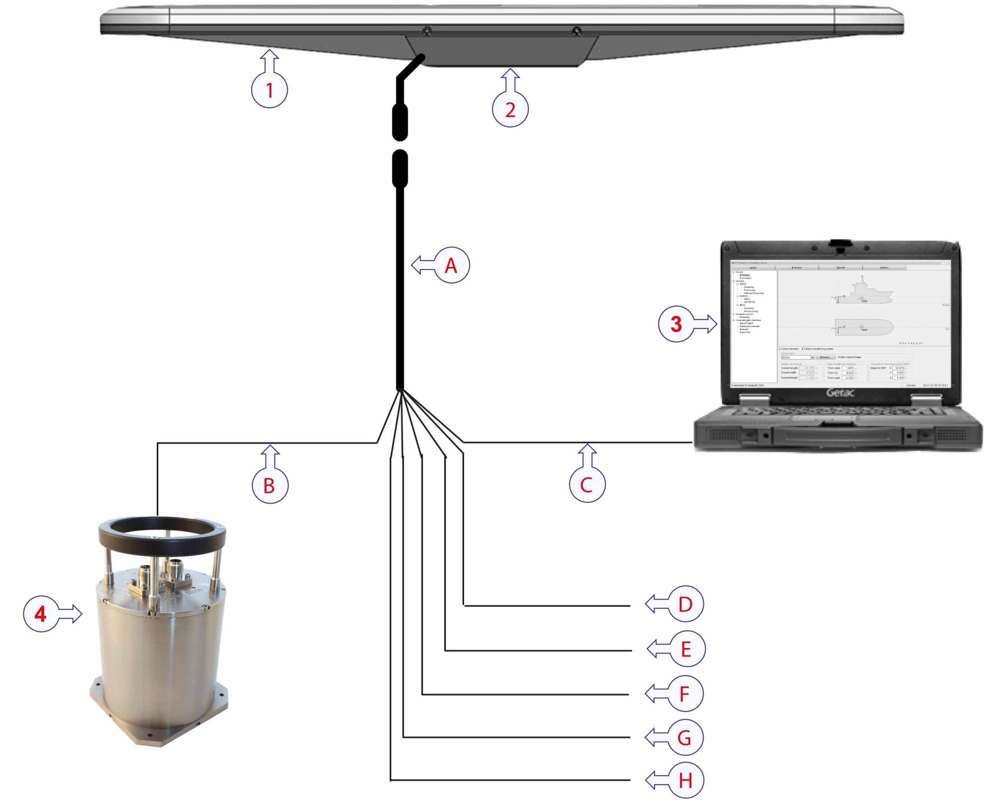


The product has three configurable RS-232/422 serial lines and Ethernet for output of motion data and NMEA messages to the multibeam and survey computer. Input of DGNSS corrections of various quality and sources are input on a configurable RS-232/422 serial line or Ethernet.

By utilising standard DGNSS, Fugro SeaSTAR XP2/G2/G4/G4+, VERIPOS Ultra/Ultra², C-NavC¹, C-NavC² and RTK corrections, this system is a unique solution for hydrographic surveying and dredging work which demand the most comprehensive, most accurate surveying data available.

2.2 System diagram

A system diagram for a Seapath setup.



Main units

1 Sensor unit with 1 meter cable with male connector

2 Mounting bracket

3 Seapath operator software installed on a PC (not part of the delivery)

4 MGC in subsea bottle

Cables

A Cable to the sensor unit, part of the spider cable, 20 meter length with female connector

B MGC umbilical cable with 8–pin SeaCon connector, 15 meter length

C Ethernet cable to PC and other users, 5 meter length

D Input/output serial line for GNSS corrections with 9–pin Dsub, 5 meter length

E Output serial line for motion data to multibeam or survey computer with 9–pin Dsub, 5 meter length

F Output serial line for NMEA data with 9–pin Dsub, 5 meter length

G 1PPS output with 9–pin Dsub, 5 meter length

H 24 VDC input, 5 meter length

2.3 System units

The Seapath product comprises the following main components.

2.3.1 Seapath 130 sensor unit description

The sensor unit runs the navigation software. This software combines the GNSS signal and the inertial measurements to determine accurate position, heading, attitude and heave signal. This software utilises Kongsberg Discovery AS advanced true multi-reference algorithms for real-time parallel processing of all available correction signals.

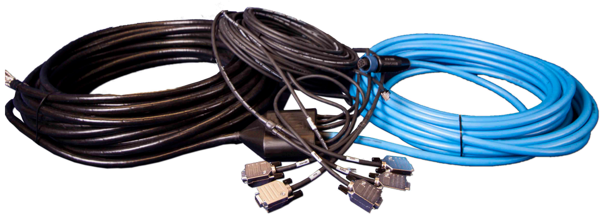
The sensor unit includes:

- Two GNSS receivers and antennas
- Motherboard
- Connector board for termination of the spider cable
- Cable of 1 meter with male connector
- Mounting bracket

2.3.2 MGC description

The MGC R2 and R3 SB50 mounted in subsea bottle. The MGC unit is a north-seeking gyro compass based on three Ring Laser Gyros (RLG) and three linear accelerometers.

2.3.3 Spider cable description



The product is delivered with a spider cable for sensor unit connection through the female connector, MGC connection through the 8–pin SeaCon connector, three configurable serial lines through 9–pin Dsubs, 1PPS output through 9–pin Dsub, network communication and power inlet.
Delivered in either 20 meter length or 8 meter length (short).

2.4 Scope of supply

2.4.1 Standard parts provided

Observe the basic items provided with a standard Seapath system delivery.

- 1 ea Seapath 130 sensor unit

  Part number M340-03
- 1 ea Seapath 130 mounting bracket

  Part number M340-05
- 1 ea MGC motion sensor and compass

  Models MGC R2 SB50 or MGC R3 SB50
- 1 ea Seapath spider cable

  Part number M340-20 (20 m length) or

  Part number M340-25, short (8 m length)
- 1 ea user documentation

2.5 Product restrictions

2.5.1 Restrictions in export

Export of the MGC R1, R2, R3, R4 and R5 COMPASS component requires an export license.

Note

Notice to importer: The MGC product specified in this document is shipped from Norway in accordance with The Ministry of Foreign Affairs' Official Notification on Export Control and U.S. Export Administration Regulations (EAR). The MGC product will be subject to restrictions if re-exported from your country, including but not limited to a re-export license from the U.S. Government.

2.5.2 Restrictions in guarantee

Changes or modifications to the product not explicitly approved by Kongsberg Discovery AS will void the guarantee.

The liability of Kongsberg Discovery AS is limited to repair of this system only under the given terms and conditions stated in the sales documents. Consequential damages such as customer's loss of profit or damage to other systems traceable back to this system's malfunctions, are excluded. The warranty does not cover malfunctions of the system resulting from the following conditions:

- The Sensor Unit is not shipped in the original transport box.
- The Sensor Unit has been exposed to extreme shock and vibrations.
- The Sensor Unit housing has been opened by the customer in an attempt to carry out repair work.
- Incorrect power connection.

2.5.3 Restrictions in use

The Seapath function is based on GNSS signals and requires free sight to the sky, minimum four visible satellites, PDOP value less than 6 and otherwise normal conditions to operate. It is designed for use on board marine surface operated vehicles with linear acceleration less than ±45 m/s^2 (±4.5g) and an angular rate range less than ±125°/s.

Specifications are valid without multipath, without shadowing of antenna and with vessel in motion.

This Seapath product is intended for use in maritime survey and navigation applications.

2.6 Seapath as NTP server

The Seapath can be used as an NTP server for clock synchronization of connected computer systems. An accuracy better than one millisecond can be achieved in local area networks under ideal conditions.

To use the Seapath as the NTP server, the NTP clients have to be configured with the Seapath IP address as the server. How this is done depends on the client software in use. Nothing in the Seapath has to be configured. The NTP server on the Seapath runs in standard mode with the PPS as reference.

2.7 Network security

Equipment manufactured by Kongsberg Discovery AS is frequently connected to local area networks (LAN). Connecting any computer to a network will always expose the data on that computer to all other computers connected to the same network. Several threats may immediately occur:

- Remote computers can read the data.
- Remote computers can change the data.
- Remote computers can change the behaviour of the computer, for example by installing unwanted software.

Usually, two parameters are used to define the threat level:

1. The likelihood that any remote connection will do any of the above.
2. The damage done if a remote connection succeeds doing this.

Because Kongsberg Discovery AS has no information regarding the complete system installation at a location, we can not estimate the threat level and the need for network security. For this reason, we can not accept responsibility for network security. Systems provided by Kongsberg Discovery AS are regarded as stand-alone offline systems, even though they may be connected to a network for sensor interfaces and/or data distribution.

Note

No network safety applications are installed on any Kongsberg Discovery computers. The computers are thus not protected against viruses, malware or unintentional access from external users.

Securing the system itself has no meaning unless there is a policy in place that secures all computers in the network. This policy must include physical access by trained and trusted users. The customer/end user of the system will always be in charge of defining and implementing a security policy, and providing the relevant network security applications.

Note

Kongsberg Discovery AS will not accept any responsibility for errors and/or damages caused by unauthorized use or access to the product.

2.8 Support information

- **Company name**: Kongsberg Discovery AS, Seatex
- **Address**: Havnegata 9, 7010 Trondheim, Norway
- **Duty phone**: +47 33 03 24 07 (24 hours)
- **Support e-mail address**: support.seatex@kd.kongsberg.com
- **Website**: http://www.kongsberg.com/discovery

KM-Support App

Support is also available from the KM Support App. This app is available for free in App Store and Google Play.

3 Installation

This chapter provides information necessary to plan the Seapath installation on a smaller hydrographic survey vessel. Correct installation is important for the system performance.

3.1 Preparing the installation

3.1.1 Necessary tools and equipment

We assume that you are equipped with a standard set of tools. This tool set must comprise the normal tools for electronic and electromechanical tasks, such as screwdrivers, pliers, spanners, a cable stripper etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment.

Unless stated otherwise, all mounting equipment (such as bolts, nuts, washers, screws etc.) referred to within this document is to be supplied by the customer or the shipyard.

Survey equipment should be made available to determine the MGC mounting angles in roll, pitch and yaw and the distance vectors from the Origin to the sensor unit, the MGC and the monitoring points.

PC with Seapath operator software

An external PC (not part of the product delivery) is required for the installation of the Seapath operator software. The minimum requirements for the PC is Windows 10 or newer, 2 GHz CPU, 2 GB RAM and 1024 x 768 screen resolution.

Motion sensor and gyro compass (MGC)

The MGC is shipped in a specially designed transportation container. Keep the MGC within the container until everything is ready for installation.

Note

After the installation, please save the transportation container. The MGC must be shipped in this container for service or repair to maintain the warranty.

3.1.2 Drawings

General arrangement drawings of the vessel should be acquired to simplify determination of offsets between the sensor unit, the MGC, the Navigation Reference Point (NRP) and the different monitoring points. Locations for the various parts of the system must be decided.

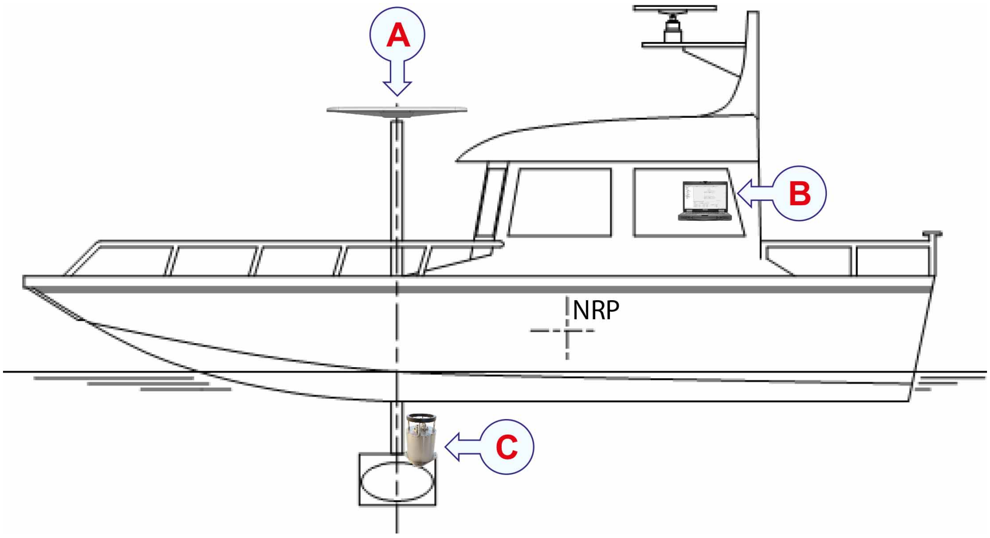
3.1.3 Radio frequency authorisation

Ensure that the data link between the reference station and the mobile Seapath system is assigned to operate on the radio frequencies that will be used in the survey area. An assigned approval from the Authorities is required before use.

3.1.4 Worker skills

Trained mechanical and electrical workers.

3.1.5 Determining the location of system parts



A Sensor unit mounted on pole

B PC with operator software installed, indoors

C MGC in subsea bottle mounted on transducer head

3.1.5.1 Sensor unit location

For the sensor unit, consider the following:

- The space above the sensor unit has to be free of obstructions of any kind.
- The sensor unit should be protected from direct illumination of radar beams and other transmitting antennas such as Inmarsat antennas. Seapath is more sensitive to blocking and reflections (multipath) of GNSS signals than GNSS sensors which only

use pseudo-range data. This is because Seapath also uses carrier phase measurements for heading determination, and both the internal GNSS antennas need to see at least four common satellites at the same time.

Caution

The sensor unit has to be mounted in such a way that blocking of the GNSS signal is avoided.

- In order to reduce problems due to multipath effects, the sensor unit has to be mounted above the nearest deck at a height which is equal to the width of this deck or higher.
- The sensor unit has to be mounted in such a way that torsion movement relative to the ship's hull is kept at an absolute minimum.

3.1.5.2 MGC location

If the MGC is mounted in a subsea bottle, the MGC is recommended mounted close to the user equipment of which it is supposed to measure the motion. This is to avoid errors in alignment with the user equipment.

Caution

Be aware of vibrations. *Direct mounting onto the main hull structure is preferable.*

Avoid mounting the sensor unit close to hydraulic pumps and valves where there are high frequency vibrations. The sensor unit has some sensitivity to vibrations around sequences of 100 Hz (100, 200, 300 Hz and so on). Such vibrations should not exceed 0.5 m/s^2 in any direction.

Caution

Be aware of resonance. *Care must be taken when mounting the sensor unit to the vessel's hull as to avoid self-resonance which in turn can amplify the dithering frequencies (around 600 Hz) of the gyroscopes. A properly mounted sensor unit will typically emit 58-64 dBA (1 meter) and improperly mounted the sound pressure level may increase to 85 dBA. It is recommended to mount it directly to solid and stable structure, like the steel deck.*

3.2 Installation summary

The installation consists of both mechanical and electrical installation.

Mechanical installation

The mechanical installation consists of:

- Installing a holder for the sensor unit and having it fastened in a suitable location in a mast or pole.
- Installing the sensor unit on a holder in the mast or pole.
- Installing the MGC with the subsea bottle near the user equipment for which attitude data is wanted, or close to the selected Navigation Reference Point (NRP).

Electrical installation

The electrical installation consists of:

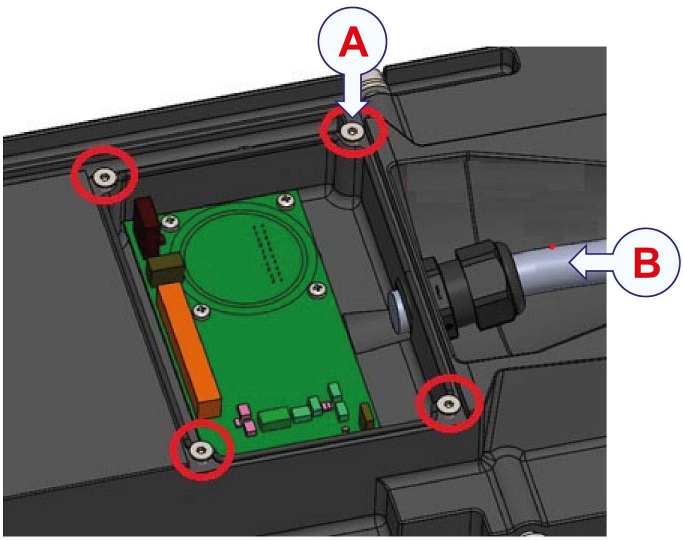
- Connecting the cable from the sensor unit to the spider cable.
- Connecting the umbilical cable to the MGC subsea bottle.
- Connecting the Ethernet cable to the PC with Seapath operator software.
- Connecting cable with DGNSS RTK corrections to the sensor unit cable.
- Connecting sensor unit cable with output data to the survey computer.
- Connecting sensor unit cable with output data to the echo sounder.
- Connecting sensor unit cable with 1PPS output to the echo sounder.
- Supplying 24 V DC power to the sensor unit cable.

3.3 Terminating the cable within the sensor unit (optional)

The sensor unit cable must be terminated in the unit before mounting it on the mast or pole. Normally the sensor unit is delivered with the cable terminated.

Procedure

1 Open the connector board cover at the bottom of the sensor unit by unscrewing the four screws marked with a red circle on the figure.



A Connector board cover screws

B Sensor unit cable

2 Run the sensor unit cable through the gland and terminate the cable wires on the connector board according to the cable wiring table.

Pin	Signal	Pair	Wire colour	Pin	Signal	Pair	Wire colour
16	PWR+	1	White	10	1PPS TX-B	8	Red
1	PWR-	1	Blue	25	1PPS TX-A	8	Green
17	ETH RXD-	2	Green	9	1PPS GND	9	Red
2	ETH RXD+	2	White	26	Echo GND	9	Grey
18	ETH TXD-	3	Orange	11	Echo TX TX-B	10	Red
3	ETH TXD+	3	White	27	Echo RTS TX-A	10	Brown
19	GNSS CTS RX-A	4	White	12	MRU RX-A	11	Black
4	GNSS RX RX-B	4	Brown	29	MRU RX-B	11	Orange
20	GNSS RTS TX-A	5	White	14	MRU TX-A	12	Black
5	GNSS TX TX-B	5	Grey	28	MRU TX-B	12	Blue
21	GNSS GND	6	Red	13	MRU GND	13	Black
23	Survey GND	6	Blue	30	MRU 1PPS N TX-A	13	Green
8	Survey TX TX-B	7	Red		Not used	14	Black
24	Survey RTS TX-A	7	Orange		Not used	14	Brown

3 Fasten the cable gland to the sensor unit chassis.

4 Re–mount the connector board cover.

3.4 Mounting the sensor unit

The sensor unit is designed to be mounted horizontally on top of a mast or pole.

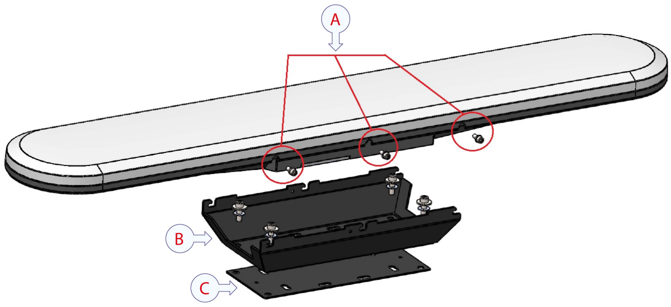
Prerequisites

A mounting arrangement for the sensor unit mounting bracket has been prepared by the customer.

Procedure

1 Make a holder for the sensor unit mounting bracket and fasten the holder properly to the mast or pole.

2 Separate the sensor unit from its mounting bracket by unscrewing the three screws on each side.



A Mounting bracket screws

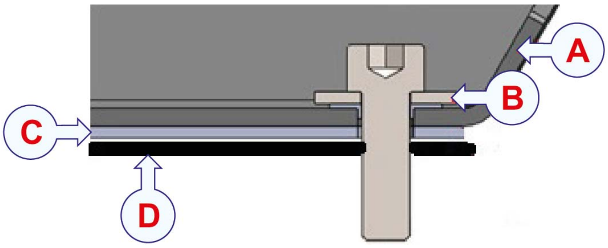
B Mounting bracket

C Plastic insulation plate

3 Bring the sensor unit, its cable and mounting bracket as close as possible to the location of the sensor unit holder.

The normal orientation of the sensor unit is along ship with heading reference point no. 1 aft. It can, however, be mounted in any orientation, provided it is approximately horizontal.

4 Place the delivered insulation plate between the sensor unit mounting bracket and the holder, and ensure that the four bushings are placed in the mounting holes before the screws are entered (to ensure galvanic isolation of the sensor unit from the mast and to prevent corrosion). The nuts should be secured with washers or by using self-locking nuts.



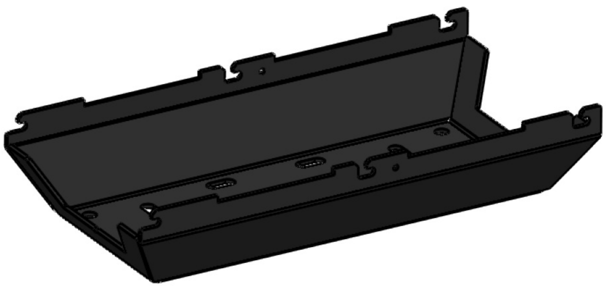
A Mounting bracket

B Plastic washer

C Plastic insulation plate

D Holder

5 Place the mounting bracket in the preferred direction on the holder.



6 Lift the sensor unit on top of the mounting bracket. Insert the three screws on each side of the mounting bracket again and fasten them to the sensor unit.

7 Connect the cable from the sensor unit to the spider cable.

Figure 2 The two cable connectors

Figure 3 The two cables connected

3.5 Mounting the MGC subsea bottle

The MGC of model R2 or R3 is delivered mounted in a subsea bottle (SB50). The subsea bottle is mounted to the vessel or the transducer head.

Prerequisites

A mounting arrangement for the subsea bottle has been prepared by the customer.

Procedure

1 Find the location on the vessel, pole or transducer head to mount the bottle. If the orientation of the bottle can be freely selected, choose a subsea bottle orientation with the x arrow pointing in the bow direction.

The bottom plate has steering pins, four outer mounting holes and four inner holes which are equal to those on the MRU subsea bottle. The connetor lid has an x arrow indication.

Figure 4 Bottom plate

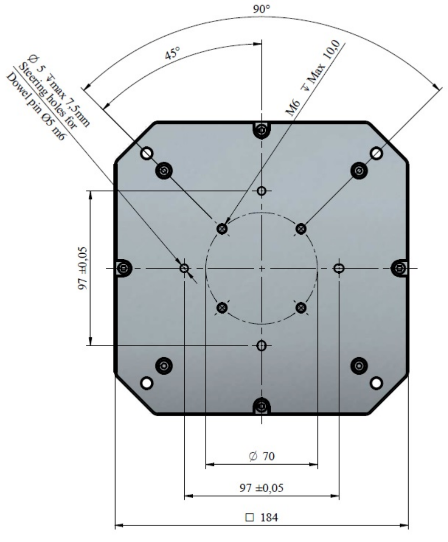
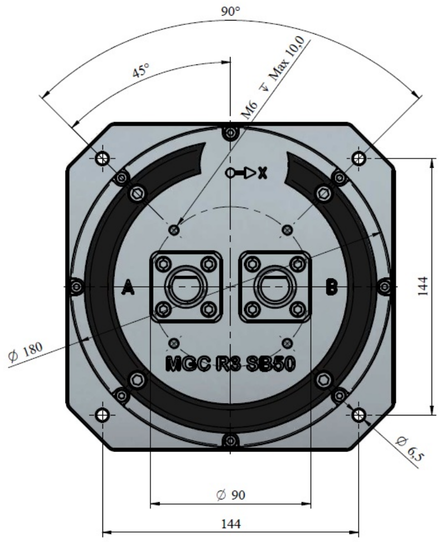
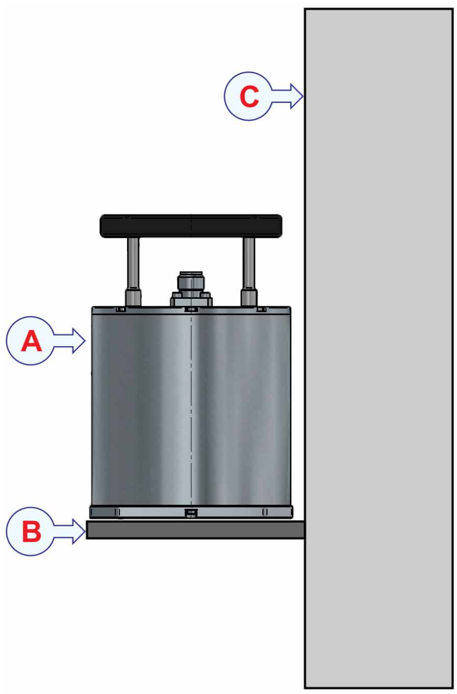


Figure 5 Connector lid



2 When the mounting location on a structure has been identified, prepare fastening plate for the subsea bottle bottom plate screws.



A Subsea bottle

B Fastening plate (provided by customer)

C Mounting structure

3 Provide the necessary number of M6 screws of stainless steel (four for each lead) for fastening the subsea bottle to the structure.

4 Connect the MGC cable to **connector A** on the connector lid. Connect the provided dummy female connector to connector B since this is not used in the Seapath.

5 Fasten the MGC cable with clips to the structure to avoid the cable to vibrate when the vessel runs through the water.

3.5.1 Subsea bottle connectors and pin configuration

The bottle includes two 8-pin Seacon connectors. The part number for the Seacon connector is 5506-1508 (male). A Seacon pigtail for the customer's own application can be delivered as an option (part no MRU-E-PT8).

Connector A: Default pin configuration for Seapath

Pin	Signal (Seapath compatible)
1	POWER -
2	POWER +
3	COM1_IN_A-
4	COM1_IN_B+
5	COM1_OUT_ B+
6	COM1_OUT_A-
7	CGND (ground ref for XIN)
8	XIN (Seapath 1PPS)

Connector B: Default pin configuration, Ethernet communication

Pin	Signal (Ethernet communication)
1	POWER -
2	POWER +
3	RD- (RJ_6)
4	RD+ (RJ_3)
5	TD- (RJ_2)
6	TD+ (RJ_1)
7	GGND
8	ALERT

3.6 Powering the Seapath system

There is no switch to power on/off the Seapath system. The system starts up when power is connected to it.

Procedure

1 When cables are connected to the sensor unit and the MGC, apply 24 V DC power.

The power connection for the spider cable is according to the table.

Signal	Sensor unit (wire colours)	MGC (wire colours)
PWR+ (+24 V DC)	Brown	Green
PWR- (0 V DC)	White	Yellow

2 The system now gets up and running.

Powering off the Seapath system

Disconnect the power input to shutdown the system. The system can now be dismantled.

3.7 Installing the Seapath operator software

This software is used to set the configuration parameters for the sensor unit and to operate the Seapath system. You must install the operator software on the local PC (standard Windows procedure).

Procedure

1 Insert the USB flash drive with the software in the USB port on the local PC.

2 Open the Removable Disk drive to which the USB flash drive is connected.

3 Locate and run the installation file `SeapathHmiInstaller.exe`.

4 Follow the instructions on the screen in order to complete the installation of the **Seapath HMI** program.

5 When you reach the last step, clear the **Run the application** check box if you do not want to start the operator software immediately after installation.

6 Remove the USB flash drive from the local PC when the installation is finished.

3.8 Uninstalling the Seapath operator software

When you do not need the Seapath operator software anymore, you can remove it from your PC.

Procedure

1 Open the **Control panel** on your PC and select **Programs and Features** (the dialog box where you remove programs).

2 Locate the **Seapath 130 series** program in the list.

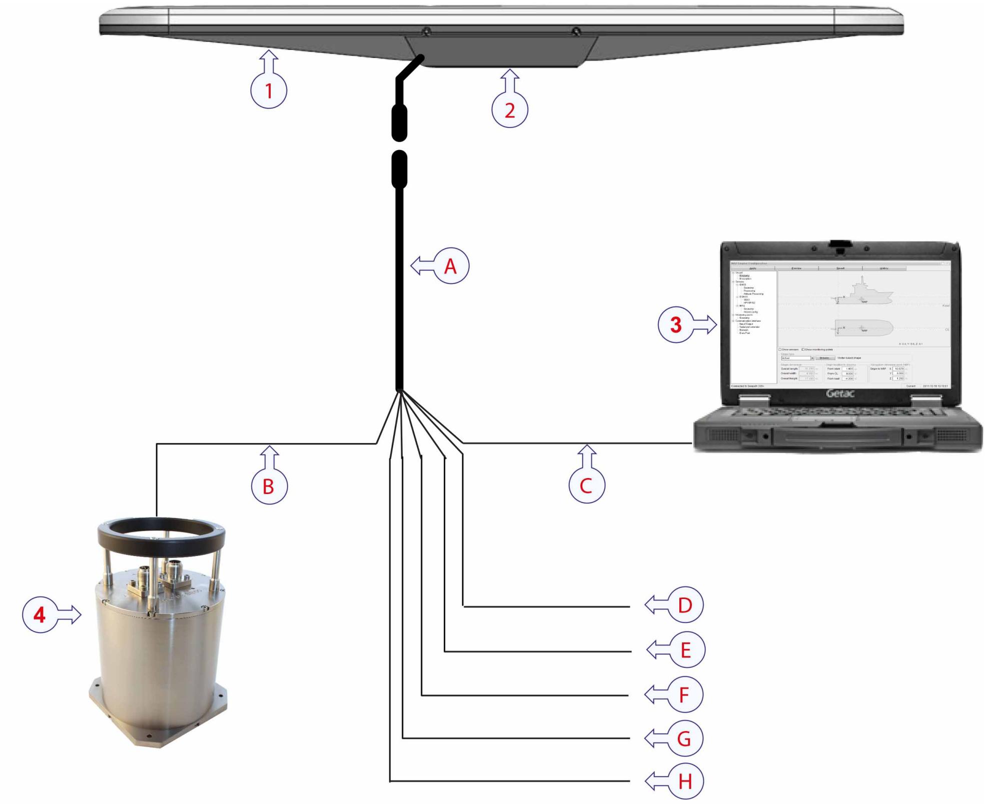
3 Click the **Uninstall** button to remove the program.

4 Follow the instructions on the screen.

4 Cable layout and interconnections

4.1 Cable plan

All the components are connected through the spider cable with MGC (Motion sensor and Gyro Compass) connection, three configurable serial lines, DGNSS (Differential GNSS) correction input, 1PPS output, network communication and power inlet.



Cables

A Cable to the sensor unit, part of the spider cable, 20 meter (default) or 8 meter (short) length with female connector

B MGC umbilical cable with 8–pin SeaCon conenctor, 15 meter length

C Ethernet cable to PC and other users, 5 meter length

D Input serial line for GNSS corrections with 9–pin Dsub, 5 meter length

E Output serial line to GNSS receiver with 9–pin Dsub, 5 meter length

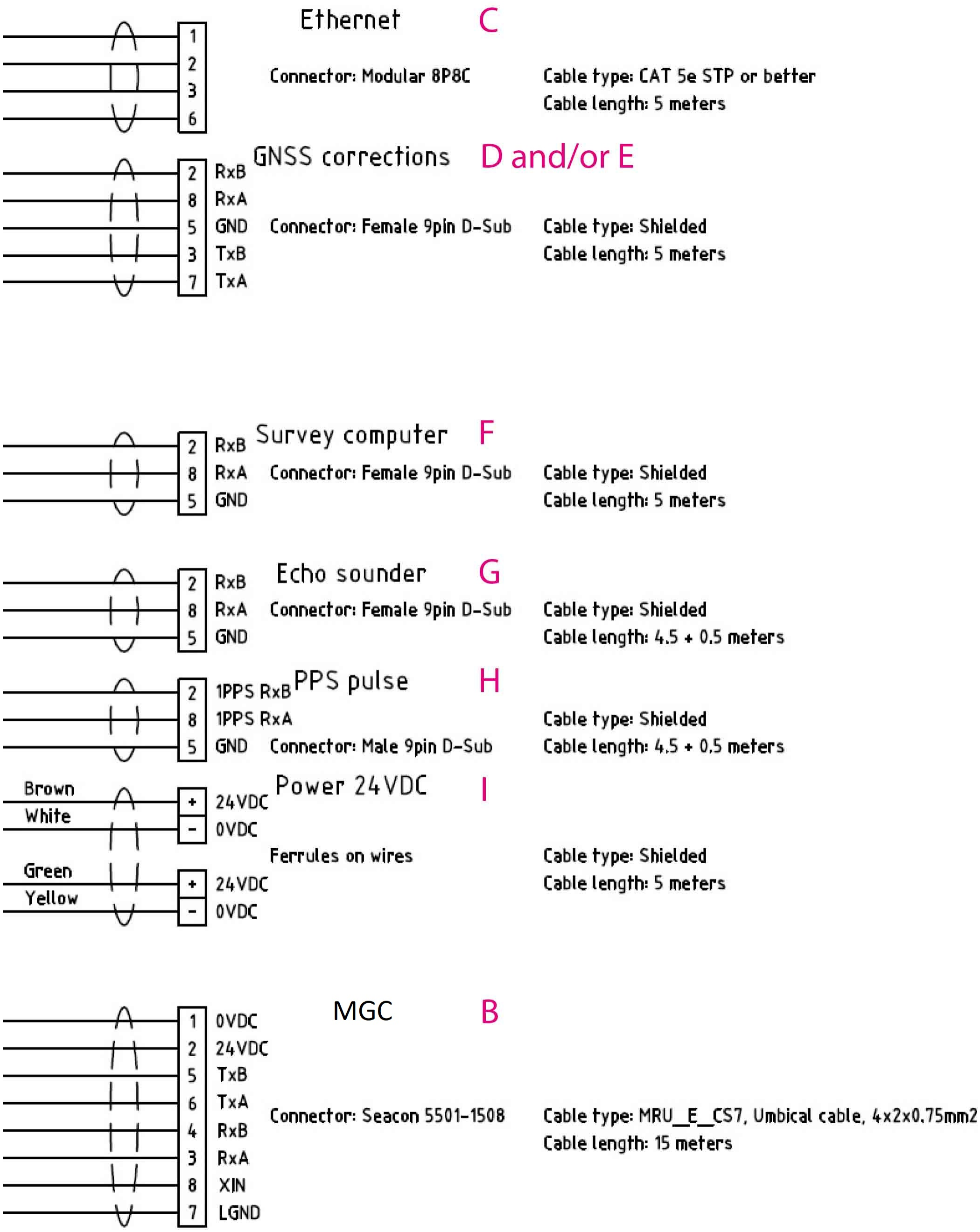
F Output serial line for motion data to multibeam or survey computer with 9–pin Dsub, 5 meter length

G Output serial line for NMEA data with 9–pin Dsub, 5 meter length

H 1PPS output with 9–pin Dsub, 5 meter length

I 24 V DC input, 5 meter length

The pin-out for the different connectors is illustrated with a corresponding letter to the cables listed above.



The serial lines can be configured in the Seapath operator for either RS-232 or RS-422 communication. The signals between the two are shared as follows:

- RTS shares pin with TX-A
- TX shares pin with TX-B
- CTS shares pin with RX-A
- RX shares pin with RX-B

4.1.1 Ethernet connections

The system has the possibility to input and output data on individually configurable network ports. The format and update rate are configured for each port in the **NAV Engine Configuration →Network**. The network ports have 10/100 Mbps capacity. For direct connection to a PC you might need a crossover cable instead of a straight-through cable. The pin wiring for the different cable configurations is according to the table.

Straight-through			**Crossover**			
Signal	**Pin no.**		**Signal**	**Pin no.**	**Pin no.**	**Signal**
TX+	1		TX+	1	3	RX+
TX-	2		TX-	2	6	RX-
RX+	3		RX+	3	1	TX+
RX-	6		RX-	6	2	TX-

4.1.2 PPS signal output description

A 1 pulse-per-second (1PPS) signal synchronized with GNSS time is available from the 9–pin Dsub marked PPS output on the spider cable. The output has galvanic separation. This RS-422 1PPS signal originates from the GNSS receiver within the sensor unit. The 1PPS signal is buffered and fed to the Dsub at 120 Ohm. The 1PPS signal has a pulse width of 10 ms. The 1PPS is generated exactly once every second with its rising edge synchronised to GPS time.

Pin no. 8 (RxA) on the 9–pin Dsub has a rising edge and pin no. 2 (RxB) has a falling edge at the beginning of the pulse.

4.1.3 Communication interfaces in the Seapath system

The table below shows all available input/output ports available in the system. Only the DGNSS, ECHO, SURVEY and LAN1 are user configurable.

Table 1 Communication interfaces

I/O Properties	**Type**	**Connected to**
GNSS1	Serial, GNSS receiver no. 1	Internal GNSS antenna no. 1
GNSS2	Serial, GNSS receiver no. 2	Internal GNSS antenna no. 2
MGC	Bidirectional, RS-422	MRU 3, MRU H, MRU 5 or MRU 5+
DGNSS	Bidirectional, RS-232/422	GNSS corrections, user configurable
ECHO	Serial output, RS-232/422	Echo sounder, user configurable

Table 1 Communication interfaces (cont'd.)

I/O Properties	Type	Connected to
SURVEY	Serial output, RS-232/422	Survey computer, user configurable
1PPS	Serial output, RS-422	External equipment
LAN1	Ethernet port, 10/100 Mbit/s	User configurable

4.1.4 DGNSS correction from Fugro SeaStar

Connection diagrams for interfacring DGNSS correction signals from Fugro Seastar receiver are shown below.

Figure 6 Spider cable connection to Fugro Seastar 3610 receiver

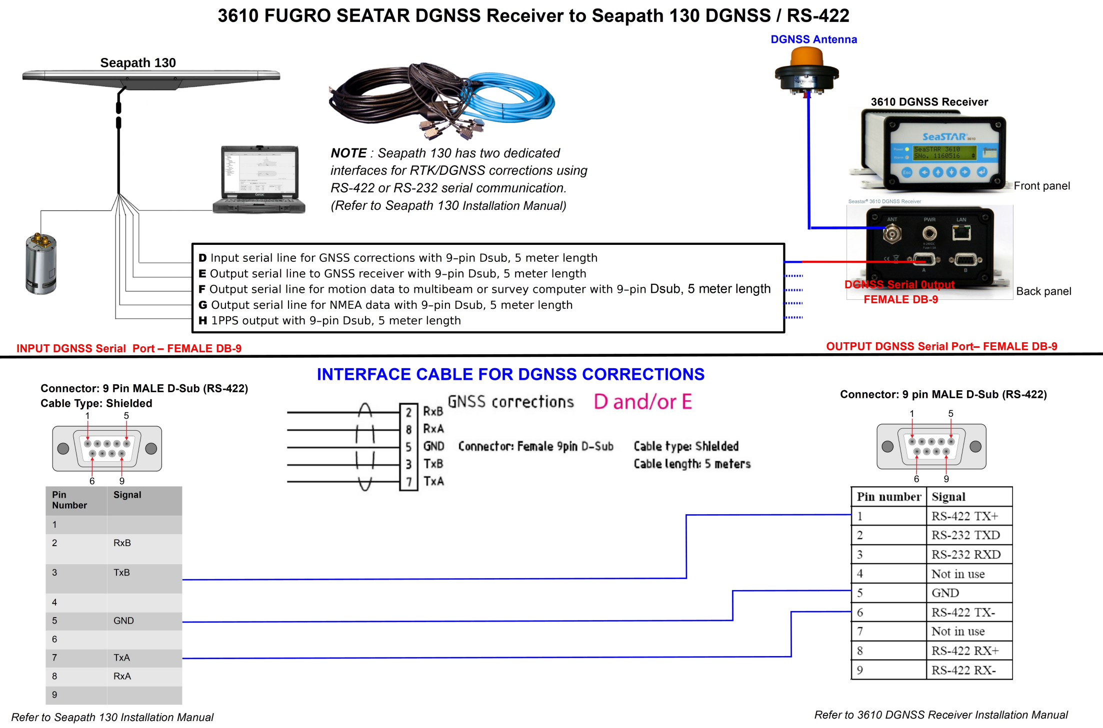
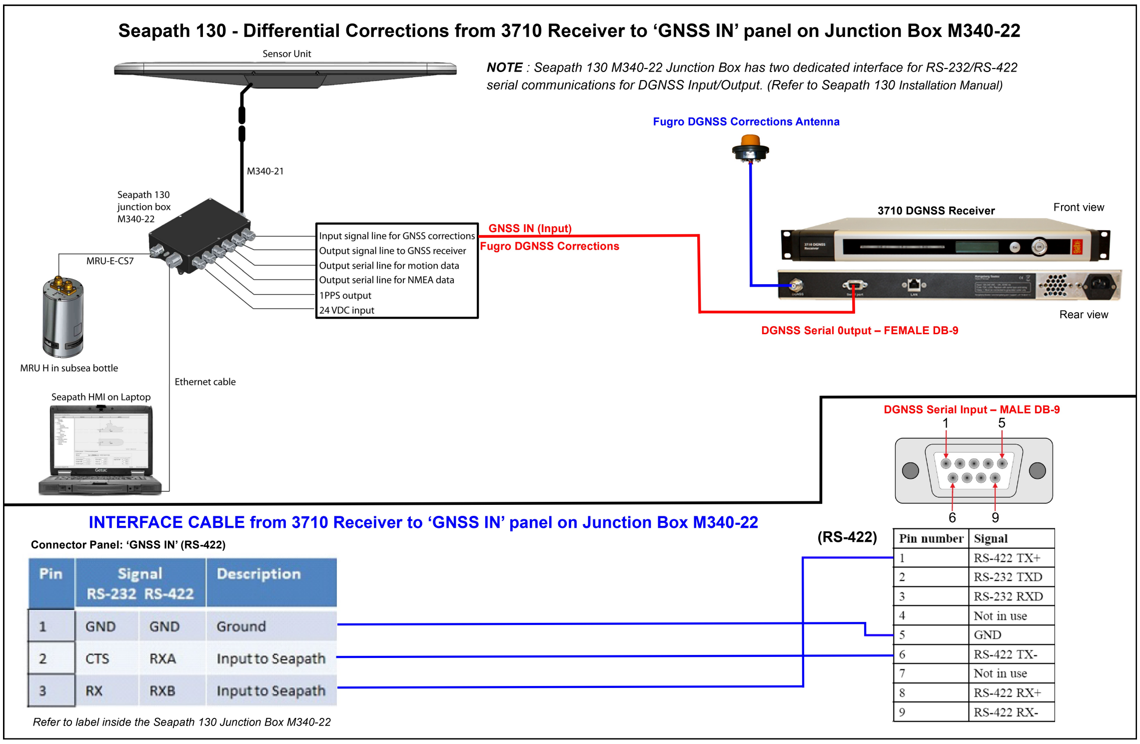


Figure 7 Fugro Seastar 3610 or 3710 receiver connection to Seapath junction box



Pin	Signal RS-232	Signal RS-422	Description
1	GND	GND	Ground
2	CTS	RXA	Input to Seapath
3	RX	RXB	Input to Seapath

Pin number	Signal
1	RS-422 TX+
2	RS-232 TXD
3	RS-232 RXD
4	Not in use
5	GND
6	RS-422 TX-
7	Not in use
8	RS-422 RX+
9	RS-422 RX-

5 Survey of sensors on vessels

In order to achieve the specified accuracy of the system have to be surveyed. The MGC (Motion sensor and Gyro Compass) and the sensor unit have to be surveyed.

The reference systems in use are:

- The vessel reference system
- The MGC subsea bottle sensor point and axes system
- The sensor unit position and heading reference points

A survey has to be performed to determine the offsets in angle and position from the vessel reference system to the MRU and the sensor unit. These offsets are input in the **NAV Engine configuration** software and stored in the Seapath.

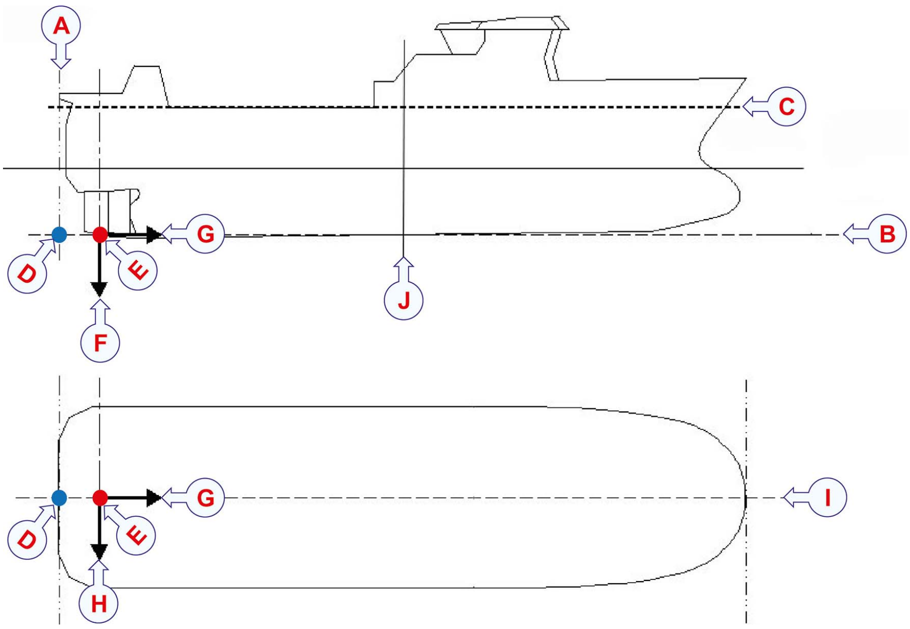
5.1 Vessel reference system definition

The following definitions are used:

- All vessels have a defined Cartesian coordinate system that all sensors can be referenced to. In this right hand system, the X-axis is positive forwards, which is parallel to the centre line of the vessel, the Y-axis, positive towards starboard, and the Z-axis, which is positive downward.
- The origin in the vessel reference system is typically frame 0 at keel level or the surveyed origin in a survey report, i.e. where X, Y and Z are all 0.
- The common reference point (CRP) is defined to be in the intersection between stern, centre line and keel. In case the keel is not parallel with the base line, the reference for CRP is where the keel crosses the vertical section amidships. The location of CRP vs the origin is configurable, and is typically set based on the survey report.
- The reference plane in this system must be well defined and described. This can be a Best Fit Plane on main deck, or a Best Fit Plane through the draught marks on the hull. This is particularly important on a floating vessel, as it is not possible to project the horizontal plane from land.

- The chosen convention must be made clear to all parties involved, both survey personnel performing the survey and the users of the survey results. Any deviation from the defined coordinate system, shown in the figure *Definition of Origin on vessel and positive X, Y and Z axes directions* on page 33, should be well described in both text and drawings to avoid common misunderstandings.

Figure 8 Definition of Origin on vessel and positive X, Y and Z axes directions



A	Stern	**F**	+Z axis
B	Keel	**G**	+X axis
C	Main deck	**H**	+Y axis
D	CRP (common reference point)	**I**	CL (centre line)
E	Origin	**J**	Amidships

5.2 Determine the MGC mounting orientation

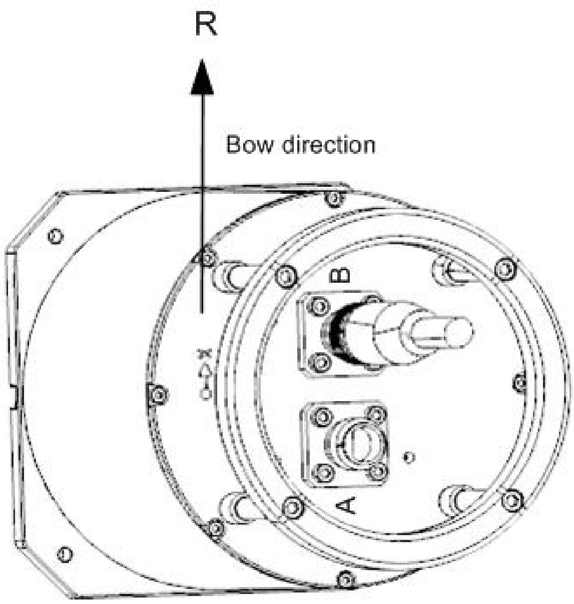
The default mounting orientation is defined with the top cover facing downward and the x-axis pointing forward. The illustration shows the mounting orientation with the MGC SB50 connector facing upward. This is the main orientation direction for this sensor. The sensor is then rotated 180 degrees round the x-axis. The body axes will then be:

- The R-axis (x arrow) points in the bow (forward) direction of the vehicle.
- The P-axis points horizontally and starboard.
- The Y-axis points in the downward direction.

Note

The x, y, z axes with the x arrow marked on the top cover is the axes orientation in the sensor frame. When mounting angles are input in the sensor configuration the sensor output axes is rotated form the sensor-frame to the body-frame (R, P, Y axes).

Figure 9 Top view of sensor unit with R direction indicated



Positive (+) output signals from the MGC include:

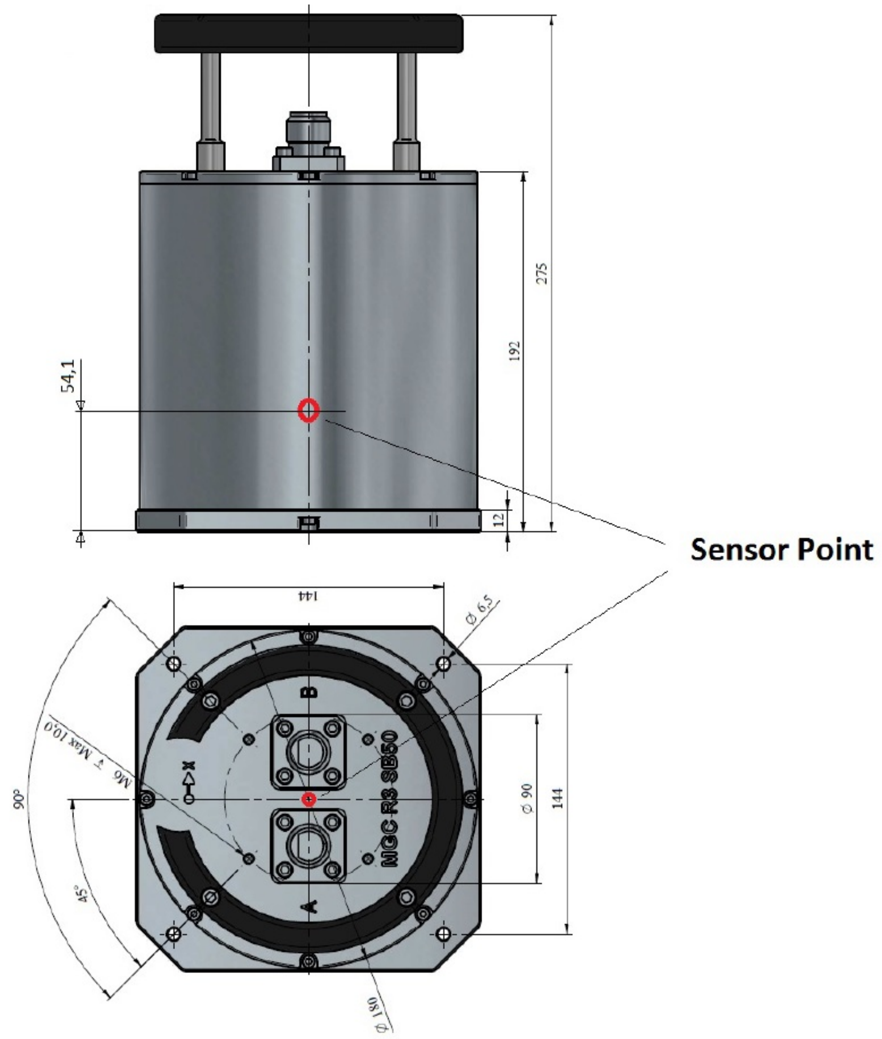
- Positive pitch means bow up, or a clockwise rotation about the P-axis.
- Positive roll means starboard (right) side facing downward, or a clockwise rotation about the R-axis.
- Positive yaw (heading, azimuth) means a turn to starboard (right), or a clockwise rotation about the Y-axis.

5.3 Surveying the MGC subsea bottle

To determine MGC mounting angles and position the following have to be surveyed:

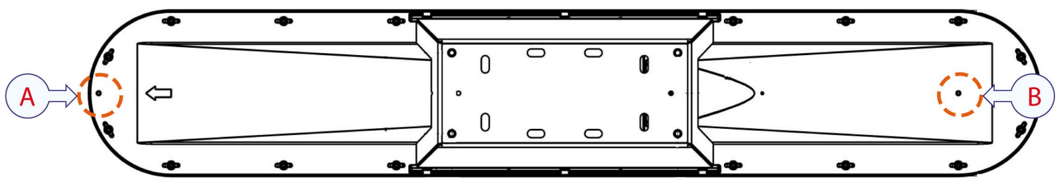
- Position (X,Y,Z) of sensor point. The distance vector from the Origin to the MGC sensor point has to be measured up.
- Mounting angles in Roll, Pitch and Yaw (heading). The MGC misalignment angles in Roll, Pitch and Yaw with the vessel axes have to be measured up.

The illustration shows the sensor point and position (0, 0, 0) for the MGC subsea bottle.



5.4 Determining the sensor unit position and orientation

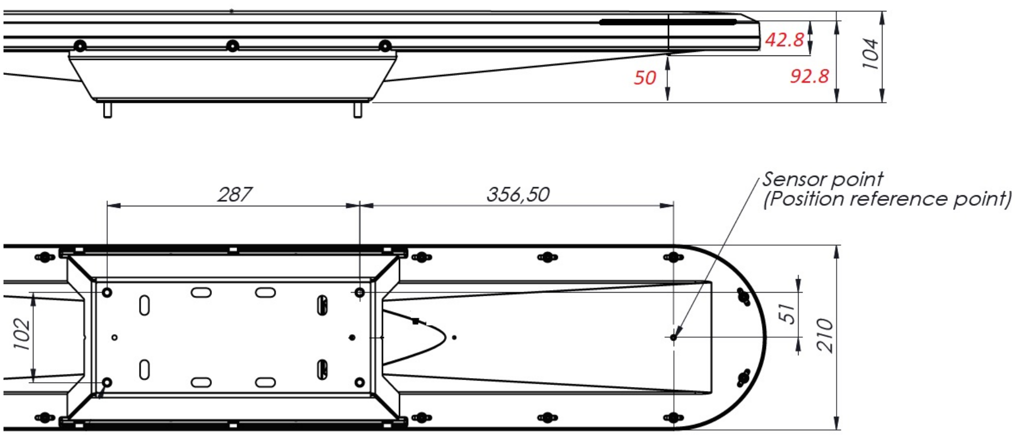
The illustration shows the reference points on the sensor unit. These points are used to determine the position and orientation of the sensor unit on the vessel it is mounted.



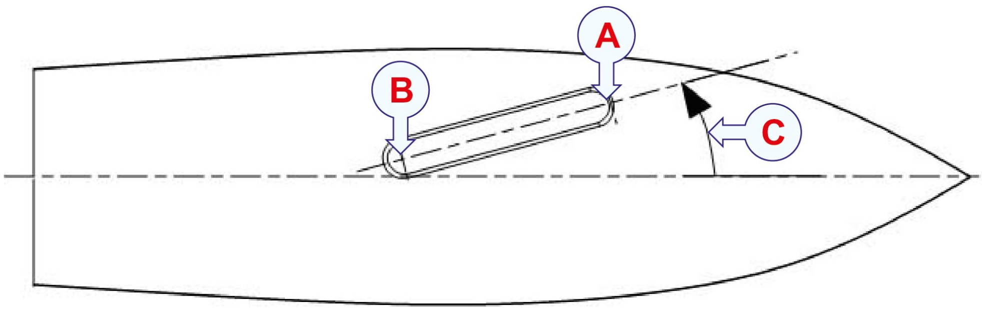
A Heading reference point #2

B Position reference point and centre of the internal GNSS antenna no. 1 **and** Heading reference point #1

Figure 10 Location of position reference point in Z direction, 92.8 mm above sensor unit holder



The location of the two heading reference points used for determining the mounting angle (heading offset). Angular offset between the line from heading reference point #1 to #2 and the vessel centre line (CL) have to be determined and input in the **NAV Engine configuration** as the heading offset.



A Heading reference point #2

B Heading reference point #1

C Heading offset

Related topics

- *Entering sensor unit location parameters* on page 46

5.4.1 Surveying the sensor unit

For the sensor unit the following should be surveyed:

- Position reference point (X, Y, Z). The distance vector from the Origin to the position reference point has to be measured up.
- Mounting angle in heading. The angular offset between the vessel centre line (CL) and the line from heading reference point #1 to #2 and have to be determined and input as heading offset in the **NAV Engine configuration**.

Related topics

- *Entering sensor unit location parameters* on page 46

5.5 Determining the distance vectors

The MGC and the sensor unit both measure the motion for the location where they are located. These measurements must be transformed to be able to measure the motion in a common reference point, NRP (Navigation Reference Point). The NRP is the reference point for all measurements in this system.

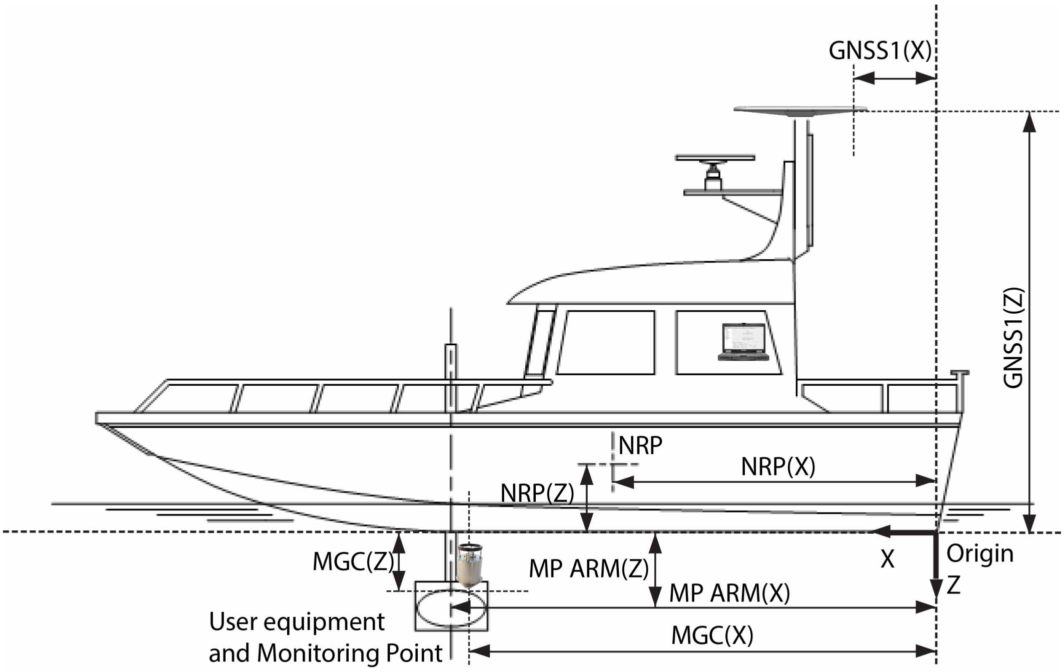
The following distance vectors have to be determined and entered into the various dialog boxes in the **NAV Engine Configuration**:

- The distance vector from the Origin to the position reference point (GNSS antenna no. 1) (GNSS Geometry).
- The distance vector from the Origin to the MGC location (MGC Geometry).
- The distance vector from the Origin to the selected NRP location (Vessel Geometry).
- The distance vectors from the Origin to each of the monitoring points (maximum eight MPs) (Monitoring points Geometry).

All these distance vectors have to be measured or calculated based upon drawings or previously measured points. These vectors are to be measured within an accuracy described in on page . Positive vector orientation for these parameters is

- X - positive forwards
- Y - positive towards starboard
- Z - positive downwards with the Origin as the reference point.

The illustration shows distance vectors between the different components.



Related topics

- *Entering sensor unit location parameters* on page 46
- *Setting vessel dimensions and reference points* on page 43
- *Setting monitoring points* on page 58
- *Survey accuracy* on page 38

5.6 Survey accuracy

The Seapath product must be surveyed to the following accuracy level. If not, the performance of the product will be degraded.

- Distance vector from the Origin to the sensor unit position reference point (X, Y, Z): < 0.01 metre
- Distance vector from the Origin to the user defined monitoring points (X, Y, Z): < 0.01 metre
- MGC misalignment angles (Roll, Pitch) with the vessel axes: < 0.1°
- MGC heading misalignment angle with the vessel axes: < 0.1°

6 Setting to work

6.1 Setting to work summary

Once all the hardware units have been installed, and all the cables have been connected, the Seapath can be powered up for the first time, and set to work.

Prerequisites

- All hardware units have been installed according to the relevant instructions.
- All system cables have been installed.
- All connections have been made.
- All operating power is available.
- All external devices which shall communicate with the Seapath are available and operational.
- All relevant personnel and tools are available.

Procedure

1 Verify that the Seapath is ready for operational use.

- **a** Verify that all hardware units have been installed correctly.
- **b** Verify that all cables have been connected correctly.
- **c** Verify that the Seapath operator software is installed on an external PC.

2 Power up the Seapath for the first time.

3 Configure the Seapath for operational use.

- **a** Configure the location and heading offset of the sensor unit.
- **b** Configure location and mounting angles for the MGC.
- **c** Configure location of monitoring points.
- **d** Configuration of communication interfaces.

4 Set up interfaces to external devices.

To provide correct information the system needs to communicate with external devices. All these interfaces must be set up in the system software.

5 Create a backup with the system configuration and software installation.

Once all system configuration and testing have been completed, it is recommended to make a backup of the configuration data and software installation

6.2 Verifying that the Seapath is ready for operational use

The Seapath system is ready for operational use when:

- All cables are properly connected. Verify that the MGC cable is connected to connector A on the subsea bottle.
- The power is correct. The system operates on 24 V DC power from the vessel's mains supply.
- The Seapath application has been installed on an external PC.

6.3 Powering up the Seapath for the first time

When you have verified that all hardware units and cables have been properly installed, and that the supply power is correct, you can power up the Seapath system for the first time. The Seapath starts up automatically when correct power is applied.

6.4 Configuration management description

6.4.1 Entering the configuration management system

The configuration parameters are available from:

- the **System** menu →**NAVEngine** →**Standard** for system configuration and
- the **System** menu →**Operator SW** for display views configuration.

To be able to make changes to the setup you must be in **Configuration** mode for standard configuration tasks or **Engineering** mode for advanced configuration and diagnostic tasks.

Note

Advanced NAVEngine configuration is for service personnel only.

6.4.2 Operator software configuration description

You can adjust the appearance of the display views through the **Operator software configuration** dialog box.

The dialog box contains tab pages for various presentation options and each page contains two confirmation buttons with different properties and a cancel button.

- **OK button**: selecting the **OK** button will save the changes and close the **Operator software configuration** dialog box.

- **Apply button**: selecting the **Apply** button will save the changes but the **Operator software configuration** dialog box will not close.
- **Cancel button**: selecting the **Cancel** button will close the dialog box and changes will not be saved.

Note

The position properties selected in the Operator software configuration dialog box are only for display purposes.

6.4.3 NAV Engine Configuration

You can configure the system parameters from the **NAV Engine Configuration** dialog box.

The dialog box consists of a list of configuration options, a parameter settings section, an exit button and three buttons which each has different properties with regard to configuration changes.

Apply

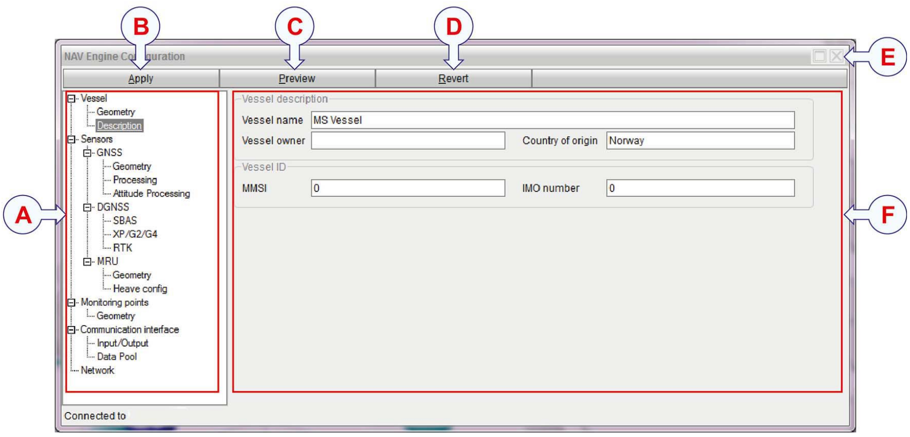
Select **Apply** to apply the configuration changes to the system. This button is disabled until you have made configuration changes. The button will be disabled when there are no configuration changes to apply.

Preview

Select the **Preview** button to see which parameters have changed since the configuration was loaded. Changed settings are highlighted in bold face. This button is disabled until you have made any configuration changes. Please note that monitoring point changes are displayed in the coordinate system in which they are actually stored by the configuration, i.e. related to the navigation reference point rather than origin.

Revert

Select the **Revert** button to reject all changes you made since the configuration was loaded. The button is disabled until changes have been made.



A Configuration options list

B Apply confirmation changes button

C Preview last configuration settings button

D Revert to previous settings button

E Exit NAV Engine Configuration

F Parameter settings section

6.4.4 Changing the system mode

The system has three modes: **Operation**, **Configuration**, **Engineering**. To be able to make changes to the setup you must be in **Configuration** or **Engineering** mode. You need a password to enter these modes. The password is **STX** and it is not case sensitive. The password is not possible to change.

Via the System menu

Procedure

1. Select the **System** menu →**Change system mode**.
2. Select either **Configuration** or **Engineering** to open the **Change system mode** dialog box.

3. Type the password **STX** and select **OK**. The password is not case sensitive.

   You are now able to carry out changes and/or set system parameters.

With keyboard commands directly from the display

Procedure

1. In the display, press
   - **CTRL+E** to enter Configuration mode
   - **CTRL+A** to enter Engineering mode

   Observe that the **Change system mode** dialog box appears.
2. Type the password **STX** and select **OK**. The password is not case sensitive.

   You are now able to carry out changes and/or set system parameters.

6.5 Required sensor unit configuration

6.5.1 Setting vessel dimensions and reference points

Prerequisites

The navigation reference points you enter in this dialog box must be measured or defined before you start the configuration process.

Context

This is information you need in order to specify correct location of various sensors, equipment and monitoring points on a vessel. The information you enter in this dialog box will help you later in the configuration process. The drawing is correctly scaled based on the vessel dimensions to ensure correct indication of the various points. The measurement unit of the entered coordinates is metres.

Shape type

Defines the shape of the vessel hosting the system. You can select between Ship, Rig, Jackup (3 leg) and Jackup (4 leg). These are all scaled according to the dimensions given in the **Shape dimension** section. The general shape outline can be overridden by an actual shape defined in a drawing file. Supported file extensions are **Vessel models(*.svm)**, **Vessel vector images (*.svi)** and **Old vessel images (*.txt)**. This file can be created or edited in a text editor. When a valid drawing file has been loaded, the dimensions are defined by the loaded shape and the **Shape dimension** parameters are locked.

Shape dimensions

Holds parameters for the overall length of the vessel from stern to bow, the overall width of the vessel and the overall height, which is the distance from the highest point of the vessel to the keel.

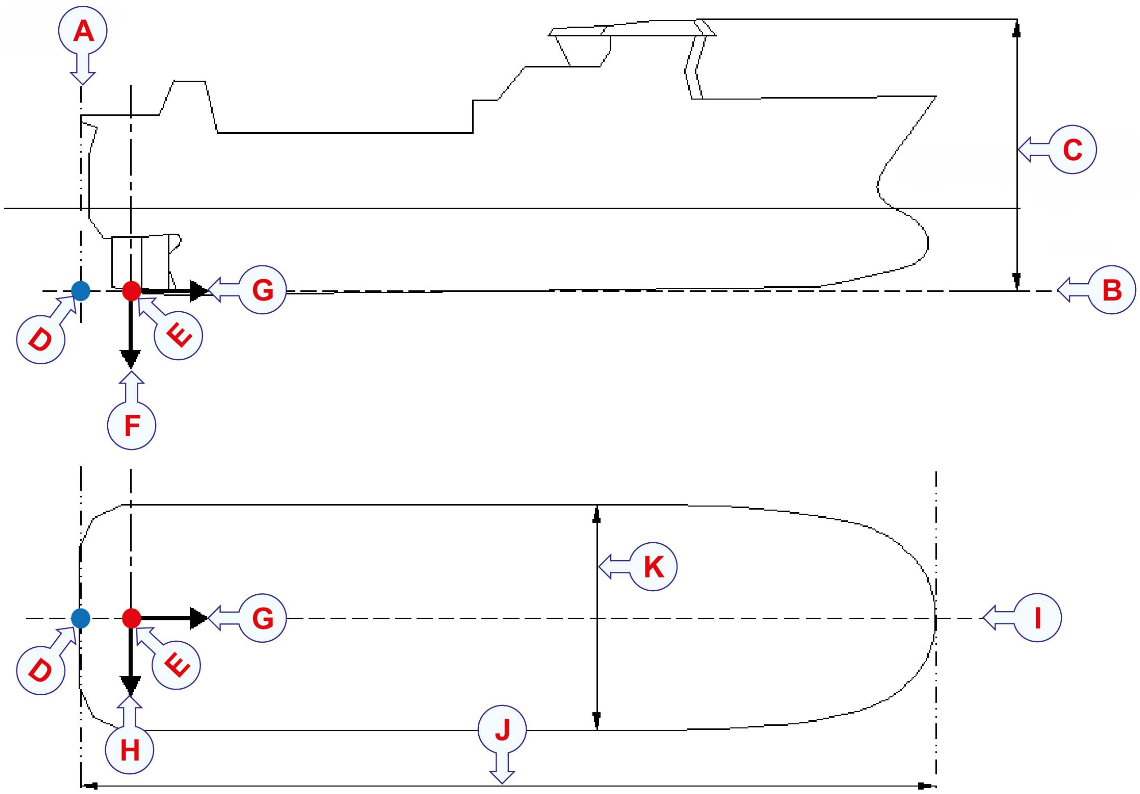
Origin location in drawing

All point locations in the configuration refer to the origin. The location of the origin is defined using distance from stern, center line and keel (often referred to as the CRP (common reference point) in survey reports). The distance from stern is the distance from the aft point of the ship to origin along the X axis. The distance from CL is the distance from the vessel's centre line, positive towards starboard. The distance from keel is the distance from the keel, positive downwards.

Navigation reference point (NRP)

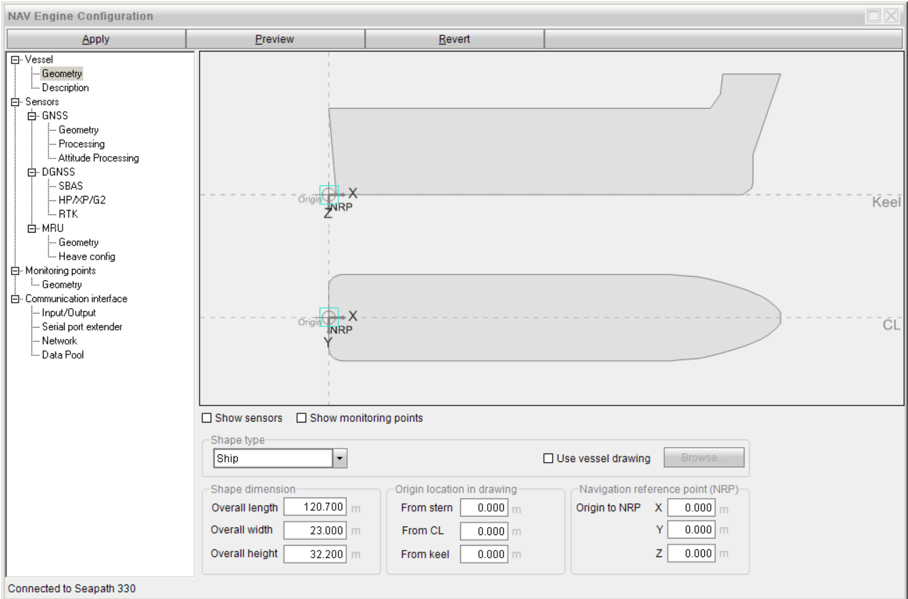
The Navigation Reference Point location (NRP) is the reference point for all measurements in the system. The recommended NRP is near the Centre of Gravity (CG), but can be chosen freely. It is always defined related to the origin.

The illustration shows different vessel dimensions and location of origin. If a survey report is available the vessel origin should be located in the common reference point (CRP) used in the report.



A	Stern	**G**	+X axis
B	Keel	**H**	+Y axis
C	Overall height	**I**	CL (centre line)
D	CRP (common reference point)	**J**	Overall length
E	Origin	**K**	Overall width

F +Z axis



Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Vessel** →**Geometry**.

3 Select the shape of your vessel from the **Shape type** list or select **Use vessel drawing** if you have a specific vessel shape file you want to use. Select **Browse** to search for the wanted file.

If you select **Use vessel drawing**, the Shape dimension parameters will be locked.

4 Type the overall length, width and height dimensions of your vessel.

5 Type the parameters for location of origin (survey origin).

6 Type the navigation reference point location, X, Y, Z.

7 Select **Show sensors** and/or **Show monitoring points** if you want to display these objects in the vessel illustration.

8 Select **Apply** to store the settings.

Related topics

- *Importing vessel shape from file* on page 70
- *Determining the distance vectors* on page 37
- *Survey accuracy* on page 38

6.5.2 Entering sensor unit location parameters

The antenna position, heading offset and height difference parameters have to be input correctly. If not, the performance of the system will be degraded. The antennas are included in the sensor unit.

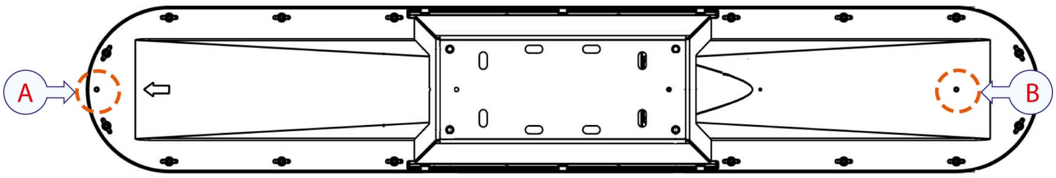
Prerequisites

The sensor unit location parameters have been surveyed or measured:

- For **Antenna location**: The position reference point (X, Y, Z). The distance vector from the Origin to the position reference point.
- For **Antenna offset**: The mounting angle in heading. The angular offset between the vessel centre line (CL) and the line from heading reference point #1 to #2 called the heading offset.

Context

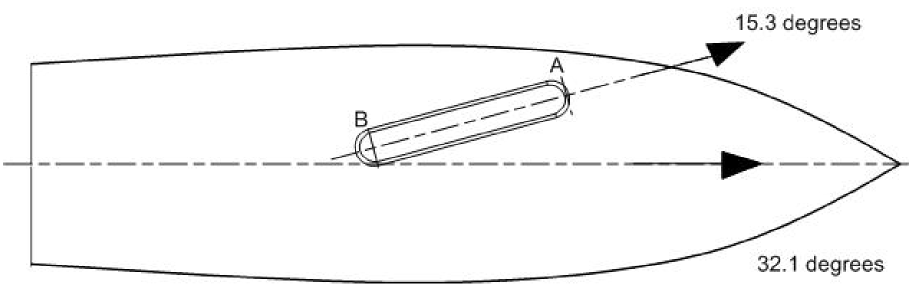
The reference points on the sensor unit are used to determine the position and orientation of the sensor unit on the vessel where it is mounted.



A Heading reference point #2

B Position reference point and centre of the internal GNSS antenna no. 1 **and** Heading reference point #1

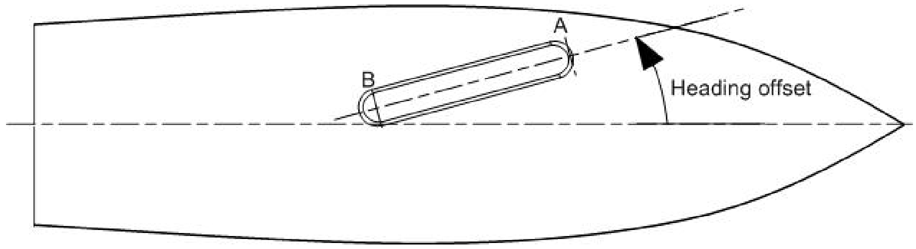
The location of the two heading reference points is used to determine the mounting angle (heading offset). The angular offset between the line from heading reference point #1 to #2 and the vessel centre line (CL) have to be determined and entered into the **NAV Engine configuration** as the heading offset.

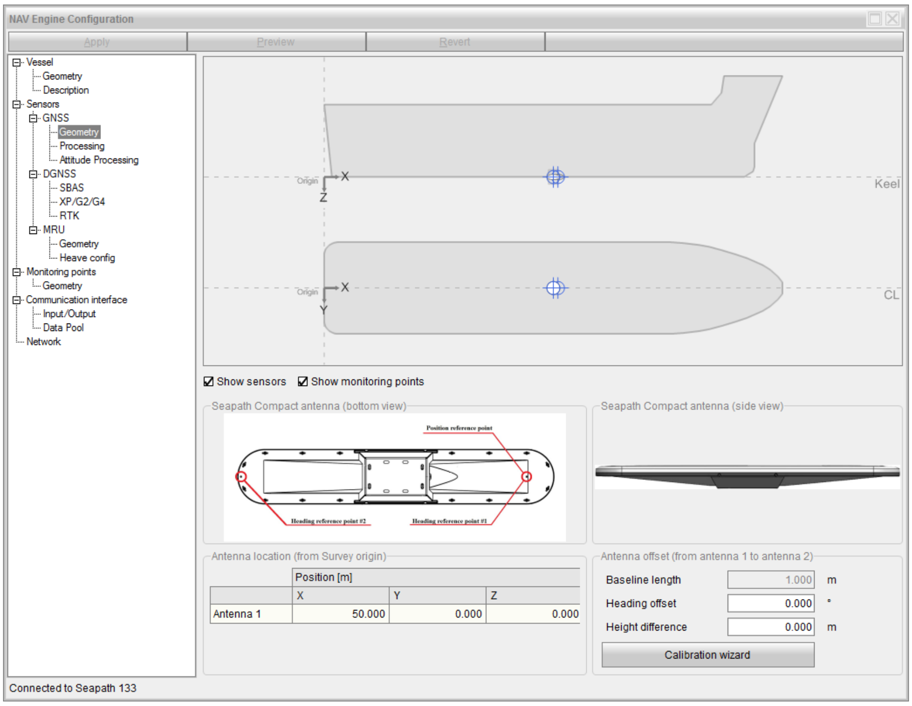


Example 1 Heading offset calculation

If the **Reference heading** measured by the reference system is found to be 32.1 degrees and the **GNSS heading** after the calibration is 15.3 degrees, the **Determined heading offset** will be (32.1 - 15.3). Observe that the heading offset is positive counterclockwise, and in the range [0,360] degrees.

Example 1 Heading offset calculation (cont'd.)





Procedure

1 Click the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Click the **Sensors** node →**GNSS** →**Geometry**.

3 Type the surveyed distance vector to the position reference point (antenna 1) in metres in the **Antenna location (from Origin)** table (X, Y and Z coordinates).

4 Type the surveyed **Heading offset** in degrees.

5 Type the **Height difference** in metres. For first time installation use the **Calibration Wizard** to calculate the correct height difference.

6 Observe that the sensor unit is located as expected in the vessel drawing. If not, check the signs and the location entered for the Antenna 1. Also, check the vessel dimensions and origin location in **Vessel geometry**.

Related topics

- *Determining the sensor unit position and orientation* on page 35

- *Surveying the sensor unit* on page 36
- *Determining the distance vectors* on page 37

6.5.3 Using Calibration Wizard to determine antenna parameters

Use the Calibration Wizard to determine the heading offset and the antenna height difference for the sensor unit.

Prerequisites

Readings of the vessel reference heading data on another PC or by manual readings have to be available before starting the wizard.

Context

Calibration the direction of the sensor unit against an external reference. Type of reference must be decided according to the required accuracy. The following calibration parameters have to be determined:

- **Heading offset**. The direction of the sensor unit relative to the vessel's longitudinal axis is measured in degrees.
- **Height difference**. The height difference between the two internal antennas within the sensor unit according to the vessel horizontal plane (the height to antenna #1 minus the height to antenna #2, compensated for vessel roll and pitch) is measured in metres..

It is of crucial importance to calibrate the heading offset correctly. During this calibration, several accurate reference measurements of the vessel heading must be read/logged simultaneously with the heading output from the Seapath. The data logging should continue for at least two hours under calm conditions alongside a quay. The best results are achieved if continuous logging of both the reference system and the Seapath measurements can be performed during the calibration period. If simultaneous logging of the two systems is not possible, one reading from both systems should be done at least every 30 seconds for a minimum of two full hours.

The long calibration time is necessary in order to eliminate errors in the Seapath measurements caused by multipath effects, which may be particularly pronounced in the static conditions of a harbour area.

Note

*Before entering the **Calibration wizard**, ensure that all configuration changes, including the correct MGC mounting angles, are applied by pressing the **Apply** button in the menu bar. Also, verify that roll, pitch and heading measurements are indicated as valid (green) before starting the wizard.*

Procedure

1 Click the **Calibration wizard** button to start the calibration. The system will indicate when calibration measurements are ready.

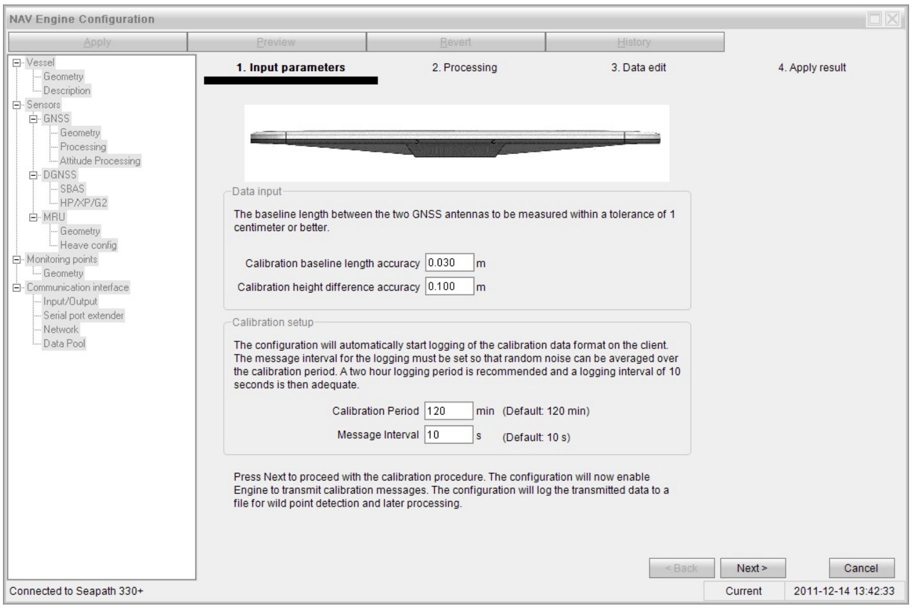
2 In the antenna Calibration Wizard Step 1 **Accuracy**, modify the baseline length and height difference accuracy values if needed. Clicking **Apply** will restart the calibration measurements.

3 If calibration measurements are unavailable, click **Cancel** and check that the prerequisites listed in the note above are all met. Then restart the Calibration Wizard.

4 The **Next** button will be enabled as soon as measurements are ready.

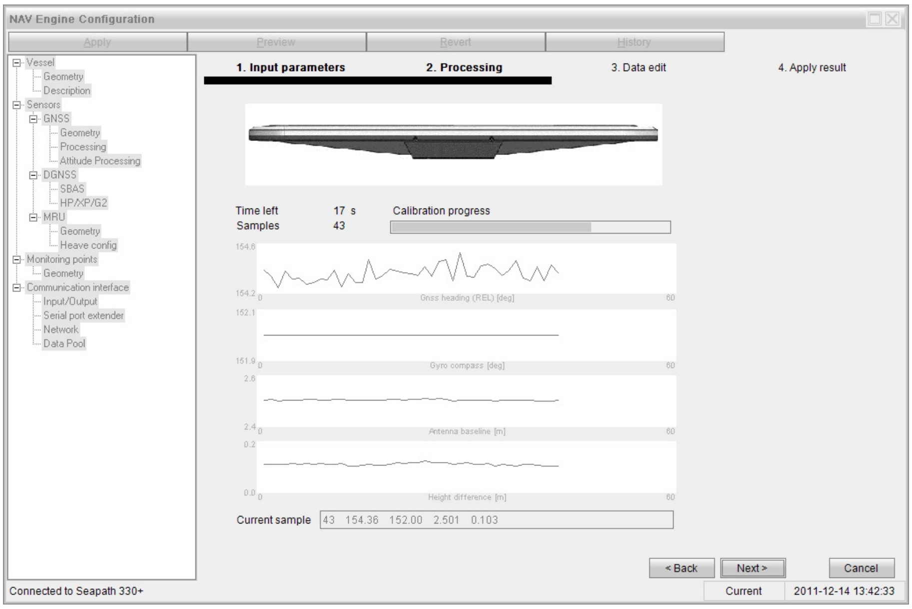
5 Click **Next** to continue to Calibration Wizard Step 2 **Period**.

6 Modify calibration period and message interval if needed. The default values are recommended.

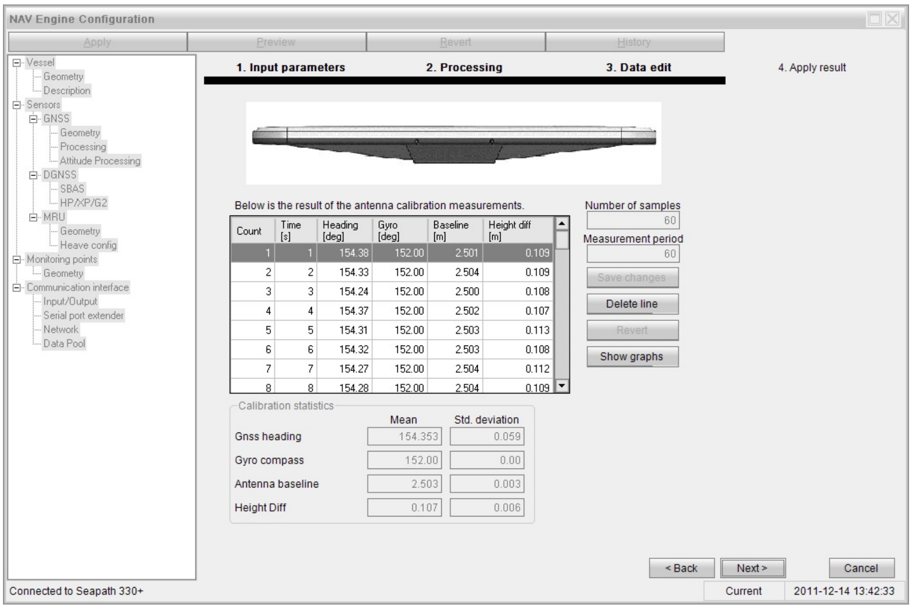


7 Before clicking **Next** to start the calibration logging, it is recommended to start recording data of the vessel reference heading on another PC or by manual readings. When logging of the reference heading has started, click **Next** in order to proceed to page 3 **Processing**.

8 The progress of the logging is indicated on the screen with a graphical presentation of the measured data.



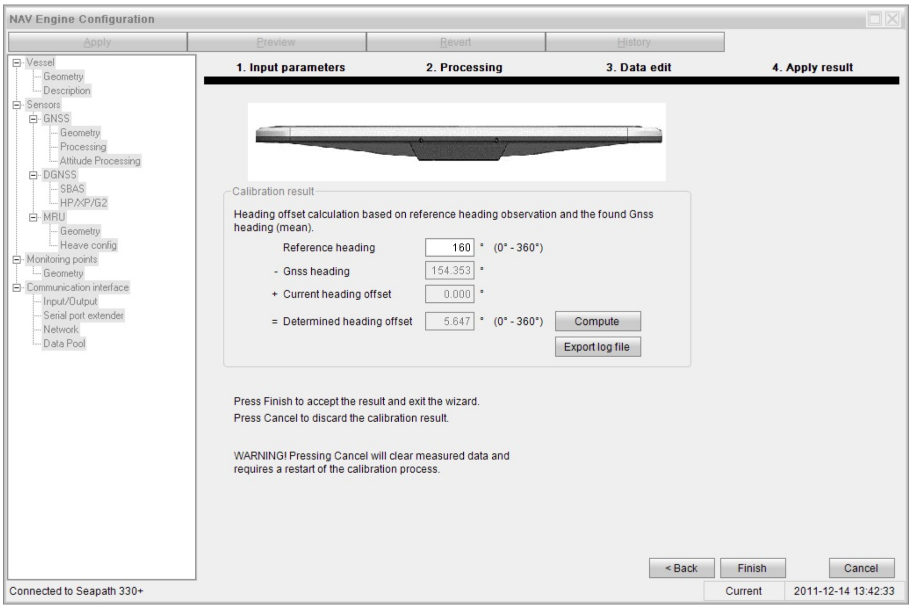
9 Click **Next** to proceed to Step 4 **Validation** for inspection of the logged data.



10 Delete possible wild points by selecting the corresponding row in the table, then click **Delete line**.

11 When the calibration result has been found acceptable, click **Next** to proceed to the last step, **Apply result**.

12 Enter the mean value for the vessel heading reference, then click **Update** in order to calculate the heading offset.



Click **Export log file** if the calibration data are wanted for post processing.

13 Click **Finish** to accept the result and exit the antenna Calibration Wizard.

14 The **Baseline length**, **Heading offset** and **Height difference** fields are automatically updated upon successful completion of the Calibration Wizard, according to the calibration result.

15 Click **Apply** in the menu bar to save the calibration information.

6.5.4 Setting MGC location and mounting angles

The physical location of the MGC relative to the origin and its mounting angles is required for the Seapath system to be able to calculate position, roll, pitch and heading correctly.

Prerequisites

For accurate location of the motion reference unit you will need detailed vessel drawings.

Context

The MGC measures the roll, pitch, yaw and heave motions of the vessel. In the **MGC Geometry** dialog box you must define the physical location of the MGC sensor related to the origin location you created in the **Vessel Geometry** dialog box.

In the **MGC Geometry** dialog box you enter the MGC location parameters, the X, Y and Z coordinates in meters and the MGC mounting angles, the roll, pitch and yaw parameters in degrees. Look at the vessel drawing to help you enter the correct signs for the coordinates and to check if the motion reference unit appears on the expected spot.

If something looks out of place, check the signs and X, Y, Z coordinates you typed for the sensor location and/or return to the **Vessel Geometry** dialog box and check the vessel shape dimensions, the origin location and the navigation reference point (NRP) location.

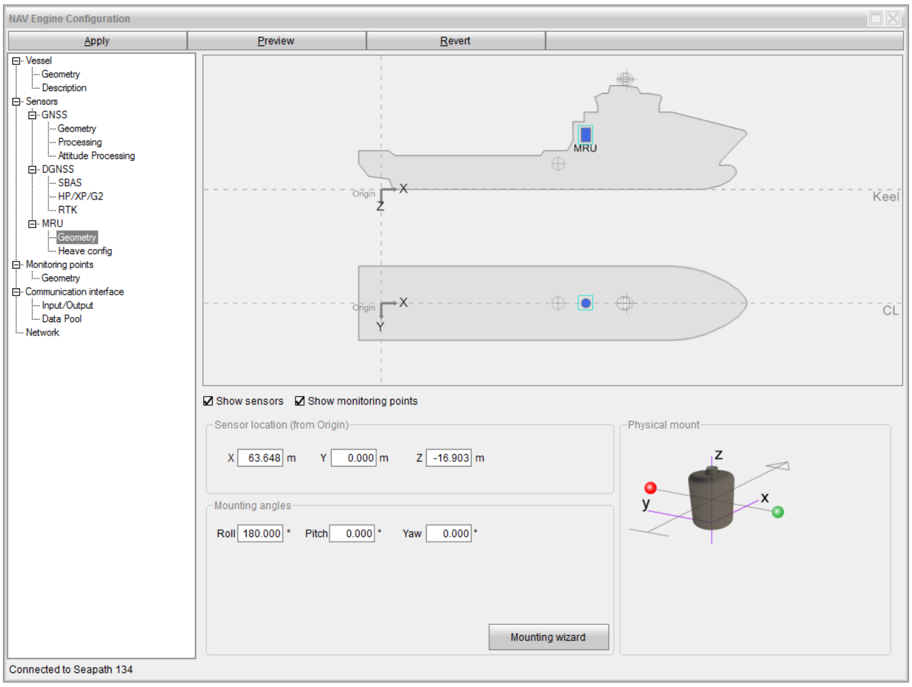
The MGC mounting angles can either be input manually or determined by use of the **Mounting wizard**. The Mounting Wizard is located in the **NAV Engine Configuration →Sensors →MGC →Geometry**.

Sensor location (from origin)

The position of the MGC in X, Y, Z coordinates in metres from Origin. The sensor unit location has to be measured or calculated based upon drawings or previously measured points. The default location of the sensor unit is in the vessel Origin.

Mounting angles

The mounting angles of the sensor unit in degrees for roll, pitch and yaw.



Procedure

1 Click the **System** menu, **→NAVEngine →Standard** to open the **NAV Engine Configuration** dialog box.

2 Click the **Sensors** node **→MGC →Geometry**.

3 Type the X, Y and Z coordinates in metres from Origin to MGC location.

4 Type the mounting angles in degrees for roll, pitch and yaw.

If the mounting angle values are not known to you, use the Mounting Wizard to calculate these values.

5 Click **Apply** to store the settings.

Related topics

- *Determining the distance vectors* on page 37
- *Using Mounting Wizard to determine MGC mounting angles* on page 53

6.5.5 Using Mounting Wizard to determine MGC mounting angles

Use the Mounting Wizard to determine the roll, pitch and yaw mounting angles in degrees for the MGC sensor.

Prerequisites

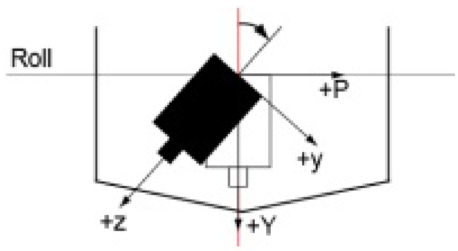
The MGC offset angles have to be available from a survey report or through other methods with similar accuracy.

Context

The mounting bracket offset angles which have to be entered are roll, pitch and yaw.

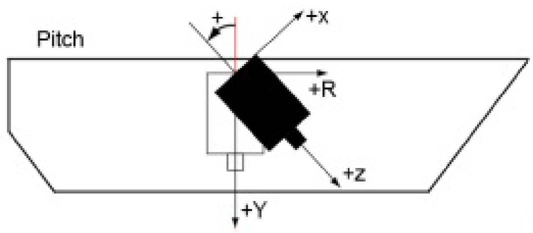
Roll offset angle

The angle between the ship's Y-axis and the projection of the sensor z-axis in the ship's PY-plane. Positive roll offset angle if the bracket tilts to starboard.



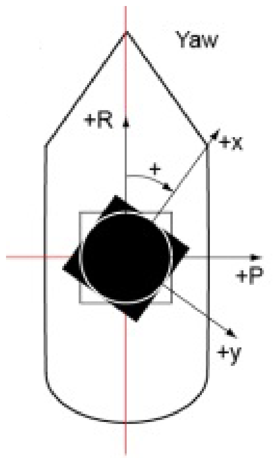
Pitch offset angle

The angle between the ship's Y-axis and the projection of the sensor z-axis in the ship's RY-plane. Positive pitch offset angle if the bracket tilts to stern.



Yaw offset angle

The angle between the ship's R-axis and the projection of the sensor x-axis in the ship's RP-plane. Positive yaw offset angle if bracket is rotated clockwise.



Note

If the mounting bracket offset angles exceed 45 degrees, another main rotation should be selected.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select the **Sensors** node →**MGC** →**Geometry**.

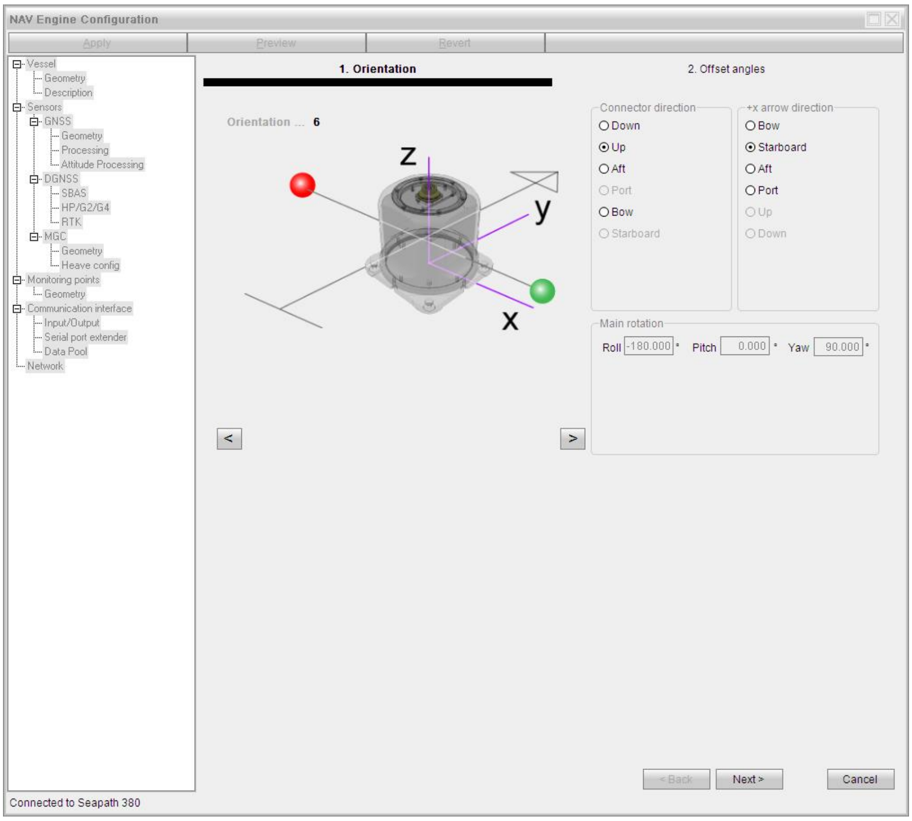
3 Select the **Mounting Wizard** button and use the wizard to calculate the roll, pitch and yaw mounting angles.

   The red circle indicates Port and the green circle indicates Starboard. The arrow points in the bow direction.

4 In step 1, **Orientation**, select the < or > buttons to turn the motion reference unit around in 90-degree steps, axis by axis. Click until the correct mounting orientation of the motion reference unit has been found.

   Observe that the parameters for roll, pitch and yaw in the Main rotation group are automatically updated with the actual main rotation of the motion sensor and gyro compass.

   Alternatively, select the **Connector direction** or **+x arrow direction** option buttons to select the motion sensor and gyro compass orientation.

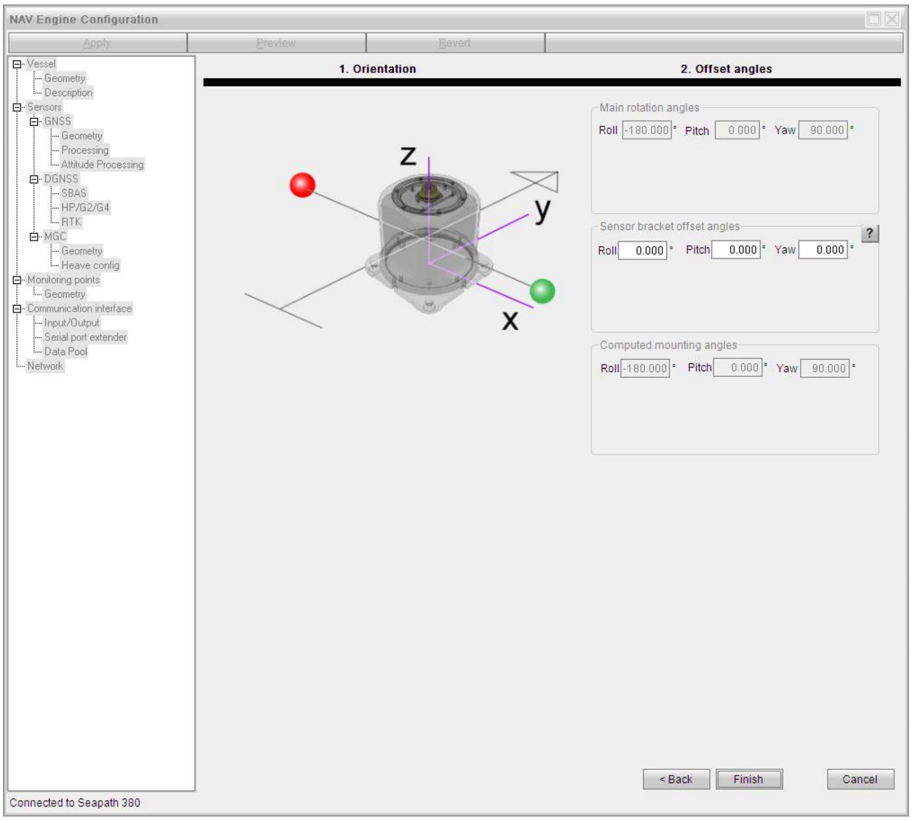


5 Select **Next** to continue to step 2, **Offset angles**.

Observe that the roll, pitch and yaw mounting angles are now indicated in the **Main rotation angles** group.

6 Type the surveyed sensor bracket offset angles in degrees for roll, pitch and yaw.

The system calculates the mounting angles automatically and the values appear in the **Computed mounting angles** group.



7 Select **Finish** when you are ready to complete the offset angle setting.

This will exit the wizard and take you back to the initial MGC **Geometry** dialog box.

8 Select **Apply** to store the settings.

Related topics

- *Survey accuracy* on page 38

6.5.6 Selecting heave filter options

The heave configuration parameters allow you to tune the heave parameters to the vessel motion characteristics for the actual weather conditions. This is important when using real-time heave measurements in order to achieve optimum heave performance.

Context

Before a survey and/or during operation check the heave performance and tune the heave parameters until the best heave performance is achieved. An alternative is to select *Automatic* and let the system automatically choose the best settings.

Heave filter options

Hydrographic survey

To be selected when the heave phase and amplitude have to be output correctly in real time. This mode is typically selected when the heave output signal from the system is to be used for heave compensation of echo sounders and offshore crane systems.

Automatic

To be selected when the vessel is operating in various sea states or when the average heave period is unknown. The *Automatic* filter mode estimates the average heave period and automatically sets the filter period in real time during operation. The *Automatic* filter mode uses the *Hydrographic survey* filter structure.

GNSS aided

To be selected when RTK DGNSS corrections are available or the GNSS velocity measurements are accurate. In this mode the heave and height measurements are determined by blending vertical acceleration and GNSS height measurements in a Kalman filter. This combination makes it possible to measure wave slopes and the tide in real time with high precision ideal for hydrographic work. The height measurements are provided with centimeter accuracy and independent of wave frequency. If RTK is not available the algorithm will use the GNSS velocity measurements for aiding the heave. If GNSS velocities are not available, the **Automatic** algorithm is used.

General purpose

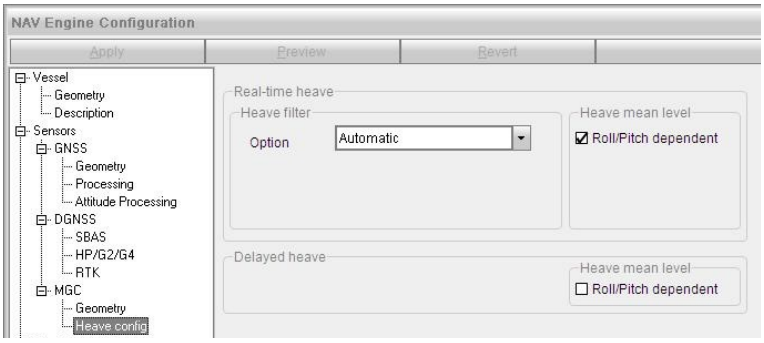
Is selected when the heave phase is of no importance. This mode is typically selected when the system is to be used for measuring the heave height and period on oceanographic buoys.

Period

An expected average heave period has to be set to the heave filter unless the automatic mode is chosen. The settling time for the heave measurements from power-on or after a turn will be about 10 times the selected period, T_0.

Roll/pitch dependent

Use the check box to enable whether the heave mean level should be dependent on the roll and pitch measurements or not. When enabled, the heave position in the monitoring points (MP) has now longer zero mean level, instead its value depends on the vessel tilt at any time. This option is useful especially in applications where the distance between the MP and the sea level is to be determined, like in echo sounder installations with depth changes due to changes in vessel trim and list. If not enabled, the heave will always have zero mean level. It is separate selections for the real time heave and the delayed heave (PFreeHeave).



Procedure

1 Click the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Click the **MGC** node →**Heave config**.

3 Select the heave filter mode you want to use from the **Options** list.

4 If you select **Hydrographic survey** or **General purpose**,

  a Type the wanted filter period. Allowed value between 1 and 25 seconds.

5 Select the **Roll/Pitch dependent** box if you want the heave measurement dependent on the roll and pitch measurements. It is separate selections for the real time heave and the delayed heave (PFreeHeave).

6 Click **Apply** to store the settings.

6.5.7 Setting monitoring points

You must define the locations on the vessel for which you want the system to calculate the position.

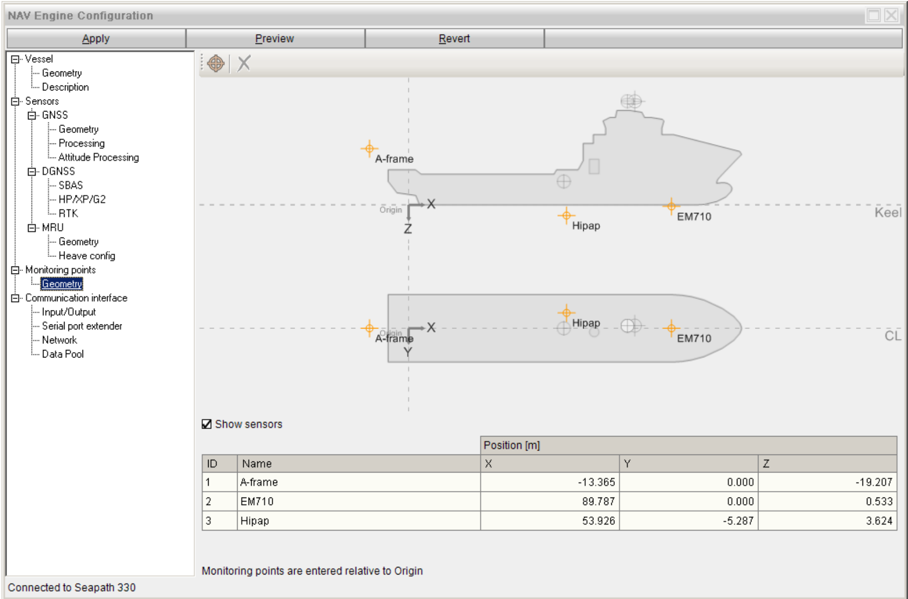
Prerequisites

To get exact coordinates from Origin to each monitoring point, each monitoring point has to be measured or calculated based upon drawings or previously measured points.

Context

In this dialog box you can define points (monitoring points) on the vessel where you want the position measurements to be output. The monitoring points are given relative to Origin (positive forward, towards starboard and down). The position of a monitoring point relative to the Origin is indicated in the drawing when the cursor is over the monitoring point. As soon as a monitoring point has been defined, its location is indicated in the vessel drawing. If a monitoring point appears incorrect, check the signs and the coordinates input for each monitoring point and the vessel dimensions and the entered location of Origin in the **Vessel Geometry** dialog box.

The system supports up to eight user definable monitoring points.



Procedure

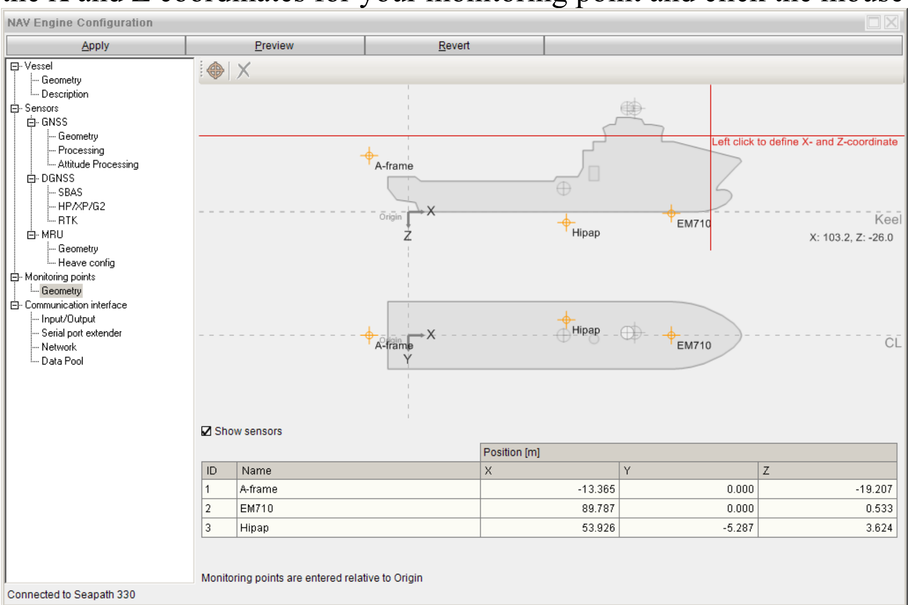
1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Monitoring points** →**Geometry**.

3 Select **Add** at the top of the page to add a monitoring point.

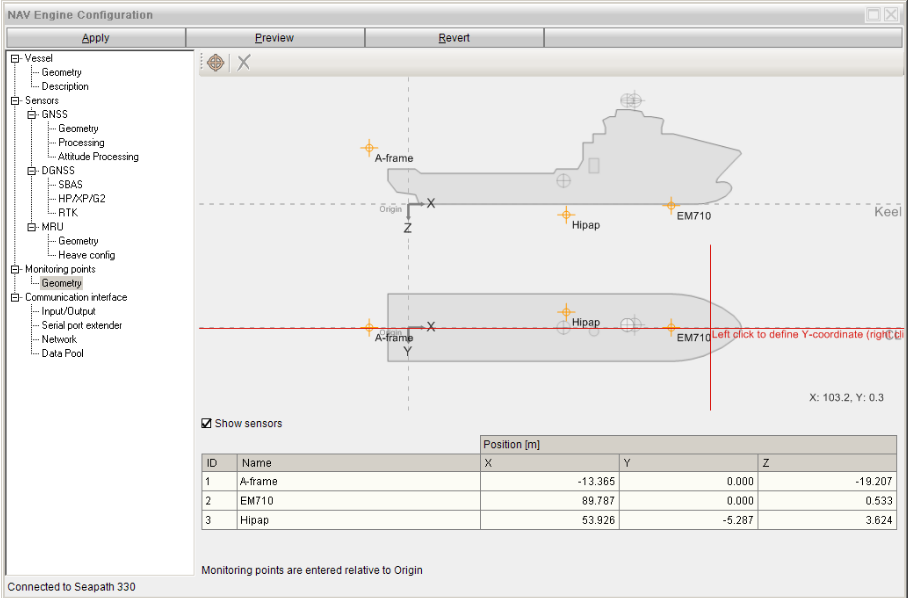
Observe that the cursor changes to two red lines which will help you to place the new monitoring point in the drawing.

4 Drag the cursor to the location on the **upper** vessel drawing where you want to add the **X** and **Z** coordinates for your monitoring point and click the mouse button.

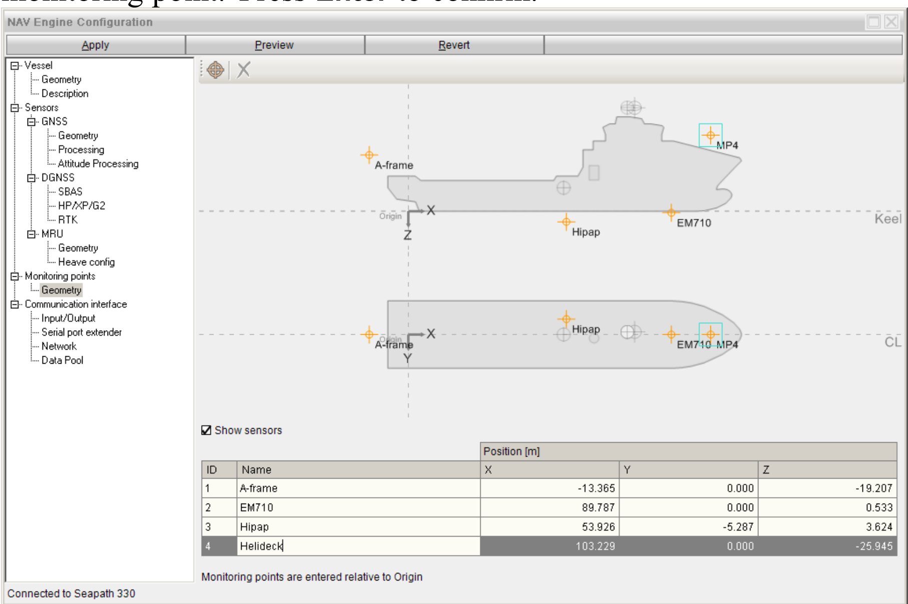


5 Continue and drag the cursor to the location in the **lower** vessel drawing where you want to add the **Y** coordinate for your monitoring point and click the mouse button.

Observe that coordinates for the new monitoring point appear in the monitoring points table. These will also help you to get the wanted location for your monitoring point.



6 Select the **Name** column in the table and type an identifying name for your monitoring point. Press **Enter** to confirm.



7 Select the **X**, **Y** and **Z** columns and adjust the coordinates by typing the exact location of the monitoring point, if necessary. Press **Enter** to confirm.

8 Select **Apply** to store the settings.

Deleting a monitoring point

You can delete a monitoring point by selecting the wanted point in the table and clicking **Delete** X.

Related topics

- *Determining the distance vectors* on page 37
- *Survey accuracy* on page 38

6.5.8 Communication interfaces description

The communication interfaces are set in the **NAV Engine Configuration** dialog box under **Communication →Input/Output**. The **Input/Output list** shows all input and output ports which are available in the system.

When you select an **Interface** in the **Input/Output list**, the **Configuration details** part for that particular interface will appear in the lower part of the page. These details will change based on the interface type you have selected, Serial or Ethernet. You must select either Serial or Ethernet for all available interfaces before you select the specific parameters for a particular interface.

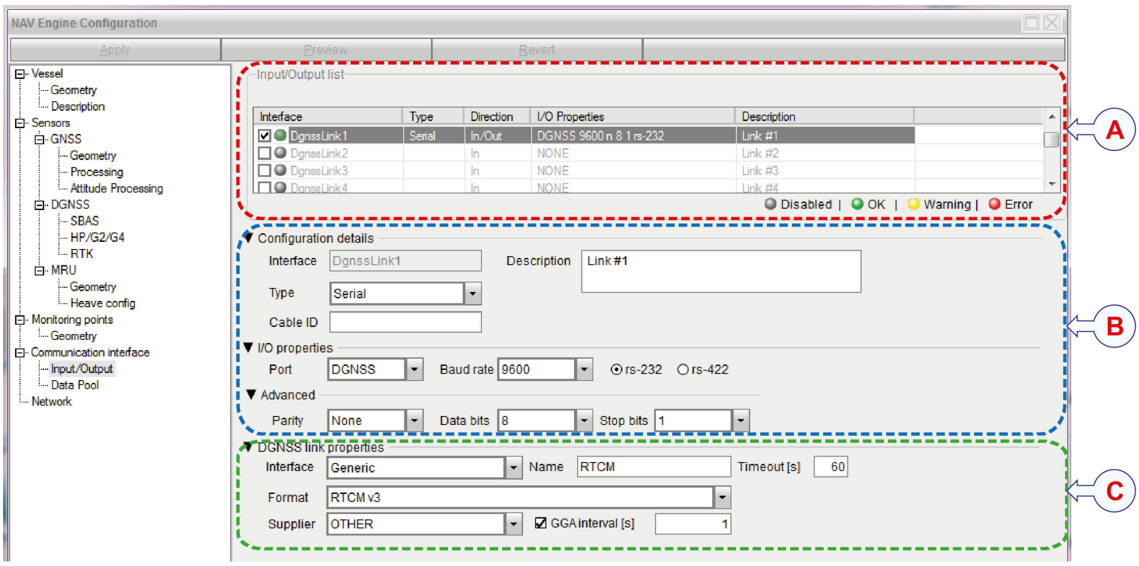
Select the arrow next to the group headings to show or hide the information.

To be able to get a properly working system you must set up these communication interfaces:

- MGC
- Telegram out
- DGNSS link

Note

You are not able to configure the GnssReceiver interface and the MRU interface.



A Selected interface in Input/Output list

B Type of interface selection: Serial or Ethernet

C Specific configuration details for the selected interface

This procedure sums up the steps you have to go through to set up the communication interfaces for the system.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Communication interface** →**Input/Output**.

3 Select the interface you want to set up in the **Input/Output list**.

Observe that the **Configuration details** parameters appear at the lower part of the page.

4 Select which type of interface you want to use from the **Type** list: Serial or Ethernet.

5 Select the wanted I/O parameters. These will vary depending on the type of interface you selected.

6 Select the specific parameters you want for the interface you selected.

7 Select **Apply** to store the settings.

6.5.9 Using the Serial interface

The Serial interface allows you to decide how the sensor unit shall communicate and interface to other equipment.

Context

If you have decided to use a Serial interface, you must set up the port number, the baud rate and select RS-232 or RS-422 mode.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Communication interface** →**Input/Output**.

3 Select the interface you want to set up.

Observe that the **Configuration details** parameters appear at the lower part of the page.

4 Select **Serial** in the **Type** list.

5 Type an informative text about the interface in the **Description** box. This is optional.

6 Type a short identification text for the cables connected to the sensor unit in the **Cable ID** box. This is optional.

7 Select which port to use from the **Port** list.

The serial port number corresponds with the number on the sensor unit.

8 Select which baud rate you want to use from the **Baud rate** list. Maximum baud rate is 115200 bits/second.

9 Depending on which port you selected, select if you want to use RS-232 or RS-422 for the electrical interface.

10 Select the properties for the interface you selected in the **Input/Output list**.

- MGC: **MGC** properties

- DGNSS link: **DGNSS link** properties
- Telegram out: **Telegram out** properties and **Telegram timing**

Result

You are now ready to set the specific parameters for the interface you have selected. See separate sections for selection details.

Related topics

- *Output protocols* on page 105

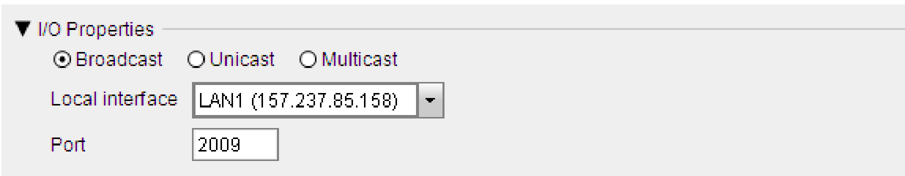
6.5.10 Using the Ethernet interface

The Ethernet interface allows you to decide how the sensor unit shall communicate via the internet protocol (IP) network.

Context

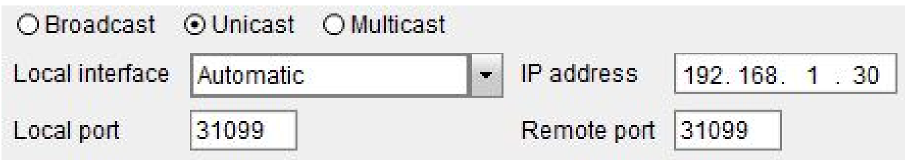
Broadcast

Broadcasting is a method of transferring a message to all recipients simultaneously.



Unicast

Unicast transmission is the sending of messages to a single network destination identified by a unique address.



Multicast

Multicast (one-to-many or many-to-many distribution) is group communication where information is addressed to a group of destination computers simultaneously.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Communication interface** →**Input/Output**.

3 Select the interface you want to set up in the **Input/Output list**.

Observe that the **Configuration details** parameters appear at the lower part of the page.

4 Select **Ethernet** in the **Type** list.

5 Type a short identification text for the cables connected to the sensor unit in the **Cable ID** box. This is optional.

6 Select the wanted connection type: Broadcast, Unicast or Multicast.

- **Local interface**: The LAN port on the sensor unit.
- **Local port**: When receiving, this is the port on which the unit listens.
- **Remote port**: When transmitting, this is the port to which the unit sends.
- **IP address Unicast**: The target IP address, to which the unit is receiving or sending.
- **IP address Multicast**: The multicast group address. Recommended range: 239.255.000.000 to 239.255.255.255.

Note

It is recommended to use the same port number for both Local and Remote ports.

7 Depending on the connection type you have selected, select which local interface you want to use from the **Local interface** list.

8 Select the properties for the interface you selected in the **Input/Output list**.

- DGNSS link: **DGNSS link** properties
- Telegram out: **Telegram out** properties and **Telegram timing**

Result

You are now ready to set the specific parameters for the interface you have selected. See separate sections for selection details.

Related topics

- *Output protocols* on page 105

6.5.11 Setting up the Telegram out interface

The Telegram out function allows you to enable and set up data messages transmitted to external equipment.

Context

Up to 16 serial and/or network interfaces can be configured.

Format

The format of the output telegrams.

Datum

The datum selection is only valid if the datum on the corrections input to the product are in WGS84 or no corrections are input. If the corrections input are in another datum than WGS84, you must select **WGS84** (which should actually have been labelled "No transformation" in this software). The datum of the output will then be on the same datum as the datum on the corrections input to the product. The other choices can only be used when the system navigates in WGS84 datum.

Monitoring point

A point on the vessel for which you want the position measurements to be output.

NMEA selection

The NMEA selection option is activated if the Format is selected as NMEA. Select between a number of NMEA telegrams.

Options

The contents of some of the available NMEA telegrams can be modified according to options listed in the **Options** list. This is for example useful when interfacing to older equipment.

NMEA talker ID

The talker ID of NMEA messages sent from this output. The default is IN.

Log to file

Logs the measurements to file internally in the system.

Time precision

Number of decimals in the time field in NMEA telegrams which supports Time precision.

Interval

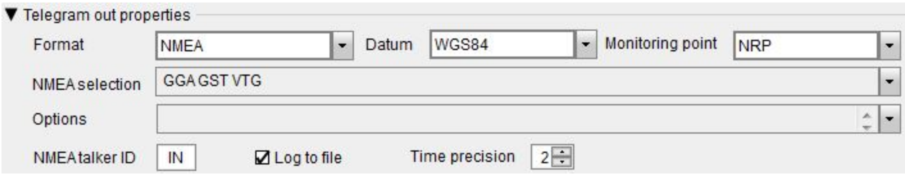
The interval between each sample. Can be selected in the range 0.005 to 3000 seconds.

Event driven

The output of data is driven by receipt of MRU data to the Processing Unit. **Event driven** data is valid for the point in time the sensors within the MRU are sampled. Recommended used when transmission in real time is not required, typically for telegrams that include time information like Seapath binary 3, 11, 23 and 26.

Timer driven

By timer driven output the data will be output in real time (0 ms delay). **Timer driven** output is recommended used when the data is preferred in real-time and for instance when the system that receives the data time stamp it by receipt. Typically used when the EM3000 format is output.



Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select the **Communication interface** node →**Input/Output**.

3 Select the **TelegramOut** interface you want to set up in the **Input/Output list**.

Observe that the **Configuration details** parameters appear at the lower part of the page.

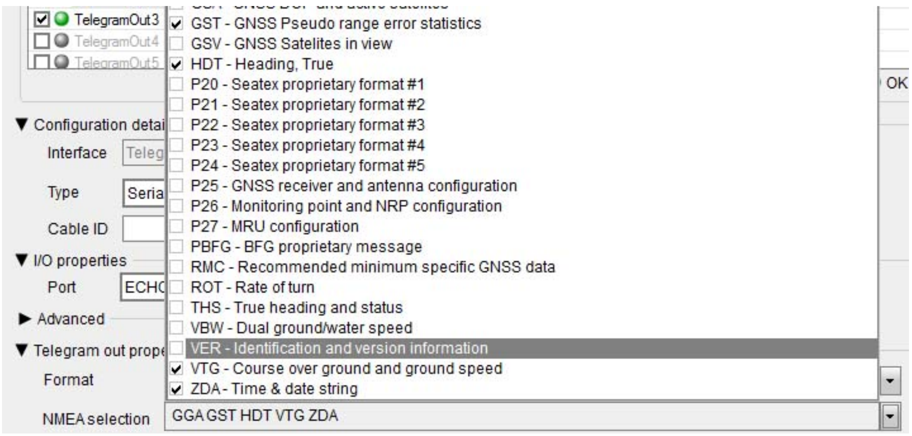
4 Select either **Ethernet** or **Serial** in the **Type** list.

Enter the appropriate parameters for the selected interface type.

5 Continue to the **Telegram out properties** group.

6 Select the wanted output telegram format from the **Format** list.

Observe that if you select **NMEA** as telegram format, the **NMEA selection** list becomes active.



7 If NMEA is selected, select the wanted NMEA telegrams to use from the **NMEA** list.

8 Select the wanted datum format from the **Datum** list.

9 Select the wanted monitoring point from the **Monitoring point** list.

10 Type the talker ID of NMEA messages sent from this output in the **NMEA talker ID** box.

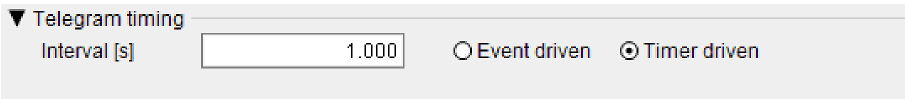
The default value is IN.

11 Select the **Log to file** box if you want to log the measurements to file internally in the system.

12 Select the wanted number of decimals in the time field in NMEA telegrams which supports Time precision from the **Time precision** box.

13 In the **Telegram timing** group, select the wanted output interval for the messages.

- **Event driven**: Outputs data only when the data are calculated or when a change occurs. Output data are delayed.
- **Timer driven**: The interval between each sample, type wanted interval in seconds in the **Interval** box. Range 0.01 to 3000 seconds.



14 Select **Apply** to store the settings.

Related topics

- *NMEA TelegramOut options* on page 129

6.5.12 Setting up the DGNSS correction link parameters

You can set up the system to receive various types of corrections which will improve the position accuracy.

Prerequisites

Check whether the reference station requires to know the position of your system to be able to send valid corrections back. If this is required, then enable **GGA Interval [s]** and set up how often the GGA message shall be sent to the reference station in the **DGNSS link properties**.

Context

Interface

Which external equipment you want to interface. Some configuration parameters are dependent on the interface selection.

Name

The name you want to give the DGNSS correction link.

Timeout

Age limit. If the age of the corrections exceeds this limit, the corrections are invalid.

Format

The format types which are supported by the system.

GGA interval

If selected, sends GGA messages to the DGNSS receiver at specified intervals in seconds.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Communication interface** →**Input/Output**.

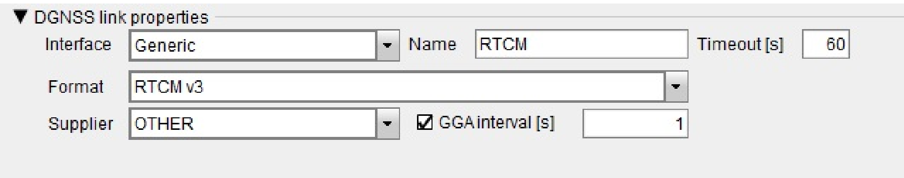
3 Select the **DGNSSlink** interface you want to set up in the **Input/Output list**.

Observe that the **Configuration details** parameters appear at the lower part of the page.

4 Select either **Ethernet** or **Serial** in the **Type** list.

Enter the appropriate parameters for the selected interface type.

5 Continue to the **DGNSS link properties** group.



6 Select the wanted interface from the **Interface** list.

The content of the **Format** list will depend on this selection.

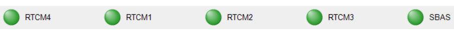
7 Select the wanted format from the **Format** list.

8 Select the name of the correction link supplier from the **Supplier** list.

This selection depends on the parameter you selected in the **Interface** list.

9 Type the name of the DGNSS correction link.

This name will be displayed in the DGNSS link status bar at the bottom of View 1.



10 Type the correction Timeout age limit in seconds.

If the age of the correction exceeds this limit, the corrections are invalid.

11 Select the **GGA Interval** box if you want the system to send GGA messages to the DGNSS receiver. Type the wanted interval in seconds between the telegrams.

12 Select **Apply** to store the settings.

Related topics

- *Communication interfaces description* on page 61

6.5.13 Connecting to a network

Enter the Internet Protocol (IP) addresses for the sensor unit to be able to communicate on the local area network (LAN).

Context

The Interface settings group allows you to modify the IP address of the physical interface selected in the **Interface** list.

The sensor unit communicates with the operator software using multicast UDP/IP. Any client may join the configured multicast group provided that the network hardware between the sensor unit and the client supports multicast forwarding.

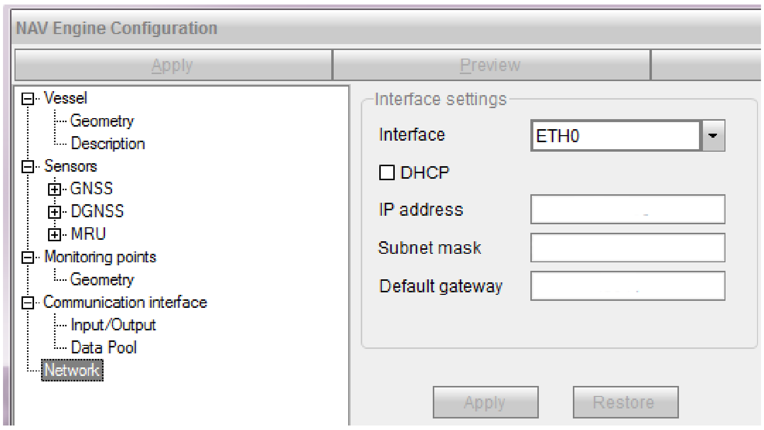
The default IP address for the sensor unit is: 192.168.1.10.

The default multicast address for the sensor unit is: 239.255.0.3.

The default subnet mask for the sensor unit is: 255.255.255.0.

The PC running Operator SW needs to be on the same subnet. Unless the IP address of the sensor unit is changed, the valid IP address for the PC would be 192.168.1.0-255 (excluding the address of the sensor unit itself).

Contact the network administrator for advice on IP address assignments.



Procedure

1 Click the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Click the **Network** node.

3 Select the interface for which you want to change the IP address.

4 Select the DHCP box if the IP address is given by a DHCP server.

5 Type the new IP address for the interface.

6 Type the subnet mask address for this interface.

7 Type the IP address for the default gateway.

8 Click the **Apply** button to confirm the changes.

9 Restart the sensor unit for these changes to take effect and for the new settings to be used by NAV Engine.

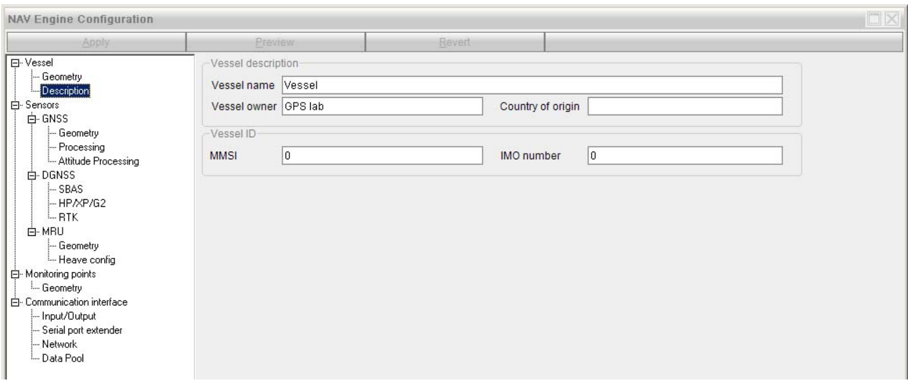
- To restart, click the **System** menu →**Restart** →**Sensor Unit**.

If you click the **Restore** button you will return to the previous interface settings.

6.6 Additional sensor unit configuration

6.6.1 Entering vessel identification parameters

The vessel Description parameters allow you to enter information about the vessel which are needed for identification purposes.



Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Vessel** →**Description**.

3 Type the name of your vessel. This box cannot be empty. The default value is VESSEL.

4 Type the name of the vessel owner. This is optional information.

5 Type the country of origin for the vessel. This is optional information.

6 Type the MMSI number assigned to the vessel. Default value is 0.

7 Type the IMO number assigned to the vessel. Default value is 0.

8 Select **Apply** to store the settings.

6.6.2 Importing vessel shape from file

You can load a vessel model from file in order to get accurate dimensions for your vessel.

Context

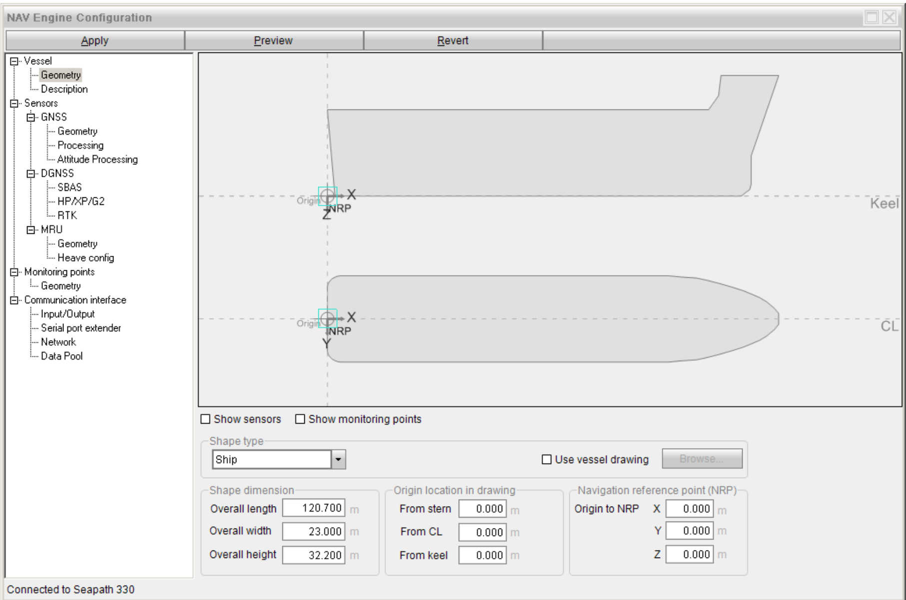
The pre-defined scalable vessel shapes represent the actual vessel outline only in rare cases. In order to configure the accurate location of various sensors, equipment and monitoring points, it is recommended to load a separate vessel model from file.

The system supports two types of two dimensional outlines: side view (towards starboard) and top view. Three file types are available: **Vessel models(*.svm), Vessel vector images (*.svi)** and **Old vessel images (*.txt)**.

The vessel image file must meet the following requirements:

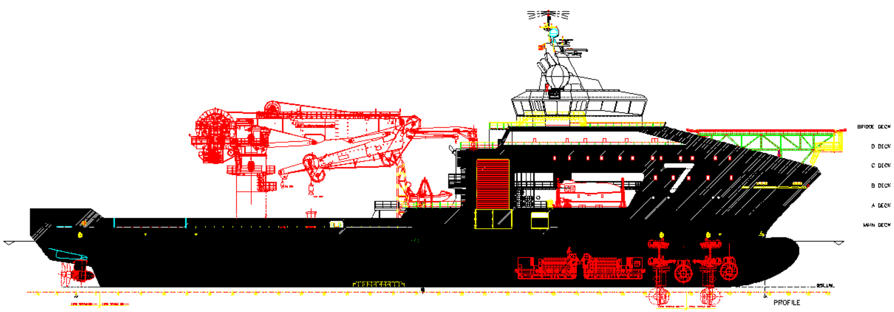
- The vessel data have to be in an ASCII file generated by Excel, Notepad or similar tools.
- The file head includes Overall length (LOA), Overall width, Overall height and Stern to Origin data in metres.
- Profile (side view) data in X and Z coordinates in metres, related to the origin. Coordinates are specified clockwise from a point aft of the origin, and the last coordinate has to equal the first coordinate to form a closed polygon.
- The top view data in X and Y coordinates in metres. The first coordinate has to be aft of the origin along the centre line. Successive coordinates are specified clockwise, and the last coordinate has to equal the first to form a closed polygon.

Vessel image files can be created by Kongsberg Discovery AS upon customer request. GA drawings or similar are required to create vessel image files.



Example 2 Vessel shape from file

The illustration shows an example of a GA drawing of a multi-purpose vessel.



A user text file from Notepad may look like this.

Example 2   Vessel shape from file (cont'd.)

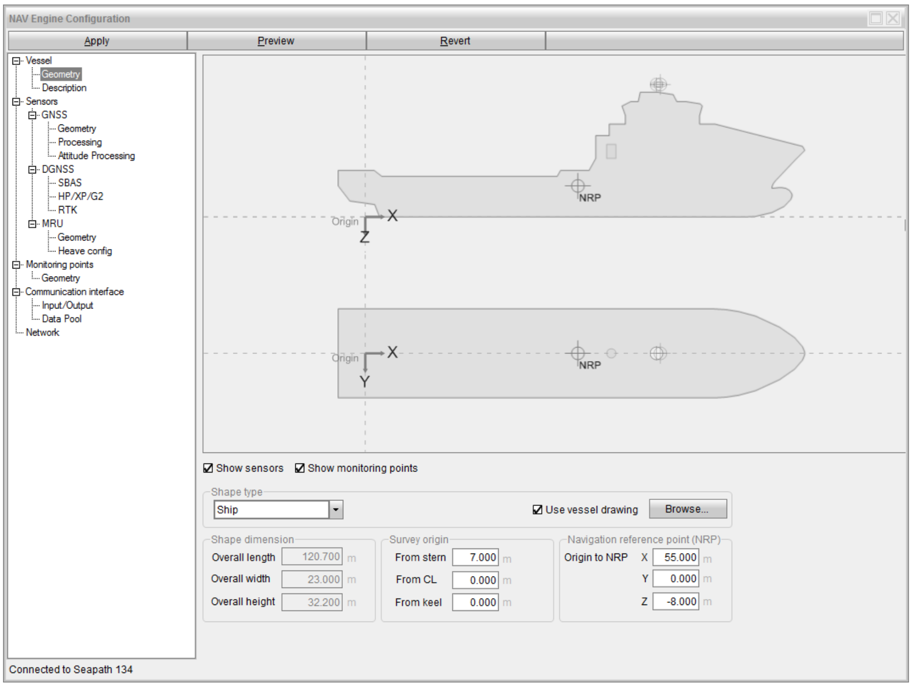
```
%Vessel Data [m]
%LOA = 120.70
%Width = 23.00
%Height = 32.20
%Aft to AP = 7.00

%Profile coordinates in (X,Z) [m]
0.00,-3.55
2.44,-3.19
3.69,0.00
98.60,0.00
101.00,-0.14
105.20,-1.12
108.36,-2.70
110.09,-4.51
110.35,-5.20
110.40,-5.43
110.40,-5.69
.
.
.
63.10,-24.00
63.10,-21.00
59.62,-21.00
59.62,-15.13
57.87,-12.99
49.65,-10.50
4.25,-10.50
2.31,-12.00
-7.00,-12.00
-7.00,-8.00
-4.00,-4.11
0.00,-3.55

%Profile cutout
-23.20,-36.48
-23.20,-10.24
23.20,-10.24
23.20,-36.48
-23.20,-36.48

%Top view coordinates in (X,Y) [m]
-7.00,0.00
-7.00,11.50
90.30,11.50
.
.
.
113.60,0.57
113.70,0.00
```

The vessel shape in the NAV Engine Configuration looks like this.



Example 2 Vessel shape from file (cont'd.)

In the example, only the port side of the vessel top view is defined in the file. Symmetry is assumed, so this is sufficient to draw a symmetric vessel shape. If the vessel is *not* symmetric, use the section code `%Top view coordinates in (X,Y) [m] Complete` and give the coordinates along the complete shape, defined clockwise.

It is possible to define cutouts within the profile or top view polygons. For profile cutout, use `%Profile cutout n`, where *n* identifies the cutout.

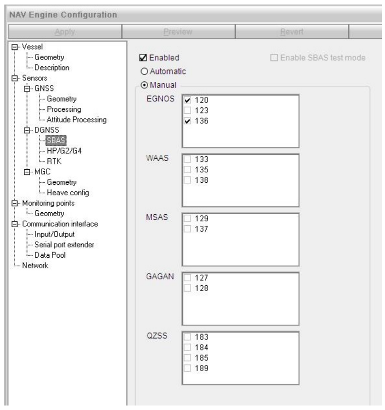
Procedure

1. Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.
2. Select **Vessel** →**Geometry**.
3. Select **Use vessel drawing** and click **Browse** to search for the wanted image file.

   If you select **Use vessel drawing**, the Shape dimension parameters will be locked.
4. Type the parameters for location of origin (survey origin).
5. Type the navigation reference point location, X, Y, Z.
6. Select **Apply** to store the settings.

6.6.3 Selecting SBAS satellites

The SBAS parameters allow you enable tracking of SBAS satellites and to set up automatic or manual tracking of these satellites.



Context

Enable

Select this box if you want your system to track SBAS satellites.

Automatic

The GNSS receiver selects which SBAS satellites to track. (This option is currently unavailable.)

Manual

The operator must select which SBAS satellites to use. If two SBAS satellites are selected, the system will automatically use data from the best satellite. If only one SBAS satellite is selected, only correction data from this satellite will be used in the computations.

If no specific SBAS satellite is selected, the system will select and use data from the best of the available satellites. If the selected SBAS satellite is not available, the system will not use the SBAS correction data in the computations. Maximum two SBAS satellites can be tracked by the GNSS receiver.

Enable SBAS test mode

The **Enable SBAS test mode** option is typically to be used for SBAS systems which have not reached full operation. An SBAS system in test mode does not provide full integrity.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Sensors** →**DGNSS** →**SBAS**.

3 Select the **Enable** box to enable tracking of SBAS satellites.

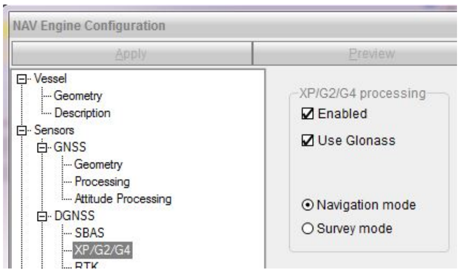
4 If you want the system to select SBAS satellites automatically, select **Automatic**.

5 If you want to select which SBAS satellites to use, instead of automatic selection by the system, select **Manual**.

6 Select which SBAS satellites to use. You can select maximum two satellites.

7 Select **Apply** to store the settings.

6.6.4 Enabling Fugro high precision services



The XP/G2/G4 parameter allows you to use high precision services to improve the accuracy of the GNSS signals which results in a more accurate position.

Prerequisites

A Fugro demodulator has to be connected and activated.

Context

The use of high precision services must be enabled by the operator as the default setting is disabled.

Enable

Select this box if you want to enable the use of high precision services in the position solution.

Use Glonass

Select this box if you want to enable the use of GLONASS corrections in the position solution.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Sensors** →**DGNSS** →**XP/G2**.

3 Select the **Enable** box to enable the use of high precision services.

4 If you want the system to use GLONASS corrections, select **Use Glonass**.

5 Select **Apply** to store the settings.

6.6.5 Selecting heading input format from gyro compass

Heading input from a gyrocompass or similar can be input to the system as a backup to improve reliability.

Telegram in properties

Format

The format of the telegram.

Timeout

Age limit. If the age of the heading message exceeds this limit, the heading message is invalid [s].

Interval

Expected interval in seconds between incoming telegrams. Can be configured.

Checksum required

Enables or disables NMEA checksum requirement. Default set to Enabled, which is the recommended setting.

GGA/VTG, interval

If selected, sends GGA and VTG messages to gyro at specified intervals in seconds.

Procedure

1 Select the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Select **Communication interface** →**Input/Output**.

3 Select the **Gyro** interface you want to set up in the **Input/Output list**.

Observe that the **Configuration details** parameters appear at the lower part of the page.

4 Select either **Ethernet** or **Serial** in the **Type** list.

Enter the appropriate parameters for the selected interface type.

5 Continue to the **Telegram in properties** group.

6 Select the wanted gyro telegram from the **Format** list.

7 Type the wanted **Timeout** age limit in seconds.

If the age of the gyro message exceeds this limit, the gyro message is invalid.

8 Type the wanted **Interval** for seconds between the incoming telegrams.

9 Select the **Checksum required** box if you want NMEA checksum to be required.

This selection is default selected. This is the recommended setting.

10 Select the **GGA/VTG** box if you want the system to send GGA and VTG messages to the gyro at specified intervals.

11 Select **Apply** to store the settings.

Related topics

- *Communication interfaces description* on page 61

6.6.6 Setting up the MGC as an inertial navigation system (INS)

You can set up the MGC to operate as an inertial navigation system.

Context

When the MGC shall operate as an INS (inertial navigation system) in addition to be an IMU (inertial measurement unit) for the Seapath, the MGC requires input of NMEA GGA, VTG and ZDA messages. For some installations it will be convenient to send these NMEA messages from the Processing Unit to the MGC instead of interfacing an external GNSS receiver to the MGC. However, be aware that if the MGC is installed as a type approved IMO gyro compass, these NMEA messages must be input from an IMO type approved GNSS receiver. Else the type approval will be voided.

Procedure

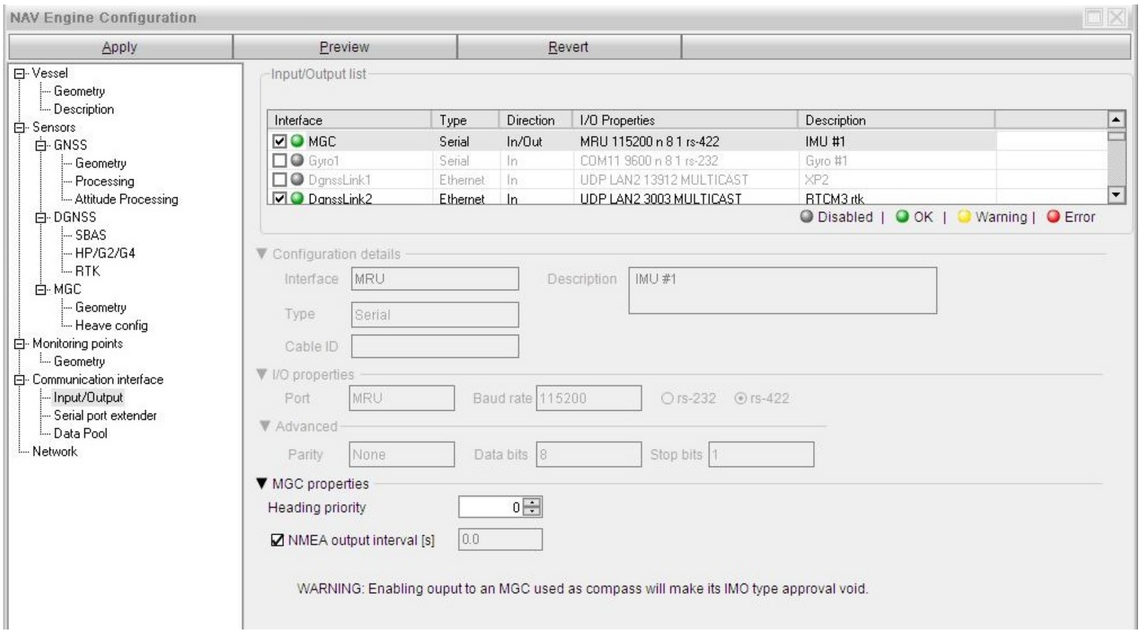
1 Click the **System** menu, →**NAVEngine** →**Standard** to open the **NAV Engine Configuration** dialog box.

2 Click the **Communication interface** node →**Input/Output**.

3 Select the interface **MGC** in the **Input/Output list**.

Observe that the **MGC properties** parameters appear at the lower part of the page.

4 Select **NMEA output interval** to enable output of NMEA GGA, VTG and ZDA messages to the MGC.



Note

Be aware that if the MGC is installed as a type approved IMO gyro compass these NMEA messages must be input from an IMO type approved GNSS receiver. Else the type approval will be voided.

5 The **Heading priority** should be set to **0**.

6 Click **Apply** to store the settings.

6.7 Operator software configuration

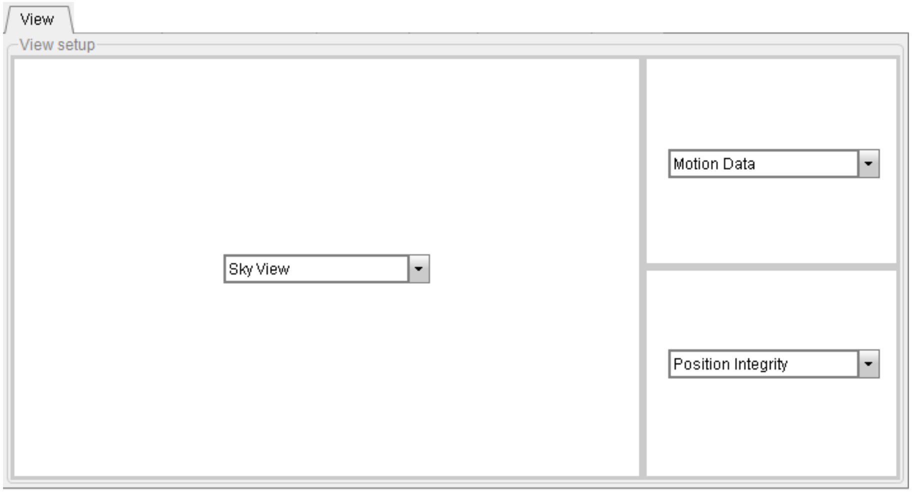
6.7.1 Selecting the position of views in the display

The **View** tab page allows you to select the contents of each view when the HMI (Human Machine Interface) application starts.

Context

The **View** tab page has the same layout as the views in the display. You can select which information shall appear in the various views.

Two views cannot have the same contents. When one view is selected as contents in **View 1**, other contents will automatically be selected for **View 2** or **View 3**.



Procedure

1 Select the **System** menu, →**Operator SW** to open the **Operator software configuration** dialog box.

2 Select the View tab.

3 Select which view you want for View 1, View 2 and View 3 from the drop-down lists.

4 Select **Apply** to store the settings.

6.7.2 Selecting the appearance of the Sky View

The **Sky View** tab page allows you to define the appearance of the Sky View.

Context

Display correction satellites

Display correction satellites allows you to show correction satellites such as Inmarsat and Spotbeam in the Sky View. The satellite positions are predefined. You must enable the satellites which you want to appear in the **Sky view** where they are shown as brown triangles. Spotbeam satellites are marked with an S while Inmarsat satellites are marked with an I. When you hover the cursor over a correction satellite in the Sky View, a tooltip with satellite name, azimuth, elevation and position will appear.

Signal strength

Signal strength allows you to display a signal bar under the satellites in the **Sky view**. The signal bar indicates the signal-to-noise ratio for the satellite, and the longer the bar, the stronger the signal.

Note

Signal strength L2 only available on dual frequency, single receiver systems.

Shadow sector

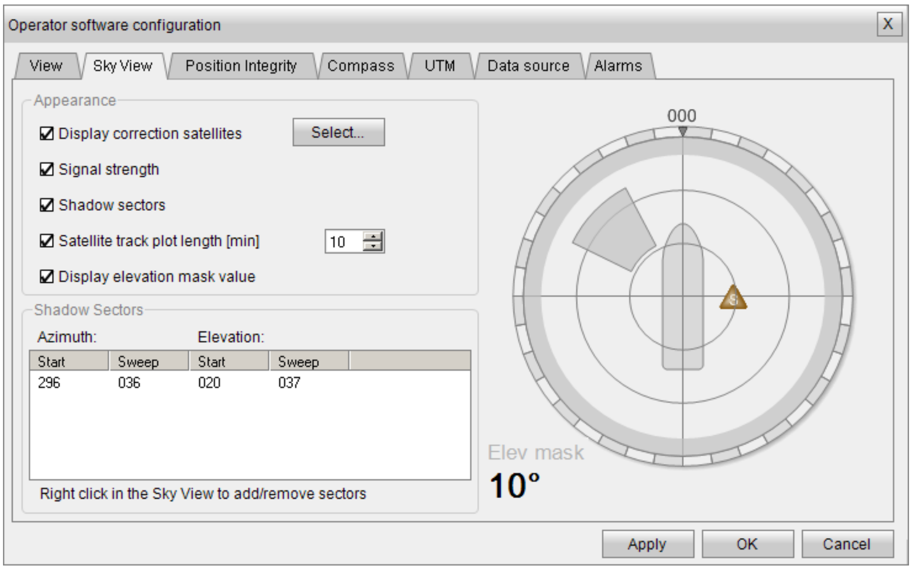
Shadow sector allows you to show the shadow sectors in the Sky View. You must add a shadow sector before you can display it in the Sky View. A shadow sector is just an indicator and does not influence the position solution in any way. The shadow sector refers to the vessel centre and will follow the vessel heading. Azimuth start describes the starting angle of the sector in degrees (0 to 360) related to North. Azimuth sweep describes the size in degrees. Elevation start describes the starting angle of the sector in degrees (0 to 90) where 0 degrees is the horizon and 90 degrees is straight above the antenna.

Satellite track plot length

Satellite track plot length assists in determining if a satellite is rising or falling in elevation. The Satellite track plot length defines how long the length of the track plot should be. When you select this option, the track plot starts to increase. Maximum length of the track plot is 720 minutes.

Display elevation mask

When you select **Display elevation mask**, the configured elevation mask is indicated in the lower left corner of the Sky view.



Procedure

1. Select the **System** menu, →**Operator SW** to open the **Operator software configuration** dialog box.
2. Select the **Sky View** tab.
3. Select **Display correction satellites**.

   Observe that the **Select** button appears.
4. Select **Select**.

   Observe that the **Select Correction Satellites** dialog box appears.

5 Select the satellites you want to appear in the Sky View and click **OK**.

6 Select **Signal strength** if you want to display the signal bar under the satellites in the Sky view.

7 Add shadow sectors to be able to display them in the Sky View.

- **a** Place the cursor over the sky view area to the right in the Sky View tab page.
- **b** Right-click and select **Add sector**.

  Observe that the sector appears in the sky view area and in the table in the **Shadow Sector** group. The table shows your shadow sectors.
- **c** Hover the cursor over the shadow sector.

  Observe that the cursor changes to arrow symbols.
- **d** Drag the arrows horizontally and vertically to create your shadow sector.

  Observe the Azimuth and Elevation values in degrees.

8 Delete shadow sectors if they are no longer applicable.

- **a** Select a sector in the sky view area to the right in the Sky View tab page.
- **b** Right-click and select Remove sector.

  Observe that the shadow sector disappears from the sky view area and from the table.

9 Select **Satellites track plot length** if you want to show this in the Sky View.

Observe that the Satellite track plot length list appears.

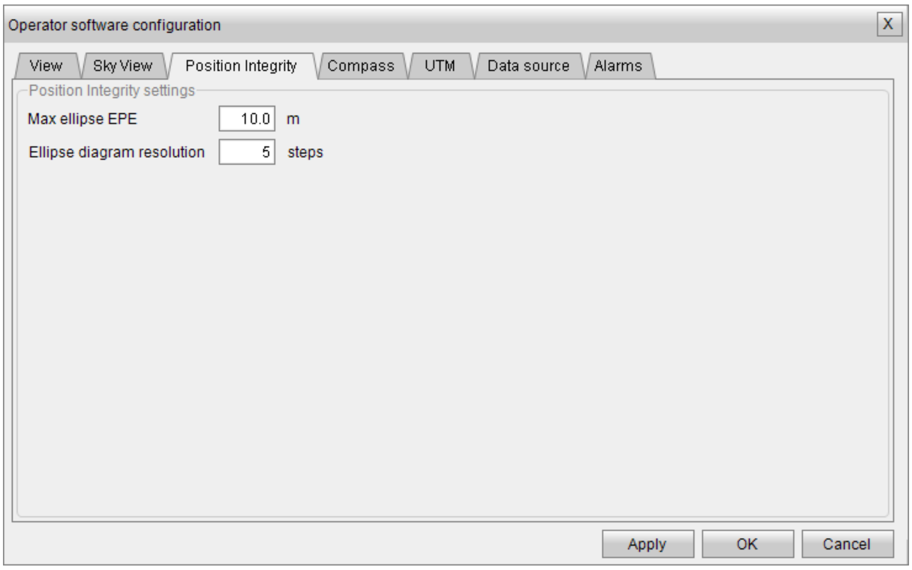
10 Select the wanted value for the satellite track plot length in minutes.

11 Select **Display the elevation mask value** if you want to display the elevation mask in degrees in the Sky View.

12 Select **Apply** to store the settings.

6.7.3 Adjusting the Integrity view

The **Position integrity** tab page allows you to adjust the scaling of the **Integrity** view.

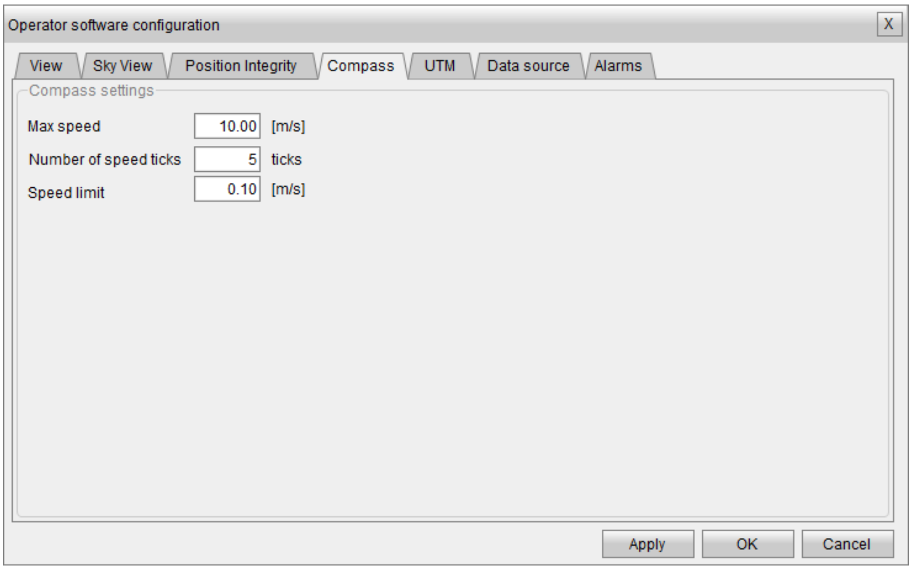


Procedure

1. Click the **System** menu, →**Operator SW** to open the **Operator software configuration** dialog box.
2. Click the **Position Integrity** tab.
3. Enter the **Max ellipse EPE** in metres.
4. Enter the steps for **Ellipse diagram resolution**.
5. Click **Apply** to store the settings.

6.7.4 Adjusting the Compass view

The **Compass** tab page allows you to adjust the speed scaling of the **Compass** view.



Procedure

1 Click the **System** menu, →**Operator SW** to open the **Operator software configuration** dialog box.

2 Click the **Compass** tab.

3 Type the maximum vessel speed in knots to be displayed in the Compass View.

4 Type the number of circles to be displayed.

This is the resolution of the graphical presentation of the speed in the compass.

5 Type the lower speed limit in knots for when COG (Course Over Ground) and SOG (Speed Over Ground) shall be displayed in the Compass View.

6 Click **Apply** to store the settings.

6.7.5 Adjusting UTM presentation

The **UTM** tab page allows you to control how UTM positions are treated by the application. UTM is the Universal Transvers Mercator coordinate system.

Context

UTM options

When selecting **False Northing**, positions south of the equator will always be presented as positive in the **Position data** area in the display. A fixed offset of 10 000 000 m is added to the northing value to avoid negative coordinates in the southern hemisphere. When selecting **False Easting**, a fixed offset of 500 000 m is added to the true easting value to avoid negative coordinates. The UTM standard uses false northing and false easting, i.e. the coordinates are never negative. In case negative northing or easting is wanted, clear the **False Northing** check box.

Note

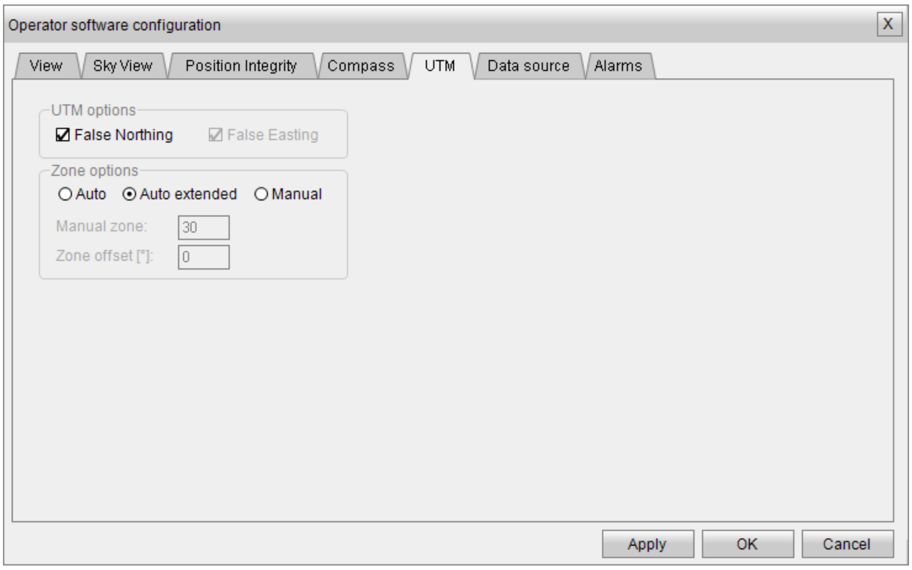
It is not possible to clear the False Easting check box.

Zone options

The UTM zone is automatically calculated by default. The **Auto extended** zone option is only applicable between 56 degrees to 64 degrees north and 3 degrees to 6 degrees east. The 32V zone is extended west to 3 degrees east, so when selecting the Auto extended zone in this area, zone 32V is used. When outside the current area and Auto extended zone is selected, the used zone is equal to the zone used when selecting **Auto** zone.

When selecting **Auto** zone, the system zone is automatically calculated in accordance with the inserted coordinates.

Selecting **Manual** zone makes it possible to define which Zone and Zone offset to use. The **Zone offset** option allows a fixed offset to be applied to the longitudinal degrees. The UTM zone can be offset up to ±3 degrees. The zone offset is typically used where the maps used have an offset. The zone range is from 1 to 60.



Procedure

1. Select the **System** menu, →**Operator SW** to open the **Operator software configuration** dialog box.
2. Select the **UTM** tab.
3. Deselect the **False Northing** check box if you want positions south of the equator to be presented as negative values in the Position data when displaying position as UTM.
4. Select which zone option you want to use.

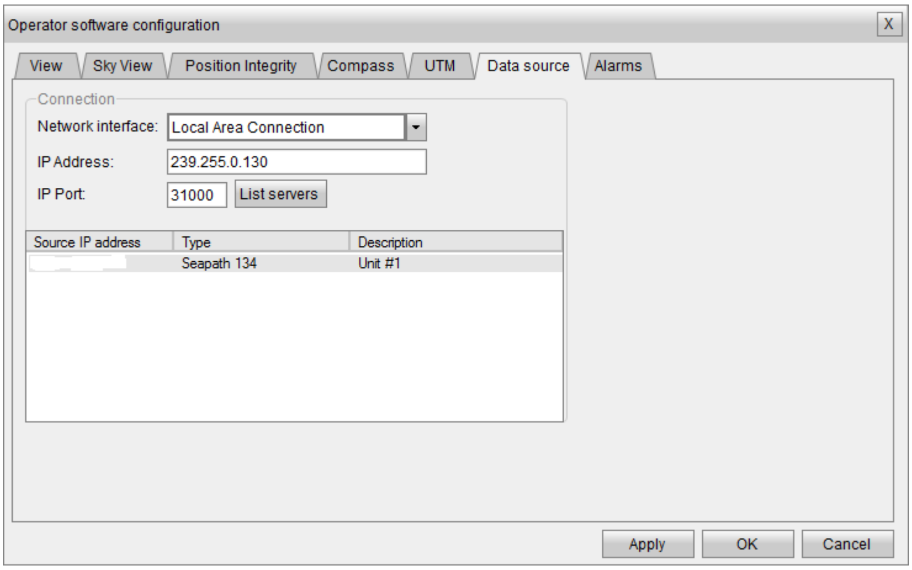
   If you select Manual

   a Type the value for the zone you want to use.

   b Type the zone offset for this zone, range 1 to 60.
5. Select **Apply** to store the settings.

6.7.6 Connecting the Seapath HMI software to the sensor unit

The **Data Source** tab page allows you to select the available physical network interface. This defines the data source for the operator software (Seapath HMI).



Procedure

1 Click the **System** menu, →**Operator SW** to open the **Operator software configuration** dialog box.

2 Click the **Data source** tab.

3 Select the interface which represents the connection to the wanted sensor unit from the **Network interface** list.

4 Type the internet protocol (IP) address on which you want the operator software to receive data.

This is normally an address in the Multicast IP range.

5 Type the internet protocol (IP) port on which you want the operator software to receive data.

Important

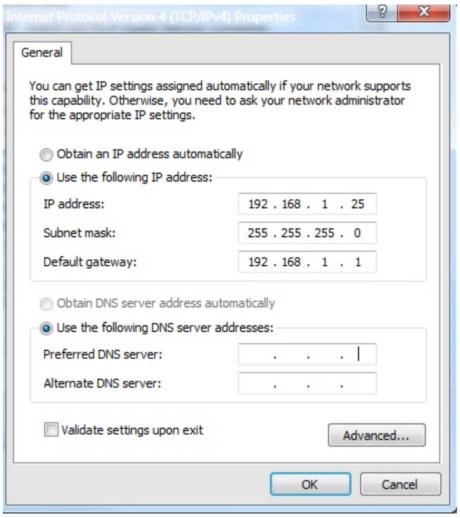
The IP Address and IP Port must match the UDP address and UDP port entered in the **NAV Engine Configuration** in order to establish communication with the operator software.

6 Click the **List servers** button to show Seapath systems available through this physical interface. Information presented for each available sensor unit is its IP address, the product type and a description.

7 Click **Apply** to store the settings.

Important

Remember that the operator software has to be located on the same IP subnet as the sensor unit.



6.7.7 Selecting alarm message reception

The **Alarm** tab page allows you to define how to receive alarm messages.

Context

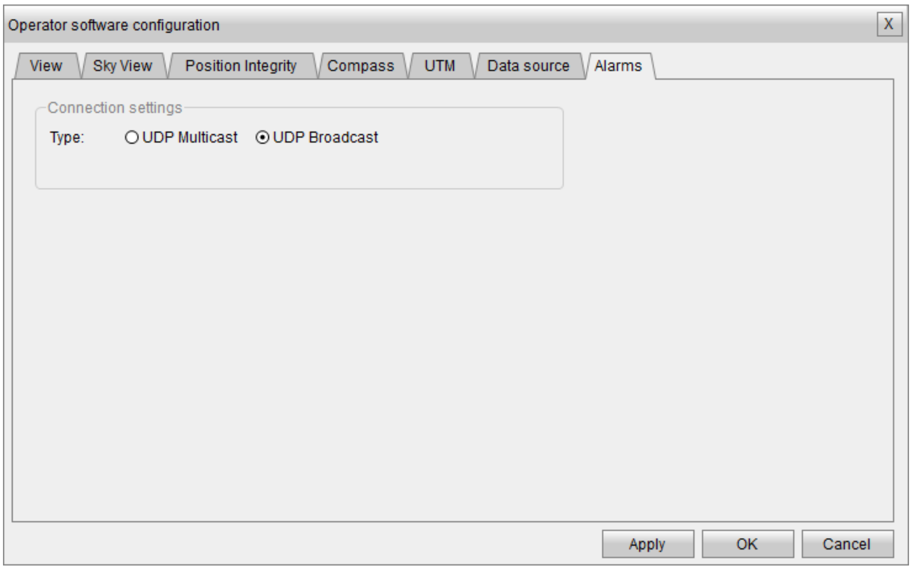
UDP Broadcast is the default (and recommended) setting. Defining a multicast address for alarm message distribution requires advanced network configuration skills.

UDP Multicast

If the operator software configuration which is performed, is not in the same network as the sensor unit, IP multicast is required. To enable multicast, select **UDP Multicast** and enter the multicast address to use for receiving alarms.

UDP Broadcast

Select this option if alarm messages are transmitted to all network units.



Procedure

1. Select the **System** menu, →**Operator SW** to open the **Operator software configuration** dialog box.
2. Select the **Alarms** tab.
3. Select the wanted connection type: UDP Multicast or UDP broadcast.
4. Select **Apply** to store the settings.

6.8 Creating a backup of the configuration and software installation

If you have a complex configuration setup in your system, it can be useful to make a copy of this configuration in case you should need it later.

Context

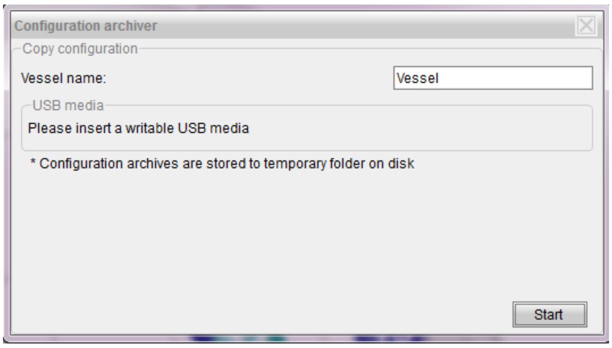
The **Copy Configuration** tool will copy the system configuration to a disk based archive file or to a USB flash drive.

Note

This procedure will only copy the configuration setup and not a full image of the installed system.

Procedure

1. Insert a USB flash drive into the USB port on the external PC with the Seapath application.
2. Select the **Tools** menu →**Copy Configuration** to open the**Configuration archiver** dialog box.



3 The configured vessel name is automatically entered into the **Vessel name** box but you can change this if you want.

4 Select **Start** to copy the configuration files to the USB flash drive.

The copied configuration will be stored as a compressed archive (ZIP file) under the `ConfigBackup` folder in the root of the USB flash drive.

Note

If a USB flash drive is not inserted, the archive will be stored in a temporary location on the local disk. In this case, the archive will only be available for restore until the next reboot.

Result

You can use the USB flash drive with the copied configuration to restore the system configuration at a later date.

6.9 Restoring the configuration backup

If you need to restore the configuration setup to your system, you can use the USB flash drive with a copy of your configuration which you created with the **Copy Configuration** tool.

Procedure

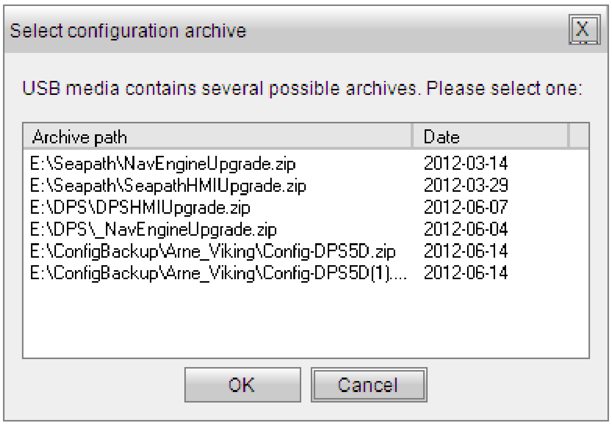
1 Insert a USB flash drive into the USB port on the external PC with the Seapath application.

2 Select the **System** menu →**Change system mode** to enter **Engineering** mode to open the **Change system mode** dialog box

3 Type the password **STX** and click **OK**. The password is not case sensitive.

You are now able to carry out changes and/or set system parameters.

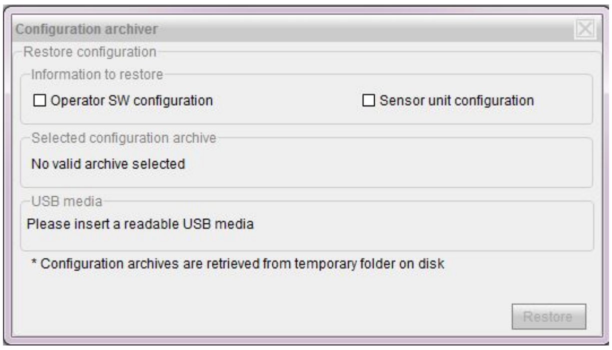
4 Select the **Tools** menu →**Restore Configuration** to open the **Select configuration archive** dialog box with a list of available archive files..



5 Select the wanted archive and click **OK** to continue.

Observe that the **Configuration archiver** dialog box appears with information about the selected configuration.

Select at least one option in the **Information to restore** group. This will enable the **Restore** button.



6 Select **Restore** to restore the wanted configuration.

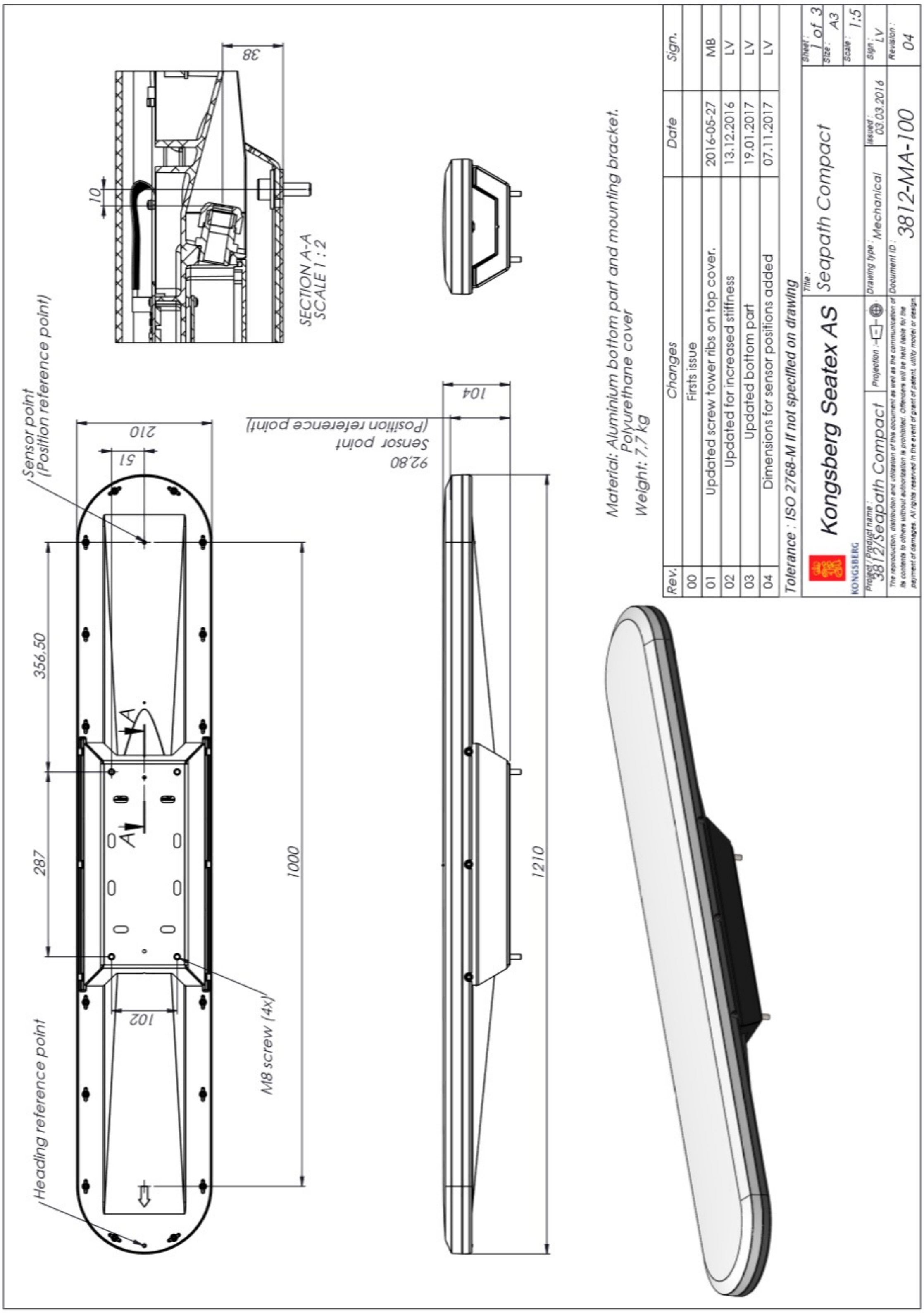
Note

*The **Restore Configuration** tool will stop NAV Engine before restoring the configuration. NAV Engine will be restarted automatically.*

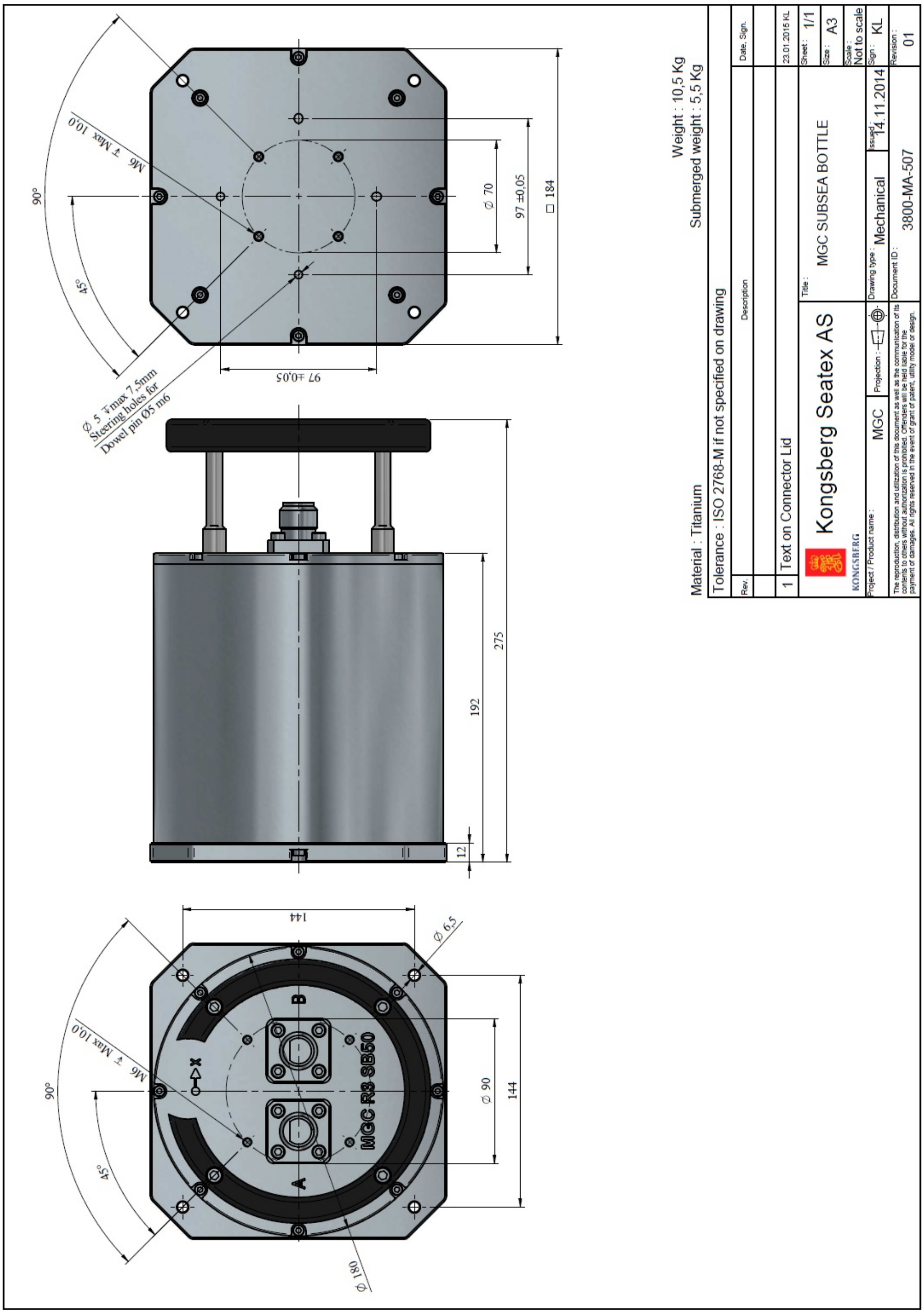
7 Drawings

Outline drawing with mechanical dimensions for the Seapath 130 sensor unit, the MGC subsea bottle and system schematics.

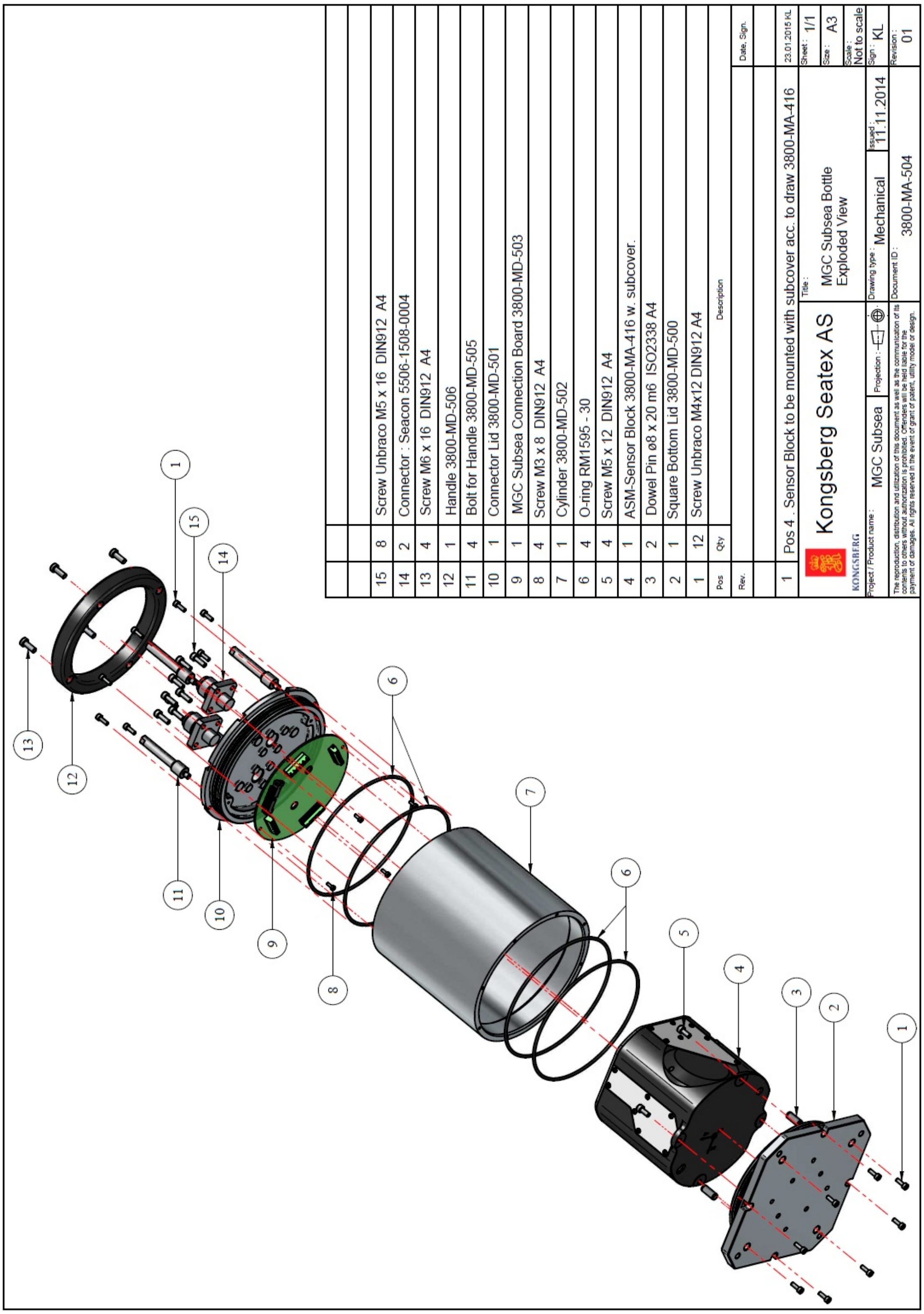
7.1 Sensor unit dimensions



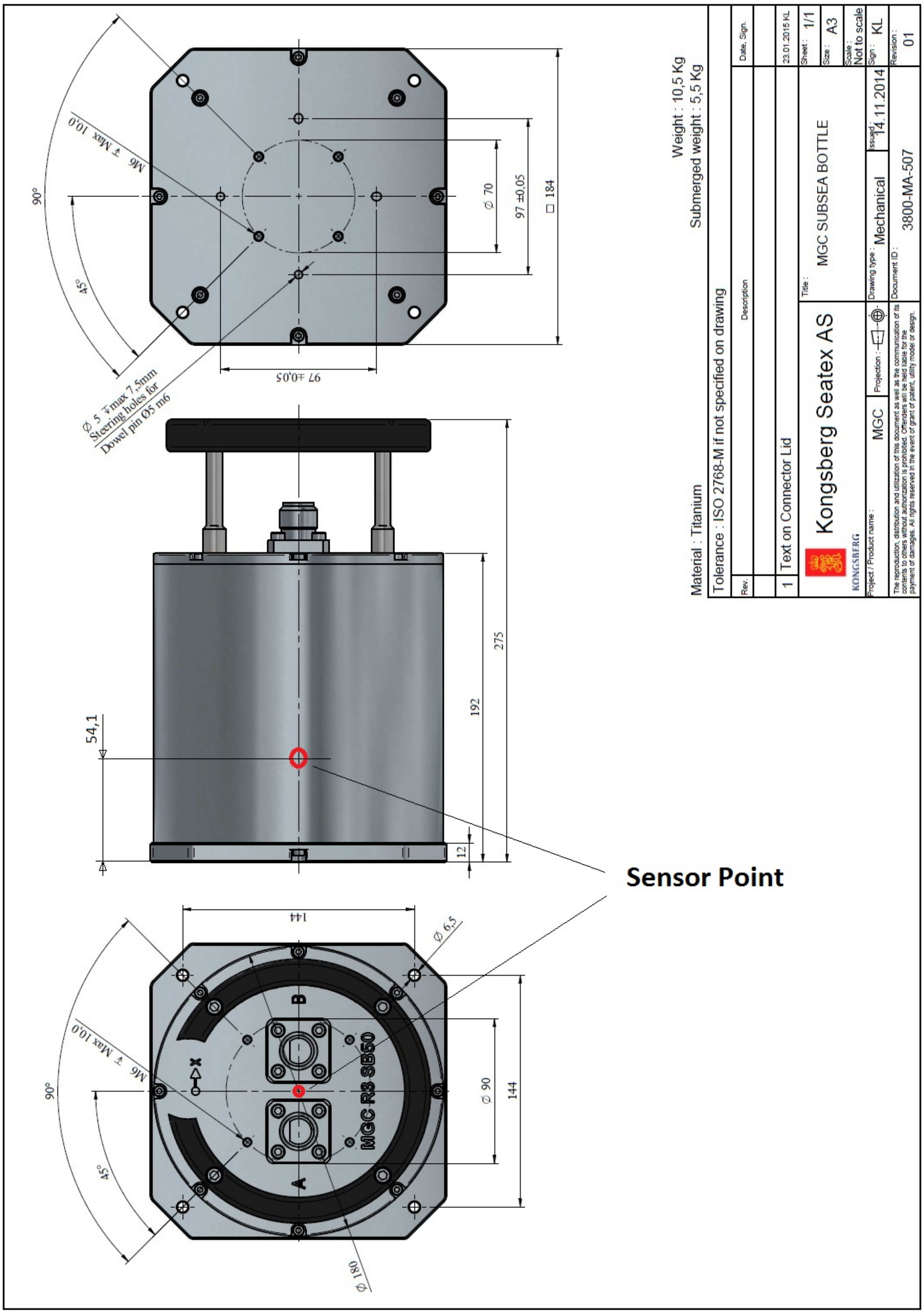
7.2 MGC R2 and R3 SB50 dimensions



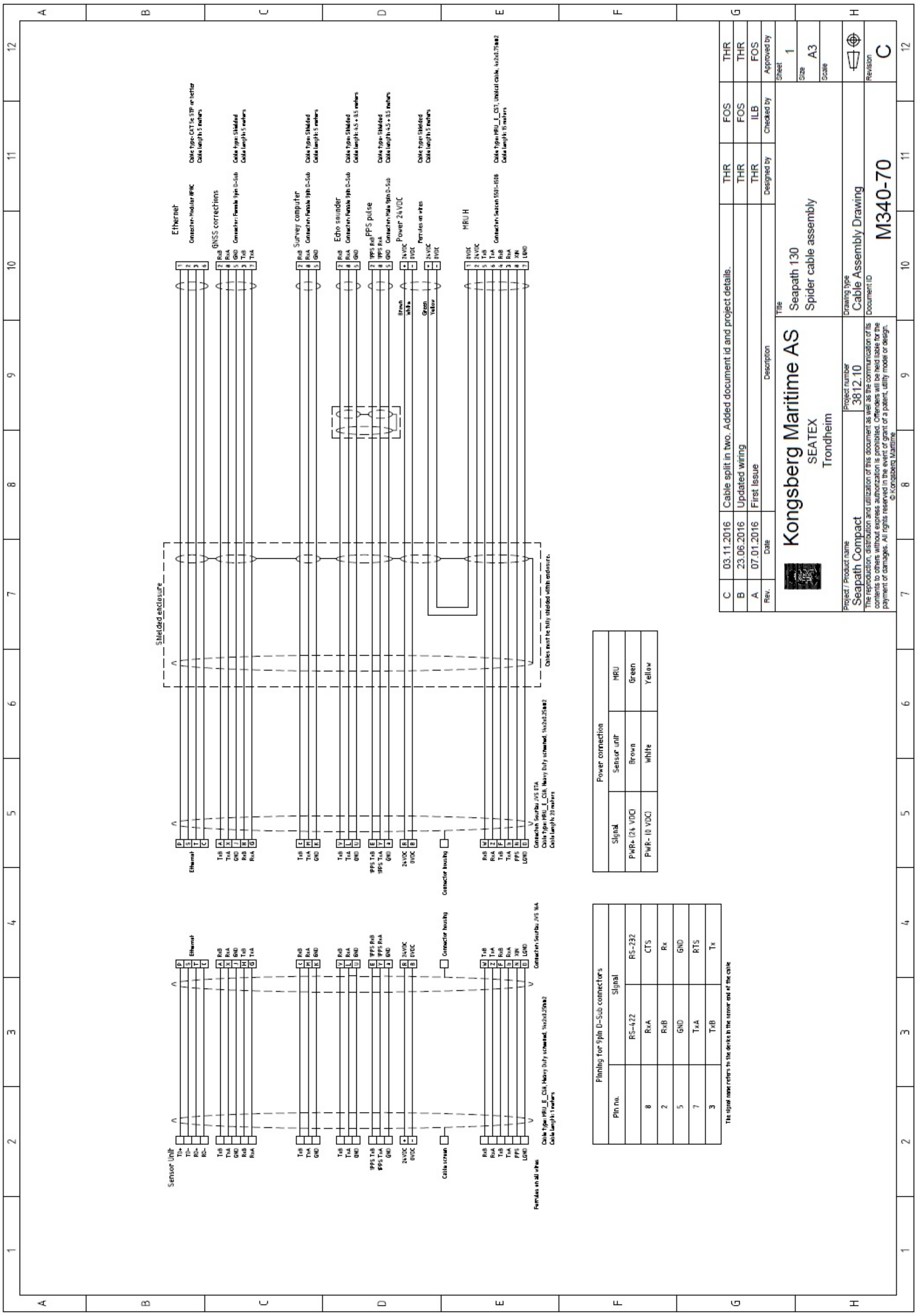
7.3 MGC R2 and R3 SB50 assembly drawing



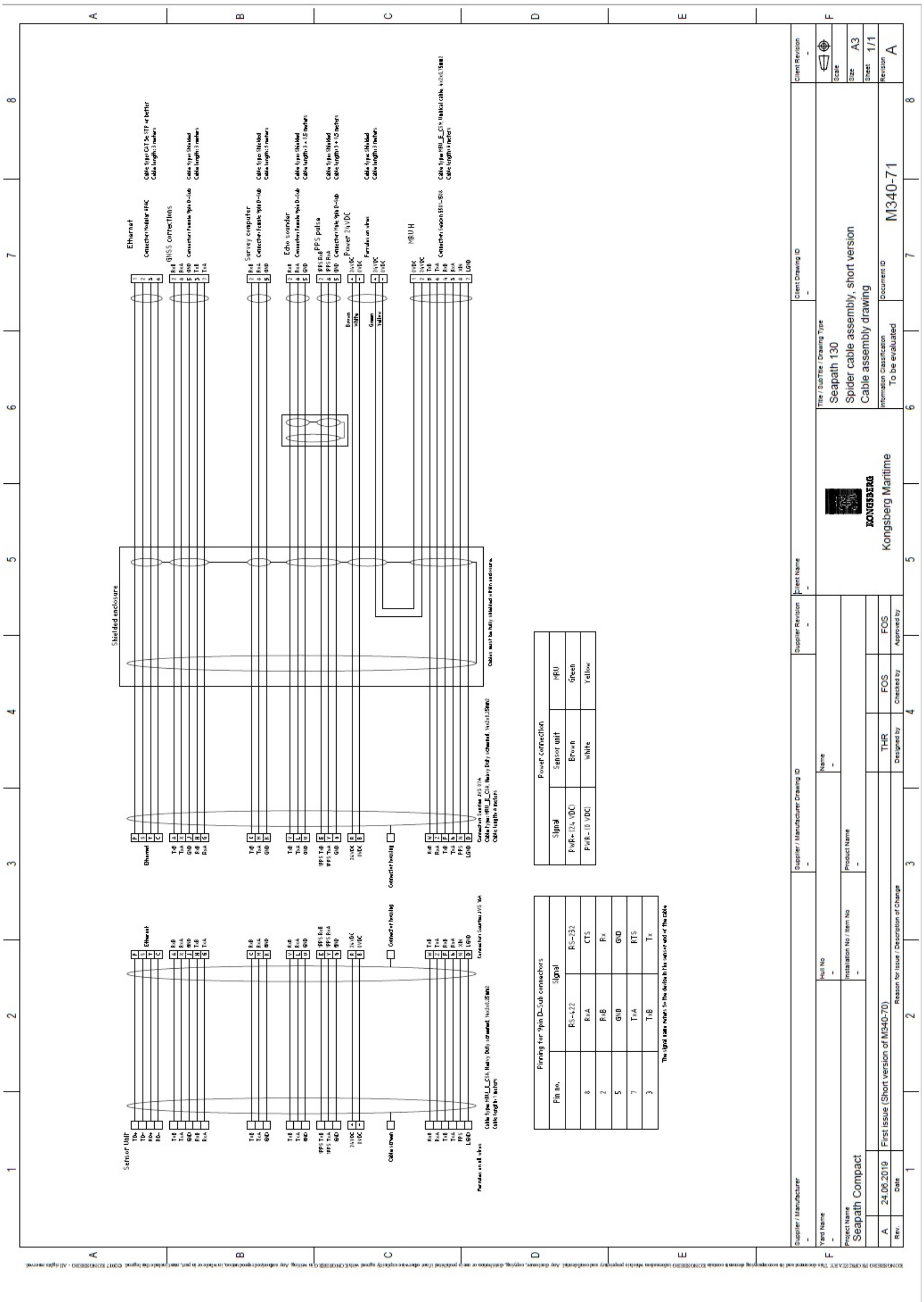
7.4 MGC R2 and R3 SB50 sensor point location



7.5 Spider cable schematics, default version



7.6 Spider cable schematics, short version



8 Technical specifications

8.1 Performance specifications

The performance specifications summarize the main functional and operational characteristics of the system.

8.1.1 Roll, pitch and heading specifications

Seapath 130–R2 Roll and pitch accuracy for ±5° amplitude	0.008° RMS[1]
Seapath 130–R3 Roll and pitch accuracy for ±5° amplitude	0.007° RMS[2]
Seapath 130–R2 heading accuracy	0.06° RMS
Seapath 130–R3 heading accuracy	0.05° RMS

8.1.2 Heave spesifications

Heave accuracy (real-time output)	5 cm or 5 % whichever is highest
Heave motion periods (real-time output)	0 to 25 seconds
Heave accuracy (delayed signal, PFreeHeave®)	2 cm or 2 % whichever is highest
Heave motion periods (delayed signal, PFreeHeave®)	0 to 50 seconds

8.1.3 Position and velocity specifications

Position accuracy with DGNSS	0.5 m RMS or 1 m 95 % CEP
Position accuracy with SBAS	0.5 m RMS or 1 m 95 % CEP

1. With Automatic Online Calibration (AOC).
2. With Automatic Online Calibration (AOC).

Position accuracy with Fugro SeaSTAR XP2/G2/G2+/G4/G4+	0.05 m RMS or 0.1 m 95 % CEP
Position accuracy with VERIPOS Ultra/Ultra^2	0.05 m RMS or 0.1 m 95 % CEP
Position accuracy with C-NavC^1, C-NavC^2	0.05 m RMS or 0.1 m 95 % CEP
Position accuracy with RTK (x and y)	1 cm + 1 ppm RMS[3]
Position accuracy with RTK (z)	2 cm + 1 ppm RMS(2)
Velocity accuracy	0.03 m/s RMS or 0.07 m/s 95 % CEP

8.1.4 Horizontal position drift specifications

Seapath 130-R2 typical position drift 1 minute after GNSS dropout (RTK)	0.6 m
Seapath 130-R3 typical position drift 1 minute after GNSS dropout (RTK)	0.2 m

8.2 Interface specifications

8.2.1 Sensor unit

Output serial ports	3 non-dedicated isolated ports, RS-232 or RS-422
Input serial ports	1 non-dedicated isolated ports, RS-232 or RS-422
Baud rate	Up to 115 200 bits/sec
LAN	1 Ethernet port
Data output rate	Up to 100 Hz
Timing accuracy	1 ms
Data delay	All data in real-time (0 ms) plus transmission delay

8.3 Weight and outline dimensions

The weights and outline dimension characteristics summarize the physical properties of the system.

3. The accuracy is dependent on GPS satellite geometry, environment, ionospheric conditions and distance to the reference station. Excessive multipath, GPS signal obstructions or interference may also reduce the performance.

Note

For more detailed information about the physical dimensions, see Drawings.

8.3.1 Sensor unit

Length	1210 mm
Width	210 mm
Height	94 mm
Weight (including 1 m cable)	7.7 kg

8.3.2 MGC R2 and R3 SB50 unit

Height	275 mm
Length	184 mm
Width	184 mm
Dry weight	10.5 kg
Submerged weight	5.5 kg
Colour	Titanium
Connectors	2, 8–pin Seacon, 5506–1508 (male)

8.4 Power specifications

The power specifications summarize the power supply requirements for the system.

8.4.1 Sensor unit

Voltage	10 to 36 V DC
Recommended voltage	24 V DC
Power consumption	Max. 10 W (typical 8 W)

8.4.2 MGC SB50 unit

Voltage input	24 V DC nominal (18 to 32 V DC
Power consumption	Max. 12 W (typical 11 W)

8.5 Environmental specifications

The environmental specifications summarize the temperature and humidity requirements for the system.

8.5.1 Sensor unit

Enclosure material	Aluminium bottom part and polyurethane cover
Operating temperature range	-40 °C to +70 °C
Storage temperature range	-40 °C to +70 °C
Operating humidity (max)	Sealed, no limit
Storage humidity	Sealed, no limit
Ingress protection	IP 56
Electromagnetic compatibility (immunity/emission)	IEC 60945/EN 60945
Vibration	IEC 60945/EN 60945

8.5.2 MGC R2 and R3 SB50 unit

Enclosure material	Titanium
Enclosure protection	IP68. Depth rated to 50 metres
Operating temperature range	-15 °C to +55 °C
Storage temperature range	-25 °C to +70 °C
Storage humidity	Sealed, no limit
Electromagnetic compatibility (immunity/emission)	IEC 60945/EN 60945
Vibration	IEC 60945/EN 60945
Max. shock non-operational (10 ms peak)	1000 m/s^2
MTBF (computed)	50000 h
MTBF (service history based)	100000 h

8.6 Radio frequency specifications

The radio frequency characteristics summarize the frequency ranges for the system.

8.6.1 GNSS antenna

Type	NovAtel GPS-713-GGG-N
Upper band	1584 ± 27 MHz
Lower band	1210 ± 45 MHz
LNA gain	35 dB (typical)

8.7 Data output specifications

The system will interface with peripheral systems and sensors using standard and/or proprietary datagram formats.

8.7.1 Sensor unit

Output formats	Simrad EM3000
	Seapath binary format 3, 11, 23, 26
	Calibration format
	Echo sounder format
	Echo sounder format 18, TSS1
	RD Instrument ADCP proprietary NMEA format, "PRDID"
	Lehmkuhl gyro repeater format
	1PPS time tag, NMEA ZDA message
	1PPS time tag, Trimble compatible messages
	Atlas Fansweep format
	RTCM v3, raw GNSS output
	PFreeHeave format
	IMU raw data output
	NMEA 0183 v. 3.0, Proprietary
NMEA message types	DTM, GBS, GGA, GLL, GNS, GRS, GSA, GST, GSV, THS, HDT, RMC, ROT, VBW, VTG, ZDA. NMEA proprietary: PSXN20, PSXN21, PSXN22, PSXN23, PSXN24, PSXN25, PSXN26, PSXN27.

8.8 Data input specifications

8.8.1 Sensor unit

DGNSS corrections	Seastar XP, Seastar G2, Seastar G4/G4+, VERIPOS Ultra/Ultra², C-NavC¹, C-NavC², RTCM-SC104 v. 2.2, 2.3, 3.0 and 3.2, Trimble CMR
Gyro compass	NMEA 0183 HDT, HDM, HRC, PSXN10, PSXN23, Robertson LR22 BCD format and EM3000

8.9 Datum specifications

8.9.1 Sensor unit

Datum types. These datum types can only be selected if the corrections input to the product is in WGS84 or no corrections are input	NAD27, ED50, WGS84, MINNA, ARATU Bahia, ARATU Campos, ARATU ES, ARATU Santos, SIRGAS2000 and CAMACUPA.

8.10 Cable specifications

The cable characteristics summarize the cable specifications for the system.

8.10.1 Sensor unit cable

Type	Heavy duty screened, 14 x 2 x 0.25 mm^2
Length	20 m
Diameter	13.5 mm
Weight	0.27 kg/m
Flame retardation	IEC 60332–1
Insulation	PP (conductors) and PUR (outer cover)
Screen	Cu-braid
Bend radius	100 mm

8.10.2 MGC umbilical cable

Type	Umbilical cable, 4 x 2 x 0.75 mm^2
Length	15 or 30 m
Screen	Alum/braid
Diameter	12.6 mm
Bend radius static/dynamic	150 mm (minimum)
Weight in Air	241 Kg/Km
Weight in Sea	112 Kg/Km

8.11 Conformity declaration

The product is tested and is compliant with the relevant product standards.

KONGSBERG

EU DECLARATION OF CONFORMITY

Manufacturer's name:	**Kongsberg Discovery AS**
Manufacturer's address:	**Havnegata 9, N-7010 Trondheim, Norway**

declares that the product:

Product name:	**Seapath 130 series**
Product items:	**Seapath 130-3, 130-H, 130-5, 130-5+, 130-R2, 130-R3**

is in conformity with the **Radio Equipment Directive, RED, 2014/53/EU** and with reference to ETSI guide **ETSI EG 203 367,** using relevant sections of the following product standards:

Essential requirements	**Standards**
Health and Safety (Article 3.1(a)	EN 61010-1:2010/IEC 61010-1:2010
EMC (Article 3.1(b) (GNSS receivers)	EN 301 489 V2.1.1 (2017-02), EN 301 489-19 (2017-03)
EMC (Article 3.1(b) (Sensor Unit)	EN 60945:2002
Spectrum (GNSS receivers)	EN 303 413 V1.1.0

Test reference
File: *Seapath 130 series TCF*, **SPH130S-2017-1**, issued by Kongsberg Seatex AS.

RoHS
To the best of our knowledge, with reference to standard **EN IEC 63000:2018,** the product is compliant with Directive **2011/65/EU** as amended by Commission Delegated Directive **EU 2015/863**.

Supplementary information
The product was tested in its normal configuration.

Date and signature
2023-11-21

Erlend Vågsholm, Vice President R&D

Doc item: 110-0058553/A

9 Equipment handling

9.1 Handling and storage

Observe the following when handling the equipment:

- All units must be handled with care.
- The equipment must not be subjected to shocks, excessive vibration or other rough handling.
- The equipment must be preserved and stored in such a way that it does not constitute any danger to health, environment or personal injury.
- For operation and storage, see the respective environmental specifications.

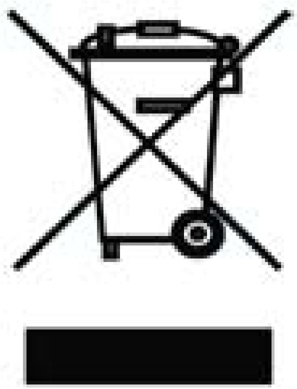
Note

After the installation please save the MGC transportation container. To maintain warranty validity, the MGC must be shipped in this container for service or repair.

Related topics

- *Environmental specifications* on page 99

9.2 Disposal



All electrical and electronic components have to be disposed of separately from the municipal waste stream via designated collection facilities appointed by the government or local authorities. The correct disposal and separate collection of your old appliance will help prevent potential negative consequences for the environment and human health. It is a precondition for reuse and recycling of used electrical and electronic equipment. For more detailed information about disposal of your old appliance, please contact your local authorities or waste disposal service.

The equipment may be returned to Kongsberg Discovery AS if there is no local WEEE (Waste Electrical and Electronic Equipment) collection. The equipment is marked with this pictogram.

Appendix A
Output protocols

The following output data protocols are available from Seapath:

Name	Format no.	Description
NMEA	1	NMEA and proprietary messages
Seapath binary fmt3	3	Seapath binary format 3
Simrad EM3000/Hipap	6	Simrad EM3000, 300 and Hipap compatible
Calibration	7	Calibration format for GPS antennas
Echo Sounder fmt9	9	Echo sounder format
RDI ADCP	10	RDI ADCP format, PRDID
Seapath binary fmt11	11	Seapath binary format 11
Lehmkuhl gyro repeater	12	Lehmkuhl gyro repeater format
1PPS NMEA ZDA	13	1PPS time tag, NMEA ZDA message
1PPS Trimble	14	1PPS time tag, Trimble compatible message
Atlas Fansweep	16	Atlas Fansweep format
Echo Sounder fmt18	18	Echo sounder format, TSS1 compatible
Seapath binary fmt 22	22	Seapath output format for VMM 200 (not documented)
Seapath binary fmt 23	23	Seapath binary format 23
PFreeHeave format	24	Delayed heave format
Seapath binary fmt 25	25	Raw IMU output (not documented)
Seapath binary fmt 26	26	Seapath binary format 26
Seapath binary fmt 27	27	Seapath output format for VMM 200 version 2 (not documented)
KM binary	30	KM echo sounder compatible
RTCM version 3	80	Raw GNSS output
Post-processing 1	81	TerraPOS multiple telegrams in same stream (not documented)

A.1 NMEA format

The NMEA format is an ASCII text format using DTM, ZDA, GGA, GLL, VTG, HDT, RMC, VBW, ROT, VER, GST, GSA and GRS messages, the proprietary PBFG and the proprietary PSXN 20, 21, 22, 23, 24, 25, 26 and 27 messages conforming to the same specification.

Format:

$INDTM,dcode,scode,latoff,{N|S},longoff,{E|W},altoff,rcode*csum term

$INZDA,time,day,month,year,,*csum term

$INGGA,time,lat,{N|S},long,{E|W},gga-qual,nsat,hdop,height,M,geoidal,M,age,stn*csum term

$INGLL,lat,{N|S},long,{E|W},time,gll-qual,mode*csum term

$INVTG,course,T,,M,speed,N,,K,mode*csum term

$INHDT,head,T*csum term

$INHRC,head,rate*csum term

$INRMC,utc,status,lat,{N|S},long,{E|W},speed,course,date,magvar,{E|W},mode*csum term

$INTHS,head,a*csum term

$INVBW,lwspeed,twspeed,Aw,lgspeed,tgspeed,Ag,stwspeed,At,stgspeed,As*csum term

$INROT,rate,Arate*csum term

$INVER,total-no,sentence-no,dev-type,vendor,,serial-no,model-code,sw-rev,hw-rev,seq-id*csum term

$INGBS,utc-fix,err-lat,err-long,err-alt,id-failed,missed,bias,sd-bias*csum term

$INGNS,time,lat,{N|S},long,{E|W},gns-mode,nsat,hdop,alt-msl,geo-sep,age,stn*csum term

$INGSV,tno,no,nsat-view,id,elev,azi,snr,.........,id,elev,azi,snr*csum term

$INGST,time,,semi-maj,semi-min,ell-orient,sd-lat,sd-long,sd-height*csum term

$INGSA,gsa-mode,gsa-status,id,id,id,id,id,id,id,id,id,id,id,id,pdop,hdop,vdop*csum term

$INGRS,time,1,res,res,res,res,res,res,res,res,res,res,res,res*csum term

$PBFG,vers,time,ro,pi,hd,hv,ro-rate,pi-rate,ya-rate,x-vel,y-vel,z-vel,sts-att,sts-hd,sts-hv,sts-vel*csum term

$PSXN,20,horiz-qual,hgt-qual,head-qual,rp-qual*csum term

$PSXN,21,event*csum term

$PSXN,22,gyro-calib,gyro-offs*csum term

$PSXN,23,roll,pitch,head,heave*csum term

$PSXN,24,roll-rate,pitch-rate,yaw-rate,vertical-vel*csum term

$PSXN,25,gnss-rec,ant-forw,ant-stb,ant-down,ant-code,rec-code*csum term

$PSXN,26,mp-no,mp-forw,mp-stb,mp-down,mp-name*csum term

$PSXN,27,mru-forw,mru-stb,mru-down,angle-ro,angle-pi,angle-yaw*csum term

Explanation:

dcode	Local datum code (null field) on format ccc.
scode	Local datum subdivision code on format a.
latoff	Latitude offset in minutes N/S on format x.x.
longoff	Longitude offset in minutes E/W on format x.x.
altoff	Altitude offset in metres (+/-) on format x.x.
rcode	Reference datum code (WGS84 = W84) on format ccc.
time	UTC time on format hhmmss.ss where hh is hours (00 - 23), mm is minutes (00 - 59) and ss.ss is seconds (00.00 - 59.99).
day	Day of month (01 - 31).
month	Month of year (01 - 12).
year	Year on format yyyy.
lat	Latitude on format ddmm.mmmmmm where dd is degrees (00 - 90) and mm.mmmmmm is minutes (00.000000 - 59.999999).
long	Longitude on format dddmm.mmmmmm where ddd is degrees (000 - 180) and mm.mmmmmm is minutes (00.000000 - 59.999999).
gga-qual	GPS quality indicator: 0 = invalid position, 1 = GPS SPS used, 2 = DGPS used, 3 = GPS PPS used, 4 = GPS RTK used, 5 = GPS float RTK used, 6 = dead reckoning.
nsat	Number of satellites in use (00 - 99).
hdop	HDOP on format x.x.
height	Height above ellipsoid in metres on format m.mm.
geoidal	Geoidal separation in metres on format m.mm.
age	Age of DGPS corrections in seconds on format s.s.
stn	DGPS reference station ID (0000 - 1023).
gll-qual	Geographic position quality: A = valid, (D)GPS used (normal or reduced performance), V = dead reckoning or invalid position.
mode	Positioning mode: A = GPS used, D = DGPS used, E = dead reckoning, N = invalid position/velocity.
course	Course over ground, degrees true on format d.dd (0.00 - 359.99).
speed	Speed over ground, knots on format k.k.
head	Heading, degrees true on format d.dd (0.00 - 359.99).

a	Mode indicator: A = Autonomous, V = Data not valid.
utc	UTC of position fix on format hhmmss.ss.
status	Status: A = Data valid, V = Navigation receiver warning.
date	Date: day, month, year on format xxxxxx.
magvar	Magnetic variation in degrees on format x.x.
lwspeed	Longitudinal water speed in knots on format x.x. Longitudinal speed: "-" = astern
twspeed	Transverse water speed in knots on format x.x. Transverse speed: "-" = port
Aw	Status: Water speed, A = valid data on format A
lgspeed	Longitudinal ground speed in knots on format x.x. Longitudinal speed: "-" = astern
tgspeed	Transverse ground speed in knots on format x.x. Transverse speed: "-" = port
Ag	Status: Ground speed, A = valid data on format A.
stwspeed	Stern transverse water speed in knots on format x.x. Transverse speed: "-" = port
At	Status: Stern water speed, A = valid data on format A.
stgspeed	Stern transverse ground speed in knots on format x.x. Transverse speed: "-" = port
As	Status: Stern ground speed, A = valid data on format A.
rate	Rate of turn (degrees/minute on format x.x. “-“ = bow turns to port
Arate	Status: A = Data valid, V = Data invalid, on format A
total-no	Total number of sentences needed (1-9) on format x.
sentence-no	Sentence number (1-9) on format x.
dev-type	The manufactured purpose of the device (GNSS).
vendor	Vendor name (KSX).
serial-no	The unique serial number for the device.
model-code	A code describing the type of model.
sw-rev	The product’s software revision.
hw-rev	The product’s hardware revision.
seq-id	Sequence message identifier (0-9) on format x.
utc-fix	UTC of the GGA or GNS fix associated with this sentence (hours, minutes, seconds) on format hhmmss.ss.
err-lat	Expected error in latitude on format x.x.
err-long	Expected error in longitude on format x.x.
err-alt	Expected error in altitude on format x.x.

id-failed	ID number of most likely failed satellite, GPS: 1-32 , WAAS: 33-64, GLONASS: 65-96 on format xx.
missed	Probability of missed detection for most likely failed satellite on format x.x.
bias	Estimate of bias in metres on most likely failed satellite on format x.x.
sd-bias	Standard deviation of bias estimate on format x.x.
gns-mode	Mode indicator on format c–c. The first character indicates the use of GPS/GLONASS satellites. N = No fix, A = Autonomous mode, D = Differential mode.
alt-msl	Antenna altitude, metres, reference: mean-sea-level (geoide) on format x.x.
geo-sep	Geoidal separation, metres: the difference between the earth ellipsoid and mean-sea-level on format x.x.
tno	Total number of messages (1-9) on format x.
no	Message number (1-9) on format x.
nsat-view	Total number of satellites in view on format x.x.
elev	Elevation in degrees, 90º maximum on format xx.
azi	Azimuth in degrees (000-359) on format xxx.
snr	SNR 00-99 dB-Hz, 0 when not tracked on format xx.
semi-maj	Standard deviation of the semi-major axis of the position error ellipse in metres on format m.mm.
semi-min	Standard deviation of the semi-minor axis of the position error ellipse in metres on format m.mm.
ell-orient	Orientation of the semi-major axis of the position error ellipse in degrees (0 - 180).
sd-lat	Standard deviation of latitude error in metres on format m.mm.
sd-long	Standard deviation of longitude error in metres on format m.mm.
sd-height	Standard deviation of height error in metres on format m.mm.
gsa-mode	GPS position mode setting: A = height aiding enabled, M = 3D only.
gsa-status	GPS position mode used: 1 = no GPS position, 2 = height aided (3 satellites), 3 = 3D.
id	Satellite ID number, GPS (01 – 32), WAAS: 33-64, GLONASS: 65-96.
pdop	PDOP on format x.x
vdop	VDOP on format x.x.
res	GPS range residual in metres on format m.m (no fraction if the value is greater than 99.9 metres).

vers	Version number (1-9) on format x.
ro	Roll in degrees on format d.ddd. Positive with starboard side down.
pi	Pitch in degrees on format d.ddd. Positive with bow up.
hd	Heading in degrees on format d.ddd.
hv	Heave in metres on format d.ddd. Positive down.
ro-rate	Roll rate in degrees per second on format d.ddd. Positive with starboard side down.
pi-rate	Pitch rate in degrees per second on format d.ddd. Positive with bow up.
ya-rate	Yaw rate in degrees per second on format d.ddd. Positive clockwise.
x-vel	Velocity in North direction on format d.ddd.
y-vel	Velocity in East direction on format d.ddd.
z-vel	Velocity in Down direction on format d.ddd. Positive down.
sts-att	Status on roll and pitch angle and rate: 0 = Invalid, 1 = Reduced, 2 = Normal.
sts-hd	Status on heading and yaw rate: 0 = Invalid, 1 = Reduced, 2 = Normal.
sts-hv	Status on heave and velocity in Z-direction: 0 = Invalid, 1 = Reduced, 2 = Normal.
sts-vel	Status on velocity in X- and Y-direction: 0 = Invalid, 1 = Reduced, 2 = Normal..
horiz-qual	Horizontal position and velocity quality: 0 = normal, 1 = reduced performance, 2 = invalid data.
hgt-qual	Height and vertical velocity quality: 0 = normal, 1 = reduced performance, 2 = invalid data.
head-qual	Heading quality: 0 = normal, 1 = reduced performance, 2 = invalid data.
rp-qual	Roll and pitch quality: 0 = normal, 1 = reduced performance, 2 = invalid data.
gyro-calib	Gyro calibration value since system start-up in degrees on format d.dd.
gyro-offs	Short-term gyro offset in degrees on format d.dd.
roll	Roll in degrees on format d.dd. Positive with port side up.
pitch	Pitch in degrees on format d.dd. Positive with bow up.
heave	Heave in metres on format d.dd. Positive down.
roll-rate	Roll rate in degrees per second on format d.dd. Positive when port side is moving upwards.

pitch-rate	Pitch rate in degrees per second on format d.dd. Positive when bow is moving upwards.
yaw-rate	Yaw rate in degrees per second on format d.dd. Positive when bow is moving towards starboard.
vertical-vel	Vertical velocity in metres per second on format d.dd. Positive when moving downwards.
gnss-no	GNSS receiver number [1..n].
ant-forw	Arm from Origin to GNSS antenna in forward direction [m].
ant-stb	Arm from Origin to GNSS antenna in starboard direction [m].
ant-down	Arm from Origin to GNSS antenna in down direction [m].
ant-code	IGS GNSS antenna code (20 characters).
rec-code	IGS GNSS receiver code (20 characters).
mp-no	Monitoring point number [0..n]. If **mp-no**= 0, them arm from Origin to NRP is input.
mp-forw	Arm from Origin to MP/NRP in forward direction [m].
mp-stb	Arm from Origin to MP/NRP in starboard direction [m].
mp-down	Arm from Origin to MP/NRP in down direction [m].
mp-name	Monitoring point name. If **mp-no**=0, then**mp-name**=NRP.
mru-forw	Arm from Origin to MRU in forward direction [m].
mru-stb	Arm from Origin to MRU in starboard direction [m].
mru-down	Arm from Origin to MRU in down direction [m].
angle-ro	MRU mounting angle roll [-180.000 to 179.999 deg].
angle-pi	MRU mounting angle pitch [-89.999 to 89.999 deg].
angle-yaw	MRU mounting angle yaw [-180.000 to 179.999 deg].
event	Event code: 1 = system restart.
csum	Checksum (exclusive or) of all characters between, but not including, the preceding $ and *, hexadecimal (00 - FF).
term	CR-LF (2 bytes, values 13 and 10).

The ZDA, GGA, GLL, VTG, HDT, GST, GSA, GRS, PSXN 20, 21, 22, 23 and 24 messages are output regularly at an adjustable rate. If gyro calibration data are not being calculated, the PSXN, 22 message is not output. The PSXN, 21 message is output once when an event occurs.

A sub set of the available NMEA messages can be configured individually for each serial line.

A.2 Binary format 3

This binary format consists of a fixed-length message using single-byte unsigned, 4-byte two-complement integer and 4-byte IEEE floating point data elements. For the multi-byte elements, the most significant byte is transmitted first.

Format:

Element	Scaling	Format	Bytes	Value
Header		ASCII	1	ASCII "q"
Length		Unsigned	1	49
Token		Unsigned	1	0 - 255
Time	nanoseconds	Integer	4	0 - 999999999
Latitude	2^{30} = 90 degrees	Integer	4	-2^{30} - 2^{30}
Longitude	2^{30} = 90 degrees	Integer	4	-2^{31} - 2^{31}
Height	metres	Float	4	
Heave	metres	Float	4	
North velocity	metres/second	Float	4	
East velocity	metres/second	Float	4	
Down velocity	metres/second	Float	4	
Roll	radians	Float	4	
Pitch	radians	Float	4	
Heading	radians	Float	4	0 - 2 pi
Status word	radians	Bit-fields	4	
Checksum		Unsigned	1	0 - 255

Length is number of bytes between, but not including, the Length and Checksum fields. Checksum is calculated modulo 256 of all bytes between, but not including, the Length and Checksum fields. The contents of the Token field is adjustable. Latitude is positive north of the Equator. Longitude is positive east of Greenwich. Height is above the ellipsoid. Heave is positive down. Roll is positive with port side up. Pitch is positive with bow up.

The status word consists of 32 single bit flags numbered from 0 to 31, where 0 is the least significant bit.

A 1 value (true) means:

Bit no.	Interpretation
0	Reduced horizontal position and velocity performance.
1	Invalid horizontal position and velocity data.

Bit no.	Interpretation
2	Reduced heave and vertical velocity performance.
3	Invalid heave and vertical velocity data.
4	Reduced roll and pitch performance.
5	Invalid roll and pitch data.
6	Reduced heading performance.
7	Invalid heading data.

The remaining bits in the status word are reserved for future expansion.

A.3 Binary format 11

This binary format consists of a fixed-length message using 1, 2 and 4–byte signal and unsigned integers. The signed integers are represented as two-complement numbers. For the multi-byte elements, the most significant byte is transmitted first. The total number of bytes is 42.

Format:

Element	Scaling	Format	Bytes	Value
Header		ASCII	1	ASCII "q"
Time, seconds	seconds	Integer	4	
Time, fraction of second	0.01 second	Unsigned	1	0 - 99
Latitude	2^{30} = 90 degrees	Integer	4	-2^{30} - 2^{30}
Longitude	2^{30} = 90 degrees	Integer	4	-2^{31} - 2^{31}
Height	centimetres	Integer	4	
Heave	centimetres	Integer	2	
North velocity	centimetres/second	Integer	2	
East velocity	centimetres/second	Integer	2	
Down velocity	centimetres/second	Integer	2	
Roll	2^{14} = 90 degrees	Integer	2	-2^{15} - 2^{15}
Pitch	2^{14} = 90 degrees	Integer	2	-2^{15} - 2^{15}
Heading	2^{14} = 90 degrees	Unsigned	2	-0 - 2^{16}
Roll rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Pitch rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}

Element	Scaling	Format	Bytes	Value
Yaw rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Status word		Bit-fields	2	
Checksum		Unsigned	2	

Checksum is calculated as a 16-bit Block Cyclic Redundancy Check of all bytes between, but not including the Header and Checksum fields. The CRC algorithm is described in a separate section. Time is divided in an integer seconds part and a fractional second part. The integer seconds part of time is counted from 1970-01-01 UTC time, ignoring leap seconds.

Latitude is positive north of the Equator. Longitude is positive east of Greenwich. Height is above the ellipsoid. Heave is positive down. Roll is positive with port side up. Pitch is positive with bow up.

The status word consists of 16 single bit flags numbered from 0 to 15, where 0 is the least significant bit.

A 1 value (true) means:

Bit no.	Interpretation
0	Reduced horizontal position and velocity performance.
1	Invalid horizontal position and velocity data.
2	Reduced heave and vertical velocity performance.
3	Invalid heave and vertical velocity data.
4	Reduced roll and pitch performance.
5	Invalid roll and pitch data.
6	Reduced heading performance.
7	Invalid heading data.

The remaining bits in the status word are reserved for future expansion.

A.4 Seapath Binary 23

This binary format consists of a fixed-length message using 1, 2 and 4–byte signal and unsigned integers. The signed integers are represented as two-complement numbers. For the multi-byte elements, the most significant byte is transmitted first. The total number of bytes is 44.

Format

Element	Scaling	Format	Bytes	Value
Header		Unsigned	1	AA Hex
Header		Unsigned	1	51 Hex
Time, seconds	seconds	Integer	4	
Time, fraction of second	0.0001 second	Unsigned	2	0 to 9999
Latitude	2^{30} = 90 degrees	Integer	4	-2^{30} - 2^{30}
Longitude	2^{30} = 90 degrees	Integer	4	-2^{31} - 2^{31}
Height	centimetres	Integer	4	
Heave	centimetres	Integer	2	
North velocity	centimetres/second	Integer	2	
East velocity	centimetres/second	Integer	2	
Down velocity	centimetres/second	Integer	2	
Roll	2^{14} = 90 degrees	Integer	2	-2^{15} - 2^{15}
Pitch	2^{14} = 90 degrees	Integer	2	-2^{15} - 2^{15}
Heading	2^{14} = 90 degrees	Unsigned	2	0 - 2^{16}
Roll rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Pitch rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Yaw rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Status word		Bit-fields	2	
Checksum		Unsigned	2	

Checksum is calculated as a 16-bit Block Cyclic Redundancy Check of all bytes between, but not including the Header and Checksum fields. The CRC algorithm is described in a separate section. Time is divided in an integer seconds part and a fractional second part. The integer seconds part of time is counted from 1970-01-01 UTC time, ignoring leap seconds.

Latitude is positive north of the Equator. Longitude is positive east of Greenwich. Height is above the ellipsoid. Heave is positive down. Roll is positive with port side up. Pitch is positive with bow up.

The status word consists of 16 single bit flags numbered from 0 to 15, where 0 is the least significant bit.

A 1 value (true) means:

Bit no.	Interpretation
0	Reduced horizontal position and velocity performance.
1	Invalid horizontal position and velocity data.
2	Reduced heave and vertical velocity performance.
3	Invalid heave and vertical velocity data.
4	Reduced roll and pitch performance.
5	Invalid roll and pitch data.
6	Reduced heading performance.
7	Invalid heading data.

The remaining bits in the status word are reserved for future expansion.

A.5 Seapath Binary 26

This binary format consists of a fixed-length message using 1, 2 and 4–byte signal and unsigned integers. The signed integers are represented as two-complement numbers. For the multi-byte elements, the most significant byte is transmitted first. The total number of bytes is 52.

Format

Element	Scaling	Format	Bytes	Value
Header		Unsigned	1	AA Hex
Header		Unsigned	1	53 Hex
Time, seconds	seconds	Integer	4	
Time, fraction of second	0.0001 second	Unsigned	2	0 to 9999
Latitude	2^{30} = 90 degrees	Integer	4	-2^{30} - 2^{30}
Longitude	2^{30} = 90 degrees	Integer	4	-2^{31} - 2^{31}
Height	centimeters	Integer	4	
Heave, real-time	centimeters	Integer	2	
North velocity	centimeters/second	Integer	2	
East velocity	centimeters/second	Integer	2	
Down velocity	centimeters/second	Integer	2	
Roll	2^{14} = 90 degrees	Integer	2	-2^{15} - 2^{15}
Pitch	2^{14} = 90 degrees	Integer	2	-2^{15} - 2^{15}

Element	Scaling	Format	Bytes	Value
Heading	2^{14} = 90 degrees	Unsigned	2	0 - 2^{16}
Roll rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Pitch rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Yaw rate	2^{14} = 90 degrees/second	Integer	2	-2^{15} - 2^{15}
Delayed heave time, seconds	seconds	Integer	4	
Delayed heave time, fraction of second	0.0001 second	Unsigned	2	0 to 9999
Heave, delayed	centimeters	Integer	2	
Status word		Bit-fields	2	
Checksum		Unsigned	2	

Checksum is calculated as a 16-bit Block Cyclic Redundancy Check of all bytes between, but not including the Header and Checksum fields. The CRC algorithm is described in a separate section. Time is divided in an integer seconds part and a fractional second part. The integer seconds part of time is counted from 1970-01-01 UTC time, ignoring leap seconds.

Latitude is positive north of the Equator. Longitude is positive east of Greenwich. Height is above the ellipsoid. Heave is positive down. Roll is positive with port side up. Pitch is positive with bow up.

The status word consists of 16 single bit flags numbered from 0 to 15, where 0 is the least significant bit.

A 1 value (true) means:

Bit no.	Interpretation
0	Reduced horizontal position and velocity performance.
1	Invalid horizontal position and velocity data.
2	Reduced heave and vertical velocity performance.
3	Invalid heave and vertical velocity data.
4	Reduced roll and pitch performance.
5	Invalid roll and pitch data.
6	Reduced heading performance.
7	Invalid heading data.
8	Invalid delayed heave data

The remaining bits in the status word are reserved for future expansion.

A.6 Simrad EM3000

The Simrad EM3000 format consists of a fixed-length message using single-byte unsigned, 2-byte unsigned and 2-byte two-complement integer data elements. For the 2-byte elements, the least significant byte is transmitted first.

Format

Element	Scaling	Format	Bytes	Value
Status byte		Unsigned	1	
Header		Unsigned	1	90 Hex
Roll	0.01 degrees	Integer	2	-17999 to 17999
Pitch	0.01 degrees	Integer	2	-17999 to 17999
Heave	1 cm	Integer	2	-999 to 999
Heading	0.01 degrees	Unsigned	2	0 to 35999

Roll is positive with port side up. Pitch is positive with bow up. Heave is positive up.

The status byte can have the following values:

Value	Interpretation
90 Hex	Normal
91 Hex	Reduced performance
A0 Hex	Invalid data

Invalid data are also indicated by values outside the specified ranges. When the status is A0, the values which are within specified ranges can be assumed to have valid, but reduced quality.

A.7 KM binary format

The KM binary protocol is a proprietary binary format used when connection to multibeam echo sounders and other systems. Length 132 bytes.

Format

		Format	# of bytes
Start id	#KMB	char	4U
Dgm length		uint16	2U
Dgm version (=1)		uint16	2U
UTC seconds	s	uint32	4U
UTC nanoseconds	ns	uint32	4U

		Format	# of bytes
Status		uint32	4U
Latitude	deg	double	8F
Longitude	deg	double	8F
Ellipsoid height	m	float	4F
Roll	deg	float	4F
Pitch	deg	float	4F
Heading	deg	float	4F
Heave	m	float	4F
Roll rate	deg/s	float	4F
Pitch rate	deg/s	float	4F
Yaw rate	deg/s	float	4F
North velocity	m/s	float	4F
East velocity	m/s	float	4F
Down velocity	m/s	float	4F
Latitude error	m	float	4F
Longitude error	m	float	4F
Height error	m	float	4F
Roll error	deg	float	4F
Pitch error	deg	float	4F
Heading error	deg	float	4F
Heave error	m	float	4F
North acceleration	m/s2	float	4F
East acceleration	m/s2	float	4F
Down acceleration	m/s2	float	4F
Delayed heave:			
UTC seconds	s	uint32	4U
UTC nanoseconds	ns	uint32	4U
Delayed heave	m	float	4F

This format include the necessary information for calculation of the Doppler effect at the transducer locations (needed in FM chirp mode). The update rate should then be minimum 100 Hz.

Definitions

Data format

Little endian (the least significant byte is transmitted first). Float is according to IEEE - 754.

Dgm length

The total number of bytes in the datagram.

Dgm version

The version is incremented if the datagram format is changed.

Timestamp format

Epoch 1970-01-01 UTC time, ignoring leap seconds.

Position and height

At user defined sensor reference point. Position in decimal degrees.

- Latitude: Negative on Southern hemisphere.
- Longitude: Negative on Western hemisphere.
- Height: Positive above ellipsoid.

Positive roll

Port side up.

Positive pitch

Bow up.

Positive heave

Downwards, at user defined sensor reference point.

Heading

True North.

Error fields

Sensor data quality: RMS

-1= not implemented

Status word

One bit per status info, 1= active

Bit #	
	Invalid data:
0	Horizontal position and velocity
1	Roll and pitch
2	Heading

Bit #	
3	Heave and vertical velocity
4	Acceleration
5	Delayed heave
	Reduced performance:
16	Horizontal position and velocity
17	Roll and pitch
18	Heading
19	Heave and vertical velocity
20	Acceleration
21	Delayed heave

A.8 Calibration format 7

The calibration format is a columnar ASCII text format for use when calibrating the GNSS antenna installation.

Format:

Element	Columns	Scaling	Decimals	Value
Time	1 - 7	seconds	1	0.0 - 86399.9
Heading	10 - 15	degrees	2	0.00 - 359.99
Gyro heading	18 - 23	degrees	2	0.00 - 359.99
Baseline	26 - 31	metres	3	
Height	34 - 38	metres	2	
Term	39 - 40			CR-LF

Each record consists of numbers on ASCII format separated by spaces and terminated by carriage return and linefeed (values 10 and 13). Leading spaces are used, so the numbers are separated by two or more spaces, and spaces may occur before the first number on the record.

Time is counted since last midnight UTC time. Heading is true heading from the GNSS phase measurement, which is not the same as the heading output on the other formats. Gyro heading is from an external gyro, 0.00 if no gyro is connected. Baseline is the slant range between the antenna centres from the GNSS phase measurement. Height is the height difference between the antennas from the GNSS phase measurement. Height is positive if antenna 1 is above antenna 2.

The data are intended for calibration of the antenna installation, so no data are output unless the GNSS phase measurements are valid.

A.9 Echo sounder format 9

This echo sounder format is a proprietary ASCII text format with fixed-length records used when connecting Simrad EA500 and other echo sounders.

Format:

Element	Columns	Scaling	Format
Header	1 - 7		:000000
Heave	9 - 13	1 cm	sdddd
Warning	14		space or “?”
Roll	15 - 19	0.01 degree	sdddd
Pitch	21 – 25	0.01 degree	sdddd
Term	26 – 27		CR-LF

Heave is positive up. Roll is positive with port side up. Pitch is positive with bow up.

The zeroes in the header occupy the columns used for acceleration when this format is output from other systems. Seapath does not output acceleration.

“s” is the sign character, space if positive and “-“ if negative. “dddd” is a decimal number with leading zeroes where appropriate.

The warning character is space if data are normal, “?” if data are invalid or of reduced quality.

Columns between elements are filled with spaces.

The definition of the attitude angles in this format is different from the Euler angles definition used elsewhere. The difference appears in the roll angle, where:

$$roll_{echo-sounder} = \arcsin\left[\sin(roll_{Euler}) \cdot \cos(pitch_{Euler})\right]$$

A.10 Echo sounder format 18, TSS1

This echo sounder format is a proprietary ASCII text format with fixed-length records used when connecting Seapath to Seabeam and other echo sounders.

Format:

Element	Columns	Scaling	Format
Header	1 - 7		:000000
Heave	9 - 13	1 cm	sdddd
Warning	14		"F" or "f"
Roll	15 - 19	0.01 degree	sdddd
Pitch	21 – 25	0.01 degree	sdddd
Term	26 – 27		CR-LF

Heave is positive up. Roll is positive with port side up. Pitch is positive with bow up.

The zeroes in the header occupy the columns used for acceleration when this format is output from other systems. Seapath does not output acceleration.

"s" is the sign character, space if positive and "-" if negative. "dddd" is a decimal number with leading zeroes where appropriate.

The warning character is "F" if data are normal, "f" if data are invalid or of reduced quality.

Columns between elements are filled with spaces.

The definition of the attitude angles in this format is different from the Euler angles definition used elsewhere. The difference appears in the roll angle, where:

$$roll_{echo-sounder} = \arcsin\left[\sin(roll_{Euler}) \cdot \cos(pitch_{Euler})\right]$$

A.11 RDI ADCP

The RDI format is a proprietary ASCII text format used when connecting RDI ADCP equipment.

Format:

$PRDID,pitch,roll,head term

Explanation:

pitch Pitch, degrees on format sddd.dd. s is the sign character, "+" or "-". ddd.dd is a decimal number with leading zeroes where appropriate. Positive with bow up.

roll Roll, degrees on format sddd.dd. s is the sign character, "+" or "-". ddd.dd is a decimal number with leading zeroes where appropriate. Positive with port side up.

head Heading, degrees true on format ddd.dd, with leading zeroes where appropriate.

term CR-LF (2 bytes, values 13 and 10).

A.12 Lehmkuhl gyro repeater format 12

This Lehmkuhl gyro repeater format is used when outputting heading from Seapath to Lehmkuhl gyro repeaters. The message is similar to the HDT message output in the standard NMEA format from Seapath. The main differences are lower resolution and no checksum.

When heading is output to devices that are compliant to the NMEA specification, it is recommended to use the standard NMEA format and not the Lehmkuhl format.

A.13 1PPS, NMEA ZDA format 13

This 1PPS time tag message is output once per second, approximately 0.5 seconds before the time pulse. The message format is ASCII text using the ZDA message. The message contains the UTC time when the message is output. The next time pulse appears at the first integer second after the time in the message.

Format:

$INZDA,time,day,month,year,,*csum term

Explanation:

time UTC time on format hhmmss.ss where hh is hours (00 - 23), mm is minutes (00 - 59) and ss.ss is seconds (00.00 - 59.99).

day Day of month (01 - 31).

month Month of year (01 - 12).

year Year on format yyyy.

csum Checksum (exclusive or) of all characters between, but not including, the preceding $ and *, hexadecimal (00 - FF).

term CR-LF (two bytes, values 13 and 10).

This format is recommended used together with 1PPS signal output on the 1PPS cable in the sensor unit spider cable. This since the message is output synchronised with the 1PPS signal and is easier/faster to decode than the standard NMEA output with a number of NMEA messages included.

A.14 1PPS, Trimble format 14

This 1PPS time tag message is output once per second, approximately 0.5 seconds before the time pulse. The message format is fixed length ASCII text. The message contains the UTC time of the next time pulse.

Format:

Element	Columns	Format
Header	1 - 3	UTC
Date	5 - 12	yy.mo.da
Time	14 - 21	hh:mm:ss
Fix type	23	digit or '?'
No. of satellites	24	digit or '?'
Term	25 - 26	CR-LF

"yy.mo.da" is year (00 - 99), month of year (01 - 12) and day of month (01 - 31). "hh:mm:ss" is hours (00 - 23), minutes (00 - 59) and seconds (00 - 59). Fix type is "5" for 3D fix with accurate time, "?" for no fix (time from receiver clock). No. of satellites is "1" – "8" for 1 - 8 satellites tracked, "9" for 9 or more satellites tracked, "?" for no fix (time from receiver clock).

Columns between elements are filled with spaces.

A.15 Atlas fansweep format 16

This Atlas format is a proprietary binary format used for outputting data to Atlas Fansweep echo sounders. It consists of a fixed-length message using single-byte and 2-byte two-complement integer data elements. For the 2-byte elements, most significant byte is transmitted first.

Format:

Element	Scaling	Format	Bytes	Value
Start byte		Integer	1	10 Hex
Roll	$2^{14} = 90$ degrees	Integer	2	
Pitch	$2^{14} = 90$ degrees	Integer	2	
Heave	millimetres	Integer	2	
Status byte		Integer	1	
Stop byte		Integer	1	10 Hex

Roll is positive with port side up. Pitch is positive with bow up. Heave is positive up.

The definition of the attitude angles in this format is different from the Euler angles definition used elsewhere. The difference appears in the roll angle, where:

$$roll_{echo-sounder} = \arcsin\left[\sin(roll_{Euler}) \cdot \cos(pitch_{Euler})\right]$$

The status byte can have the following values:

Value	Interpretation
6	Normal
7	Reduced performance or invalid data

A.16 PFreeHeave

This PFreeHeave® format consists of a fixed-length message using 1-, 2- and 4-byte signed and unsigned integers. The signed integers are represented as two-complement numbers. For the multi-byte elements, the most significant byte is transmitted first. The total number of bytes is 13.

The PFreeHeave output is delayed by a few minutes due to processing. The time fields contain time of validity for the data.

Format

Element	Scaling	Format	Bytes	Value
Header		Unsigned	1	AA Hex
Header		Unsigned	1	52 Hex
Time, seconds	Seconds	Integer	4	
Time, fraction of second	0.0001 second		2	0 to 9999
Heave	Centimetres	Integer	2	
Status word		Bit-fields	1	
Checksum		Unsigned	2	

Checksum is calculated as a 16-bit Block Cyclic Redundancy Check of all bytes between, but not including the Header and Checksum fields. The CRC algorithm is described in a separate section. Time is divided in an integer seconds part and a fractional second part. The integer seconds part of time is counted from 1970-01-01 UTC time, ignoring leap seconds.

Heave is positive down. The status field is zero if heave is valid, non-zero if heave is invalid.

A.17 Cyclic redundancy check algorithm

The 16-bit Block Cyclic Redundancy Check algorithm used to calculate the checksum in some formats is described in C and Fortran source code below.

C code

```
#define POLY 0x8408
unsigned short blkcrc(
   unsigned char *bufptr,       /* message buffer */
   unsigned long len            /* number of bytes */
   )
{
   unsigned char i;
   unsigned short data;
   unsigned short crc = 0xffff;

   if (len == 0L) {
      return ~crc;
   }

 do {
      for (i=0, data = (unsigned short) (0xff & *bufptr++);
           i < 8;
           i++, data >>= 1) {
         if ((crc & 0x0001) ^ (data & 0x0001)) {
            crc = (crc >> 1) ^ POLY;
         } else {
            crc >>= 1;
         }
      }
   } while (--len);

   crc = ~crc;
   data = crc;
   crc = (crc << 8) | ((data >> 8) & 0xff);

   return crc;
}
```

Fortran code

```
SUBROUTINE blkcrc(inbuffer, len, crc)

INTEGER*2 len, i , bit
INTEGER*4 crc, data, poly
CHARACTER inbuffer*(*)

poly = 16#8408
crc  = 16#FFFF
data = 0

IF (len.EQ.0) THEN
    crc = 0
    RETURN
END IF

DO i = 1, len
    data = ICHAR(inbuffer(i:i))
    DO bit = 1, 8
        data = IAND(data,16#FF)
        IF (IAND(crc,16#01).EQ.(IAND(data,16#01))) THEN
            crc = ISHL(crc,-1)
        ELSE
            crc = ISHL(crc,-1)
            crc = IEOR(crc, poly)
        END IF
        data = ISHL(data,-1)
    END DO
END DO

data = IEOR(crc,16#FFFF)
crc = IOR(ISHL(data,8),IAND(ISHL(data,-8),16#FF))

END
```

A.18 RTCM format 80

This protocol is based on the RTCM Standard 10403.2, *Differential GNSS services*, version 3 with Amendments 1 and 2. See this standard for a description of the output properties.

This output protocol is used for outputting raw GNSS data for post processing of the position. All data are output in the GNSS antenna only and applies for both antennas.

Appendix B
NMEA TelegramOut options

The contents of some of the available NMEA telegrams may be modified according to options listed in the configuration. This is for example useful when interfacing to older equipment.

This table holds a description of the various options.

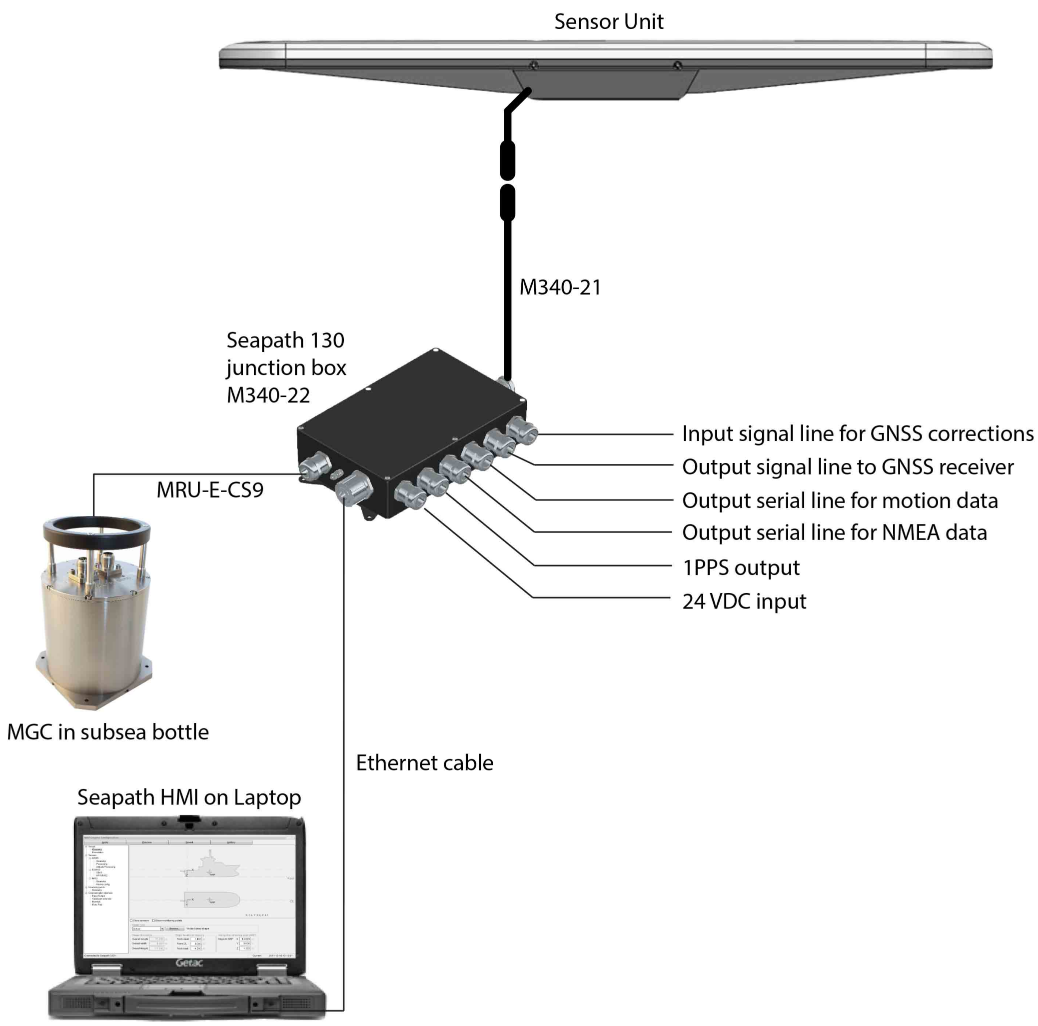
Telegram out option	Description
Output residuals on Ashtech RRE format (GRS)	Use this option if you have enabled the GRS sentence and want the residuals output on the Ashtech RRE format instead.
Send VHW message after VTG using ground speed from VTG	Use this option when a VHW sentence is needed, and vessel heading and vessel speed relative to the water are not available. When this option is enabled, an NMEA VHW sentence is output, using SOG as Speed, and COG as heading. The VHW sentence is output immediately after the VTG sentence.
Output empty fields in NMEA HDT and NMEA THS messages also for reduced accuracy	Use this option when you want to set invalid heading (empty HDT/THS field) when heading status is reduced (low accuracy).
Use inertial roll, pitch and heave only	Use this option if you want the output of roll, pitch and heave to be calculated from IMU measurements only (no GNSS).
Use time from dataset in NMEA ZDA message	GNSS systems: Use this option if you want the timestamp in the NMEA ZDA message to be equal to timestamp of the GNSS data set and the GGA message.
Disable additional GNS messages when diffcorr is used for both GPS and GLONASS	Use this option if you do not want additional NMEA messages if differential corrections are used for both GPS and GLONASS.
Limit correction age to 9.9 sec in GGA	Use this option if your system does not handle correction ages above 9.9 seconds in the GGA sentence. If this option is enabled, the correction age will increase and stop at 9.9 seconds even if the correct correction age is more than 9.9 seconds.

Telegram out option	Description
Use GNSS solution only	For Integrated systems only: Use this option if you want to output position based on GNSS only (no IMU).
Set GGA quality indicator to 5 if converged high precision	Use this option if you want the Quality Indicator in the NMEA GGA sentence set to 5, when position solution is converged clock orbit or float filter (XP, G2, Ultra, Apex etc).
Freeze NMEA position if invalid	Use this option if you want the position output to use the last known valid position when the current position becomes invalid.
Use current GNSS info if only integrated position is valid	Integrated systems only: Use this option if you want to output current HDOP, number of satellites and corrections age in the GGA message though the GNSS position is invalid and the integrated position is valid.
Allow more than 12 satellites in GGA message	The NMEA standard limits the number of satellites in the GGA sentence to 12. Use this option if you want the GGA sentence to use the actual number of satellites.
Use modified quality indicator in GGA message	Use this option if you want the quality Indicator in the NMEA GGA sentence to be replaced by GQI.
Use external attitude for lever arm compensation	Use this option if you want to use external attitude for lever arm compensation and velocity decomposition.
Use DQI(0-9) as GGA quality indicator	DP only: Use this option if you want to use talker DP and output DQI instead of NMEA Quality Indicator for GGA.
Send each NMEA telegram in separate UDP datagram	Use this option if TelegramOut is configured to send on UDP, and you want each NMEA telegram to be sent in a separate UDP telegram.
Use 2 decimals instead of 1 for velocity in NMEA VTG and RMC	Use this option if you want the velocity field in NMEA VTG and NMEA RMC to contain 2 decimals instead of the default 1.
Stop GGA, GLL, GNS and RMC output if invalid position	Use this option if you want the output of the position telegrams to stop if the position is invalid.

Appendix C Installations with junction box

For more permanent installations the Seapath 130 can be installed by use of junction box as an alternative to the spider cable. In the below figures is described some alternatives with part numbers on the necessary cables and junction boxes.

Figure 11 Installation by use of junction box and MGC in subsea bottle



The connections within the Seapath 130 junction box is described in the below figures.

Figure 12 Connections for user side terminals P2 to P9

M340-22 Seapath 130 Junction Box

P2 - MRU

Pin	Signal RS-422	Description
1	0 V	Power ground
2	24 V	Power +
3	RXA	Signal sent to MRU
4	RXB	Signal sent to MRU
5	TXB	Signal sent from MRU
6	TXA	Signal sent from MRU
7	LGND	Logical ground
8	XIN	1PPS input to MRU

P3 - ECHO

Pin	Signal RS-232	Signal RS-422	Description
1	GND	GND	Ground
2	RTS	TXA	Output from Seapath
3	TX	TXB	Output from Seapath

P4 - PPS

Pin	Signal RS-422	Description
1	GND	Ground
2	TXA	Output from Seapath
3	TXB	Output from Seapath

P5 - SURVEY

Pin	Signal RS-232	Signal RS-422	Description
1	GND	GND	Ground
2	RTS	TXA	Output from Seapath
3	TX	TXB	Output from Seapath

P6 – GNSS OUT

Pin	Signal RS-232	Signal RS-422	Description
1	GND	GND	Ground
2	RTS	TXA	Output from Seapath
3	TX	TXB	Output from Seapath

P7 – GNSS IN

Pin	Signal RS-232	Signal RS-422	Description
1	GND	GND	Ground
2	CTS	RXA	Input to Seapath
3	RX	RXB	Input to Seapath

P8 – 24 VOLT

Pin	Signal	Description
1	0 V	Power ground
2	24 V	Power +

P9 – ETHERNET

Pin	Signal	Description
1	RJ1_TXD+	TD+, Ethernet
2	RJ2_TXD-	TD-, Ethernet
3	RJ3_RXD+	RD+, Ethernet
4	RJ6_RXD-	RD-, Ethernet

Note:
Plug the unused cable glands and tighten properly to ensure that they are watertight. This to fulfil the enclosure protection specification.

Figure 13 Connections for user side terminal P1 of the Sensor Unit cable, M340–21

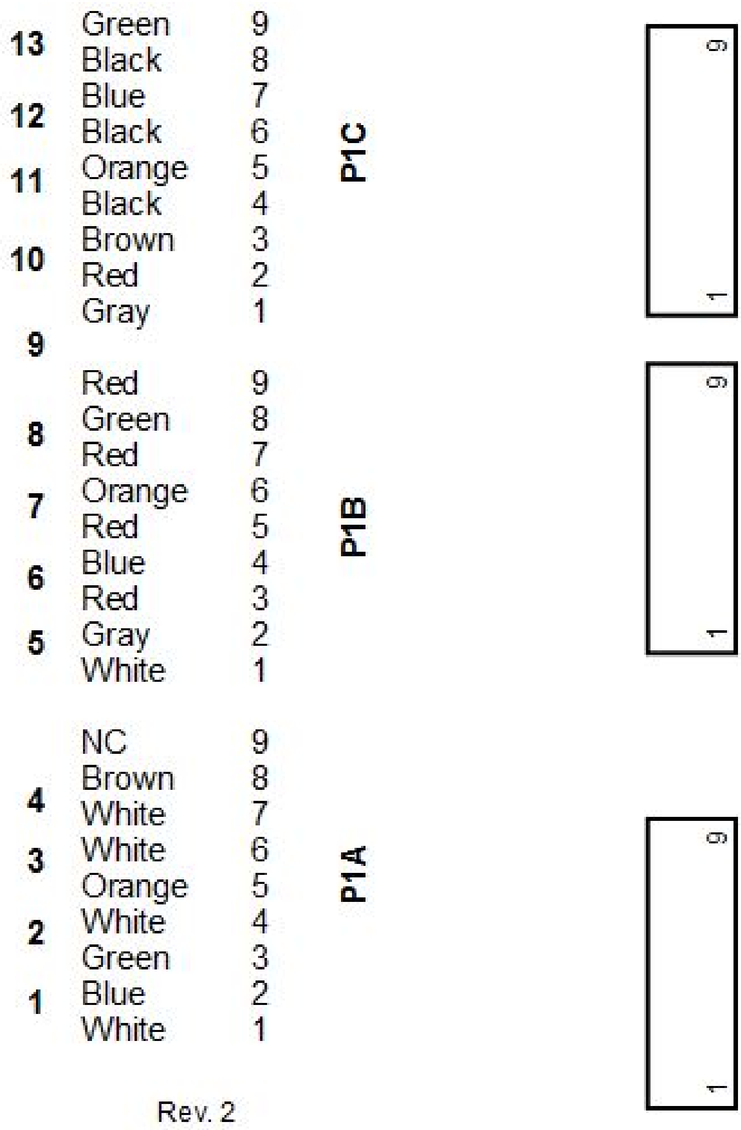


Figure 14 Cable wiring schematics for M340–21

Souriau 26 pin Signal	Conn.	Signal Description	Conductor Pair No.	Color
PWR+	R	Power supply (+24 V)	1a	White
PWR-	B	Power supply (0 V)	1b	Blue
ETH RXD-	C	RD-, Ethernet	2a	White
ETH RXD+	T	RD+, Ethernet	2b	Orange
ETH TXD-	S	TD-, Ethernet	3a	White
ETH TXD+	P	TD+, Ethernet	3b	Green
GNSS CTS RX-A	G	RS422A- or RS232 input signal from GNSS rec.	4a	White
GNSS RX RX-B	H	RS422B+ or RS232 input signal from GNSS rec.	4b	Brown
GNSS RTS TX-A	X	RS422A- or RS232 output signal to GNSS rec.	5a	White
GNSS TX TX-B	A	RS422B+ or RS232 output signal to GNSS rec.	5b	Grey
GNSS GND	J	GND GNSS receiver	6a	Red
Survey GND	K	GND survey computer	6b	Blue
Survey TX TX-B	c	RS422B+ or RS232 output signal to survey comp	7a	Red
Survey RTS TX-A	M	RS422A- or RS232 output signal to survey comp.	7b	Orange
1PPS TX-B	E	RS422B+ output 1PPS signal	8a	Red
1PPS TX-A	Y	RS422A- output 1PPS signal	8b	Green
1PPS GND	a	GND for 1PPS signal	9a	Red
Echo GND	U	GND for echo sounder	9b	Grey
Echo TX TX-B	V	RS422B+ or RS232 output signal to echo sound.	10a	Red
Echo RTS TX-A	L	RS422A- or RS232 output signal to echo sounder	10b	Brown
MRU RX-A	Z	RS422A- input signal from MRU	11a	Black
MRU RX-B	W	RS422B+ input signal from MRU	11b	Orange
MRU TX-A	b	RS422A- output signal to MRU	12a	Black
MRU TX-B	F	RS422B+ output signal to MRU	12b	Blue
MRU GND	D	GND for MRU	13a	Black
MRU 1PPS P TX-B	N	1PPS singal to MRU (XIN)	13b	Green
		Not connected	14a	Black
		Not connected	14b	Brown

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Attn.: Customer support

Pirsenteret

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Norway

E-mail: support.seatex@kd.kongsberg.com

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Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

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Version 3, 29 June 2007

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