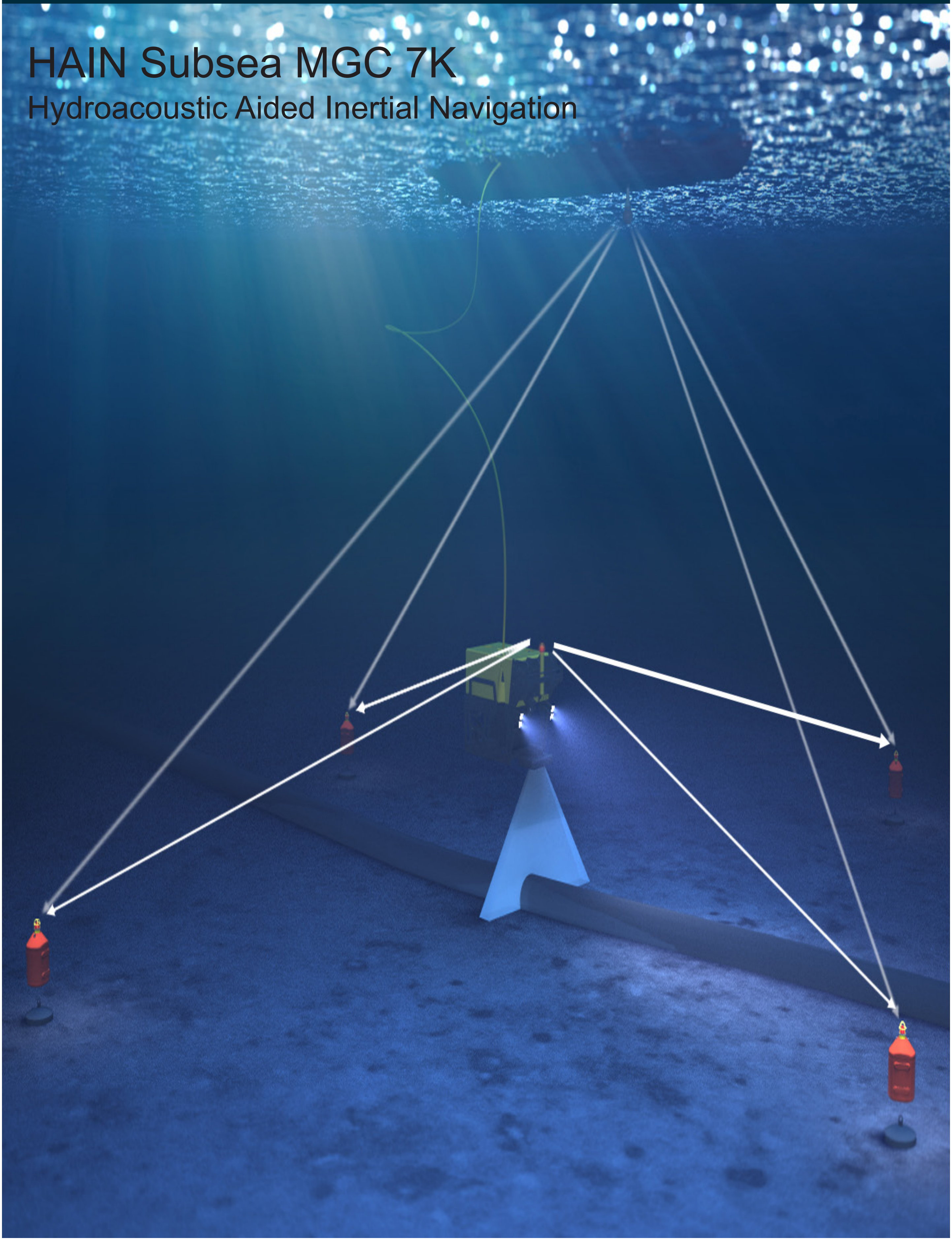
Instruction Manual

KONGSBERG

HAIN Subsea MGC 7K

Hydroacoustic Aided Inertial Navigation



HAIN Subsea

Hydroacoustic Aided Inertial Navigation

Instruction Manual

425450/A

Document information

- **Product**: Kongsberg HAIN Subsea
- **Document**: Instruction Manual
- **Document number**: 425450
- **Revision**: A
- **Date of issue**: 20 April 2017

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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. You must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.

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

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Kongsberg Maritime AS
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About this manual

Observe this general information about the HAIN Subsea Instruction Manual; its purpose and target audience.

Purpose of manual

The purpose of this instruction manual is to provide the descriptions and procedures required to install, operate and maintain the HAIN Subsea.

Target audience

The manual is intended for all users of HAIN Subsea.

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HAIN Subsea

Topics

System description

The Hydroacoustic Aided Inertial Navigation (HAIN) Subsea system is an extension to acoustic positioning systems, and it consists of an onboard operator station and a subsea sensor.

System units

HAIN Subsea

The HAIN Subsea unit holds a very accurate inertial assembly for measurements and processor for IO and navigation. The assembly consists of three accelerometers and three gyros that measures the vehicle's accelerations and rotation in all three axes.

It is required to have positioning input to the unit from APOS but it is optional to input pressure sensor and DVL. All measurements are used in an optimal manner in the navigation module to produce the best possible estimates of position, orientation and velocity.

Operator station – APOS

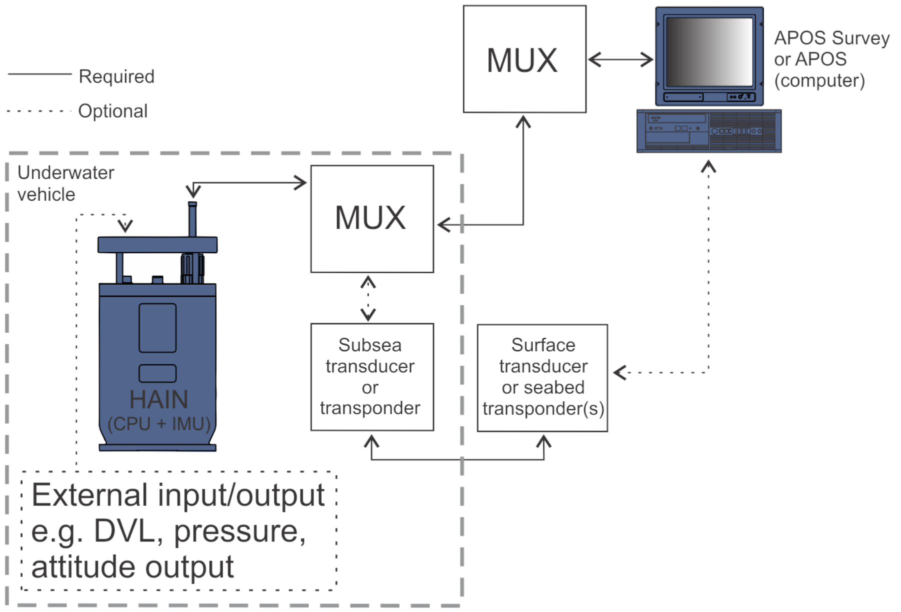
The HAIN system is operated from the Acoustic Positioning Operator Station (APOS) and has the following main functions:

- Controls the HAIN system
- Displays position and sends position and status data

The information received from HAIN is displayed and sent to external computer(s). APOS can request status information in HAIN to be displayed which helps the operator to monitor the system real-time.

System diagram

The system diagram identifies the main components of the HAIN Subsea system.



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General supply conditions

The following general supply conditions apply to this Kongsberg HAIN Subsea delivery.

Receipt, unpacking and storage

Upon accepting shipment of the equipment, the shipyard and/or the dealer must ensure that the delivery is complete and inspect each shipping container for evidence of physical damage.

If the inspection reveals any indication of crushing, dropping, immersion in water or any other form of damage, the recipient should request that a representative from the company used to transport the equipment be present during unpacking.

All equipment must be inspected for physical damage, i.e. broken controls and indicators, dents, scratches etc. during unpacking. If any damage to the equipment is discovered, the recipient must notify both the transportation company and Kongsberg Maritime so that Kongsberg Maritime can arrange for replacement or repair of the damaged equipment.

Once unpacked, the equipment must be stored in a controlled environment with an atmosphere free of corrosive agents, excessive humidity or temperature extremes.

The equipment must be covered to protect it from dust and other forms of contamination when stored.

Equipment responsibility

Unless otherwise stated in the contract, the shipyard doing the installation and/or equipment dealer becomes fully responsible for the equipment upon receipt.

The duration of responsibility cover:

- The period of time the equipment is stored locally before installation
- The entire installation process
- Commissioning
- The period of time between commissioning and the final acceptance of the equipment by the end user or owner

Unless other arrangements have been made in the contract, the Kongsberg HAIN Subsea warranty period (as specified in the contract) begins when the acceptance documents have been signed.

Support information

If you need support for your Kongsberg HAIN Subsea you must contact Kongsberg Maritime AS.

- **Company name**: Kongsberg Maritime AS
- **Address**: Strandpromenaden 50, 3190 Horten, Norway
- **Telephone, 24h support**: +47 33 03 24 07
- **Telefax**: +47 33 04 76 19
- **Website**: http://www.km.kongsberg.com
- **Support website**: http://www.km.kongsberg.com/support_hpr
- **E-mail address**: km.support.hpr@kongsberg.com

Introduction to HAIN

Topics

System introduction

The HAIN system is an extension to the acoustic positioning systems. HAIN uses acoustic position measurements and inertial navigation to get more precise, accurate, reliable, and frequent position measurements. In addition, HAIN will provide accurate measurements of the vehicle's velocity and orientation. HAIN is operated from APOS.

HAIN systems

The following two systems are available:

- HAIN Subsea

  Supplying accurate position, orientation and velocity of tethered underwater vehicles. Typically used in survey applications.
- HAIN Reference

  Supplying accurate position, orientation and velocity of surface vessels. Typically for vessels running Dynamic Positioning (DP).

Advantages of HAIN

- Increased accuracy
- Increased smoothness
- Increased robustness
- Increased reliability
- Increased update rate
- Positioning during acoustic drop out
- Optimal combination of several sensors' measurements
- Log of vehicle's motion

Inertial navigation

The base of inertial navigation is the inertial measurement unit (IMU) which measures the acceleration and angular rate in all three dimensions. This is normally done by having three perpendicular gyroscopes and accelerometers.

Navigation on inertial measurement is based on knowing the initial values of position, orientation, and velocity, and integrating the measurements from the IMU from these initial values. This means:

- Angular rates are integrated to give orientation
- Accelerations are integrated to give velocities

The calculated velocities are integrated to give position

Drift

The inertial sensors as any other sensor have errors.The integration effectively removes most of the rapid noise, but it also makes the effects of longer-term errors increase with time.The errors in inertial navigation system will therefore grow with time.This is usually called drift, as the navigation system slowly drifts off from the correct values.After a while, the drift will reach unacceptable levels.

Aiding

The solution to drift is aiding, meaning external sensors that provide input (corrections) to the navigation system. HAIN has support for aiding of the following type of measurements:

- Horizontal position – SSBL or LBL
- Vertical position – Depth or pressure sensor
- Velocity – DVL

The external measurements are compared to the estimates of the navigation system and the estimates are then updated accordingly. This will in general control the drift.

In HAIN a Kalman Filter is used to make the combination of external measurements and the estimates into an optimal updated estimate.

Acoustic and inertial positioning principles in combination are ideal, since they have complementary qualities. Acoustic positioning is characterised by relatively high and evenly distributed noise and no drift in the position, whilst inertial positioning has very low short-term noise and relatively large drift in the position over time.

Gyrocompassing

The inertial navigation system will gyrocompass, provided that the latitude and velocity is fairly correct and that the angular rate measurements are of sufficient quality.

Post–processing

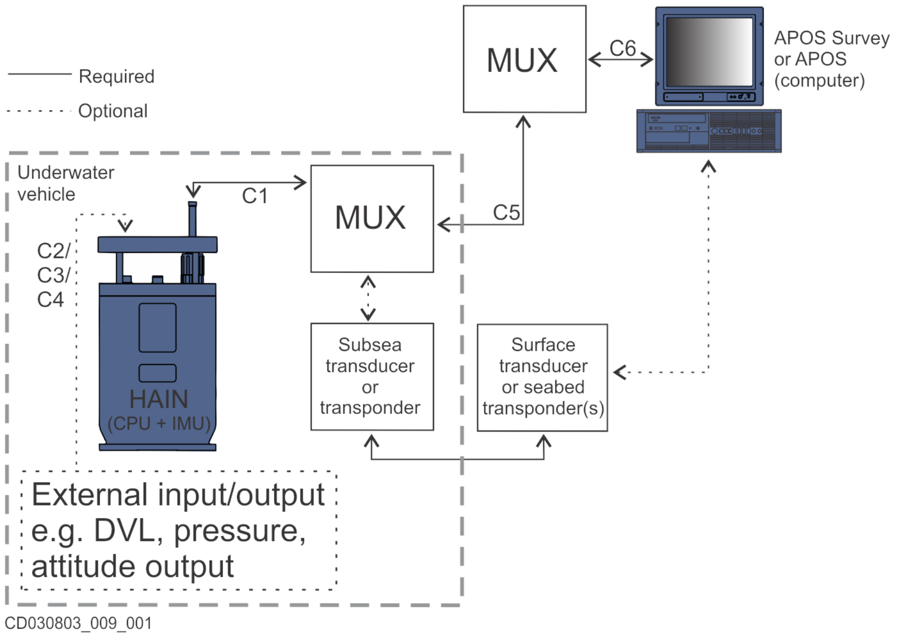
The logged HAIN data are very well fit to be post-processed with NavLab. Post-processing of inertial navigation data gives significantly smoother and more accurate estimates. NavLab also allows you to reprocess the data with different settings, should something have gone wrong online. NavLab post-processing is also good for quality assurance and control, and identifying problems.

Cable layout and interconnections

Topics

Cable plan

This cable plan shows how the HAIN Subsea unit is connected to other units.



Cable list

A set of cables is required to connect the HAIN Subsea system units to each other, to the relevant power source(s), and to peripheral devices.

Cable	Signal	From/To	Minimum requirements
C1	AC power cable/Ethernet cable/Serial line	HAIN Subsea MGC/MUX	16 pin Subconn
C2 (Optional)	Power/Serial line	HAIN Subsea/External sensor	8 pin Subconn
C3 (Optional)	Power/Serial line	HAIN Subsea/External sensor	8 pin Subconn
C4 (Optional)	Power/Serial line	HAIN Subsea/External sensor	8 pin Subconn
C5	Fibre optic	MUX/MUX	
C6	Ethernet cable	MUX/APOS Survey or APOS (computer)	CAT7

Connectors

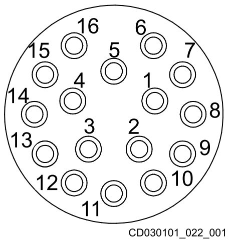
Main connector

The Main connector is for communication (Ethernet) and power input (24 VDC). It also has additional serial line for serial inputs or outputs to HAIN.

Note

It is required to use the Main connection to connect HAIN Subsea to power and APOS (Ethernet).

Face view (male):

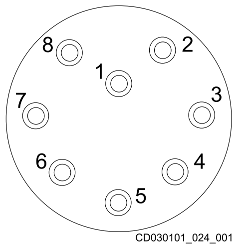


Pin number	Colour	Signal
1	Black	ETHERNET A+
2	White	ETHERNET A-
3	Red	ETHERNET B+
4	Green	ETHERNET B-
5	Orange	COM4 TX
6	Blue	COM4 GND
7	White/Black	COM4 RX
8	Red/Black	NC
9	Green/Black	NC
10	Orange/Black	NC
11	Blue/Black	NC
12	Black/White	24 VDC
13	Red/White	0VDC
14	Green/White	NC
15	Blue/White	NC
16	Black/Red	NC

P connectors (P1, P2 and P3)

These connectors (marked P1, P2 and P3) holds serial lines and power and is usually used for direct connection between HAIN Subsea and aiding sensors, or sensors using HAIN attitude output.

Face view (male):



Pin number	Colour	Signal
1	Black	TX
2	White	RX
3	Red	GND
4	Green	
5	Orange	
6	Blue	
7	White/Black	24 VDC
8	Red/Black	0 VDC

Note

24 VDC and 0 VDC is direct feed through of power from Main connection.

Installation

Topics

Installing the HAIN Subsea unit

It is important to follow the information given in regards to the mechanical installation of the subsea unit.

Unit location

The unit should be placed on a rigid frame, which also holds the DVL (if used by HAIN), and any type of equipment the HAIN outputs are used with, such as multibeam echosounders, sonars, cameras etc.

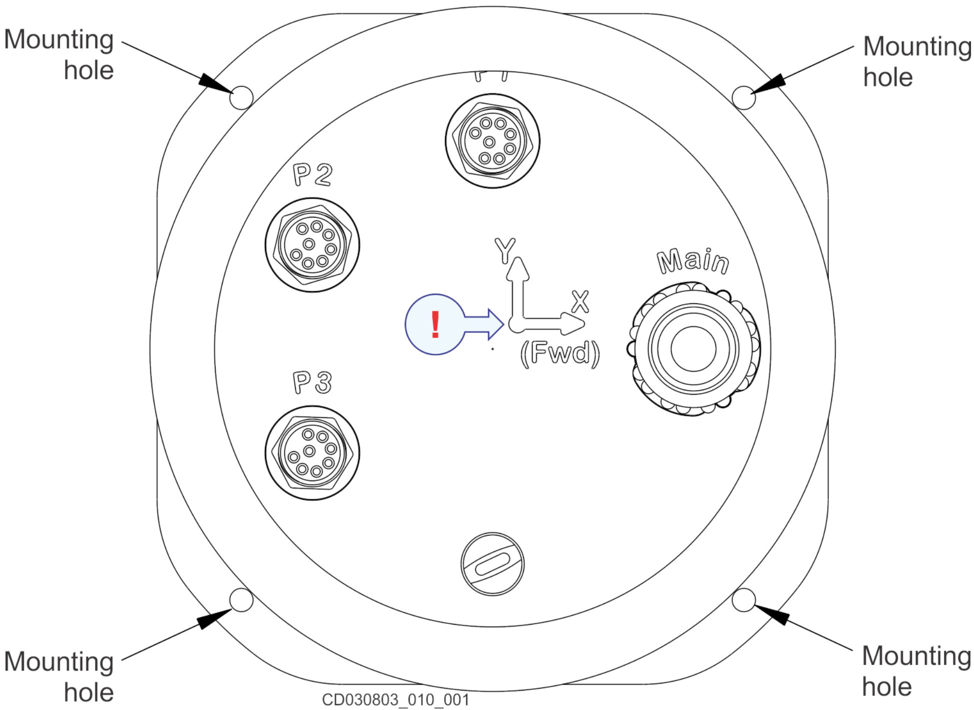
It is also recommended that the position and depth inputs (pressure sensor, acoustic transducers or others) are on this frame. However unlike the DVL some flexibility between HAIN and the position and depth inputs can be tolerated.

Lever arm

The performance of the HAIN Subsea system is affected by how accurate the physical position of the reference point relative to the vehicle reference point (datum) is entered in the HAIN configuration in APOS. The position must be measured forward/aft, starboard/port and up/down.

Note

The error of measured IMU location must be less than 5 % of expected output accuracy to be negligible.



Mounting the HAIN Subsea unit

The information regarding the unit location must be read and understood before mounting the unit.

Four (4) bolts and nuts are needed to attach the unit to a rigid frame. The mounting holes are Ø 8.5 mm.

1. Place the subsea unit in a suitable location.
2. Fasten the bolts in the 4 holes in the bottom of the unit.
3. Make sure all the bolts are tightened properly and that the unit is secured to the frame.

Setting up HAIN Subsea in APOS

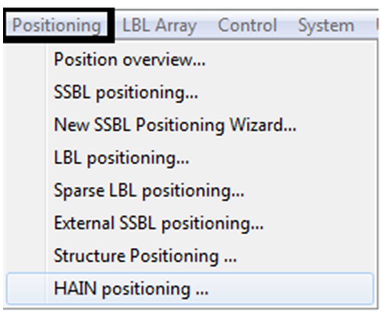
This procedure is for HAIN without DVL or pressure sensor.

Prerequisites

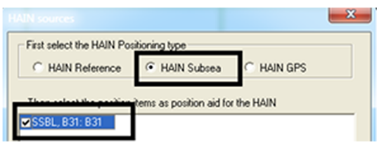
The HAIN Subsea unit must already be mounted, cables connected and lever arm measured up. Make sure APOS has valid inputs from a global reference system (GNSS or acoustics) and VRU/Gyro. Set up the transponder used as positioning of HAIN. The transponder does not need to be active.

Procedure

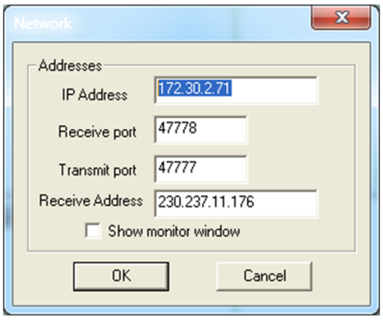
1. In APOS create the HAIN icon. Requires login as service.



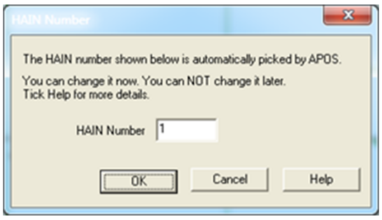
2. Select HAIN Subsea and the position source you want to use as position inputs for it.



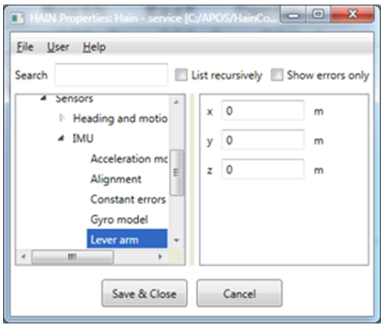
3. Setup network addresses.



4 Set the HAIN number. Normally you should use the suggested HAIN Number.

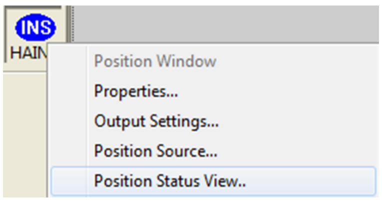


5 Enter lever arms of HAIN Subsea (Sensors/IMU/Lever arm) and position transducer (Sensors/Position/DGPS-HiPAP/Lever arm).

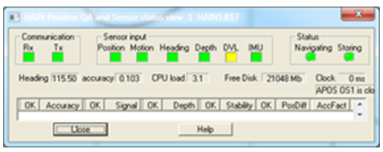


6 Change other configuration parameters if necessary, and press **Save & Close**.

7 Verify that HAIN is working. This is done by opening the **Position Status view**.



8 Red lights indicate non-working sensor. The unit takes some time to settle on heading, so the first 5-20 minutes the motion and heading lights are red.



Calibrating the DVL

Doppler Velocity Log (DVL) is an instrument used to measure velocities in water.

Prerequisites

The DVL unit must already be mounted, cables connected and lever arm measured up. Make sure APOS has valid inputs from a global reference system (GNSS or acoustics) and VRU/Gyro. Set up the transponder used as positioning of HAIN. The transponder does not need to be active.

This service requires that you have already performed a calibration run of HAIN data.

Context

Calibration is best performed with NavLab. Kongsberg Maritime can (at an extra charge) perform the actual calibration calculations.

A proper calibration can most often be achieved by using a regular survey run. A new calibration should be performed whenever HAIN or DVL is dismounted and re-mounted.

During post-processing increased performance can often be achieved by performing a DVL calibration on the data set before processing it for output.

Procedure

1 Log 20-30 minutes or more of data.

2 DVL bottom track always.

3 Well performing aiding sensors (such as pressure sensor and dGPS-HiPAP and DVL).

4 Perform frequent changes in velocity.

5 Include motion in all directions (up-down, port-starboard, forward-aft).

6 Include turns and rotations.

7 Include a figure-eight.

Configuring RDI Workhorse Navigator

The DVL is usually configured by the customer or by the surveyors. The DVL readings are often used by both the HAIN system and other systems onboard. HAIN does not configure the DVL, but the operator must know the DVL setup in order to set the HAIN parameters correctly.

Sometimes the HAIN engineer must configure the DVL. The following commands/settings were given to the RDI DVL 600 kHz Workhorse. The RDI Self Contained ADCP Application terminal program was used.

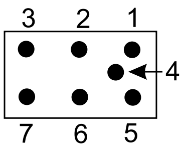
These settings are just an example:

CR1	Reset to factory settings
EA00000	No alignment values inserted
EP00000	
ER00000	
BP1	1 ping per ensemble
BK0	water mass off
CF11110	
EX10011	
ST0	
ECxxxx	Sound velocity at seabed area. Value in m/s
EZ0000000	Clears bit (6), DVL not to calc speed of sound
BM7	For 1200KHz only tracking down to 20cm
PD0	Output telegram
CS	Start continuous output
CK	Save setup in non-volatile memory

The EA, ER and EP all have 00000 as parameter, because we do all the rotations in the HAIN. The EX command allows 3-beam solution.

The c bit in the EZ command is zero, telling the DVL to use the manually set sound of speed. If either the DVL has a depth sensor or the depth is sent continuously to it, the bits in EZ should be set and the DVL will calculate the speed of sound.

Doppler



Pin	Function
1	RS232 In
2	RS232 out
3	+ 24 V
4	0 V RS232
5	422+ (trigger)
6	422- (trigger)
7	0 V

Locking into whip;
Type 9 pin impulse LPMIL-7-FS

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Testing

During operation, observe that the DVL light in the APOS Position Status view is green.

Operational procedures

Topics

Configuring sensors in APOS

The HAIN configuration program is found in APOS.

Prerequisites

APOS must be started on the computer and the system must be ready for operation.

Context

The HAIN configuration program is where the user configures all aspects of HAIN. This is where you set up all sensors for use, how they are connected and which outputs.

The configuration program has a hierarchic structure of folders on the left and shows the variables in the selected folder on the right side. Additional help about folders and variables are found by holding the mouse over them.

Procedure

1 The HAIN configuration program is opened from APOS by right-clicking the HAIN icon and selecting **Properties…**.

2 Add all relevant information into the system such as mission details, navigation information and sensor specifications.

There is search field above the folders and variables allowing for a quick search possibility of finding the variable you want to change.

To open the on-line help system, select **Help** on the **Main** menu, or the **Help** button in one of the dialog boxes.

Result

The HAIN system is now ready for operation.

Retrieving sensor data from APOS

The HAIN configuration program is found in APOS.

Prerequisites

APOS must be started on the computer and the system must be ready for operation.

Context

HAIN Subsea stores all sensor measurements and calculated values in binary log files in the unit. The disk holds roughly 24 hours of data. HAIN automatically deletes the oldest data when remaining space on disk reaches a lower limit.

Procedure

1 The data is downloaded from HAIN by right clicking the HAIN icon in APOS.

2 Selecting **Retrieve log files from HAIN…**.

The data is now downloaded.

Further requirements

The HAIN Data can be examined, post- and reprocessed in NavLab. See NavLab's own documentation for details.

Copying APOS online help to a stand-alone computer

The APOS Online help is integrated with APOS software.

Context

The APOS Online help is delivered as a chm file (WinHPR.chm).

Procedure

1 Copy the WinHPR.chm file from one computer to the other computer.

2 Double-click on the icon.

- The Windows Explorer will start and you have the online help available.
- To make changes on HAIN you generally are required to be logged in as service.

HAIN Clock synchronisation

Topics

HAIN Clock synchronisation

All measurements are time stamped by the computer reading the measurements.

1 The acoustic positions are time stamped by the APOS/HiPAP system.
2 The GPS positions are time stamped by the GPS.
3 The HAIN sensor readings are time stamped by HAIN.

The timestamp information is fully exploited in the calculations.

APOS transmits the position aid to HAIN with the timestamp based on the clock in the APOS. It also adds an age parameter in the telegram, telling how old the position aid measurement is. HAIN subtracts the age from its clock, and thereby gets a timestamp with HAIN clock. The other measurements are read by HAIN and time stamped with HAIN clock. It is therefore irrelevant whether or not computer clocks involved are synchronized.

HAIN runs a continuous integration process of the inertial measurements, and can therefore not accept a clock being adjusted more than a millisecond forwards nor backwards. Hence, time synchronization can only be performed while HAIN navigation is not running, and continuous synchronization must be performed by adjusting the rate of the HAIN clock.

Options for synchronising HAIN data

Obtaining time-synchronized data from HAIN can be achieved in several ways:

1 HAIN Subsea clock can be synchronized by NTP (see this chapter).
2 Outputs from APOS, are synchronized to APOS's clock (see APOS online help)
3 Using unstamped data valid at time of output, such as attitude output.
4 Post process the HAIN data in NavLab with "ClockCorrection" (see NavLab help).

Only option 1 is explained in this chapter. See the listed other help sources for documentation on the others.

NTP

NTP is Network Time Protocol. The synchronization consists of an NTP program running on two or more computers connected to the same Ethernet. One of the computers running NTP will be designated as the master and all the other clocks will be adjusted to match to this master. APOS and HAIN Subsea may use NTP to synchronize their clocks.

Crude clock synchronisation

The NTP works best when it fine-adjusts the clock in HAIN. It does so by just tuning the clock frequency, which causes no discontinuity in the timestamp of the IMU measurements. NTP may wait long before it sets the client clock to a new value.

The operator at HAIN may set the clock in HAIN approximately equal to the APOS clock. This is done by:

- Right-click the HAIN icon.
- Click the Synchronize Time command.
- The event view on the APOS shows how HAIN clock is adjusted.

The crude clock synchronization cannot be done when the HAIN positioning is active.

NTP for HAIN Subsea

In HAIN configuration there is a setting for turning NTP on and off (see section “APOS/NTP”).

Normal setup is to have one APOS synchronized to the GPS (see APOS online help for details) clock and have HAIN and additional APOSes synchronized to this APOS by means of NTP. It is also possible to NTP-synchronize all APOSes and HAIN Subsea another clock master on the same network.

NTP in the APOS is the timeserver, and the NTP in HAIN is a time client. If two or more APOS computers are connected in a Master/Slave configuration, the NTP in one of them must be the timeserver, and the other(s) must be time client(s).

The APOS operator stations are often clock synchronized with other Kongsberg Maritime computers (as the DP computers) on the vessel. This is done with the OSKTimeSynch program. This program must be stopped on the APOS(es) that are NTP clients. It shall execute on the APOS time server with the 1 PPS and ZDA connected, in order to synchronize the other Kongsberg Maritime computers. If, however, one of the DP computers in the network also is synchronized to the GPS clock, the OSK time synch in the APOS with the NTP server should be stopped.

The NTP is configured by the ntp.conf file. Each computer running NTP has a ntp.conf file. One computer is configured as a NTP time server. All other NTP units are configured as time clients. The IP address of the time server has to be entered in the ntp.conf file of the time clients.

When the system is switched on, we normally recommend starting the NTP server first and letting it run for some time. Then the clients can be started. They will normally synchronize time to the server within 10 - 15 minutes. The accuracy of the time synchronization will improve over time. Our observation is that after 24 hours, the time difference between computers is below 10 milliseconds. It is important that the time is relatively similar on the computers to be synchronized before NTP is started.

Note

As default, NTP will not synchronize time, if time difference is more than 1000 seconds.

You may also check that the computer time zone is set correct. NTP synchronizes on the computer UTC time.

ntp.conf

The lines in the ntp.conf starting with # are just comments. Before you start the system, you must check/edit the line starting with server followed by an IP address. There are three different IP addresses to use.

IP address line	Used when
server 127.127.1.0	The computer is the timeserver.
server 127.127.28.2 prefer	The computer is the timeserver, and it is synchronized with the GPS receiver. This line shall be set in addition to the timeserver line in the previous row.
server nnn.nnn.nnn.nnn	The computer is a NTP client. nnn.nnn.nnn.nnn is the IP address of the time server.

Example of time synchronisation Master ntp.config

```
# NTP configuration file (ntp.conf)
# for APOS
# server 157.237.11.192 # Change to match your server IP address (APOS computer)
server 127.127.28.2 prefer shared memory clock driver. Use this for IoServer!!!
server 127.127.1.0 # local clock driver. Use always when master!!
# multicastclient 224.237.1.1
```

Example of Slave ntp.config

```
# NTP configuration file (ntp.conf)
# for APOS
server 157.237.11.192 # set IP time synchronisation Master
# server 127.127.28.2 prefer
# shared memory clock driver. Use this for IoServer!!!
# server 127.127.1.0 # local clock driver. Use alway when master!!
# multicastclient 224.237.1.1
```

NTP display

The NTP writes information to its DOS command window. The command window on the NTP client shows the difference between the client clock and the server clock, as decided by the NTP.

The NTP client has IP address 157.237.10.120. You can see that there is a two-way communication with the timeserver running at 157.237.1.96. Check that there is a similar two-way communication on your HAIN desktop.

The NTP client decides that there is a difference of 14.7 ms between itself and the time server as seen after the *off* in the screen above.. The NTP client will minimise this difference by adjusting its clock frequency.

GPS UTC

HAIN subsea with the acoustic aiding positions derived from SSBL, depends on the GPS readings, because it combines the GPS positions and the SSBL positions to calculate the position aid in latitude longitude. Then the clocks in the APOS must be synchronized with the UTC in the GPS receiver. This synchronization requires both a time sentence (ZDA, UTC or similar) and a 1PPS from the GPS receiver to the APOS. APOS handles this via an IoServer.

The APOS that is synchronized with the GPS must execute the NTP timeserver. The APOS IoServer communicates with the NTP server via shared memory. The NTP must be started before the IoServer. This is automatically taken care of by the APOS. When the APOS has the HAIN option set, it starts the NTP program before it starts the IoServer.

The APOS starts the NTP server regardless of HAIN shall be clock synchronized with the APOS or not.

The serial port used can be either an RS 232 or an RS 422. The 1PPS pulse should be connected to the CTS (Clear To Send) input on the port. However, in both cases the 1PPS pulse must be compliant with the RS232 or RS422 signal levels. The following table describes the pin numbers used on the port.

RS 232 Function	**Pin Number**
RX	2
GND	5
CTS	8

RS 422 Function	**Pin Number**
RX+	1
RX-	4
GND	5
CTS+	9
CTS-	6

Maintenance

Topics

Specifications for storage prior to installation or use

When a system, a unit or a spare part has been delivered to the customer, it may be subject to long time storage prior to installation and use.

General specifications

During this storage period, certain specifications must be met. The equipment must be preserved and stored in such a way that it does not constitute any danger to health, environment or personal injury.

1 The equipment must be stored in its original transportation box.

2 Ensure that the units are clearly separated in the shelves and that each unit is easily identifiable.

3 The box must not be used for any purpose for which it was not intended (work platform, steps, table etc.).

4 Boxes must not be placed on top of each other, unless specific markings permit this.

5 Boxes must not be placed directly on a dirt floor.

6 Do not open a box for inspection unless special circumstances permit so.

“Special circumstances” may be suspected damage to the box and its content, or inspections by civil authorities.

a If a unit is damaged, prepare an inspection report stating the condition of the unit and the actions taken. Describe the damage and collect photographic evidence if possible. Re-preserve the equipment.

b If the unit is not damaged, check the humidity absorbing material. If required, dry or replace the bags, then re-pack the unit according to the packing instructions.

7 If a box has been opened, make sure that is it closed and sealed after the inspection. Use the original packing material as far as possible.

8 The storage room/area must be dry with a non-condensing atmosphere. It must be free from corrosive agents.

9 The storage room/area’s mean temperature must not be lower than -10° C, and not warmer than +50° C. If other limitations apply, the crates will be marked accordingly.

10 Boxes must not be exposed to moisture from fluid leakages.

11 Boxes must not be exposed to direct sunlight or excessive warmth from heaters.

12 Boxes must not be subjected to excessive shock and vibration.

13 If the unit contained in a box holds normal batteries, these may have been disconnected/isolated before the unit was packed. These must only be reconnected before the installation starts. Units containing batteries are marked.

Temperature protection

Any units that requires protection against extreme temperatures are identified as such in the applicable documentation. The box used to transport and store such units are clearly marked, for example:

Must not be transported or stored in temperatures below -5 °C.

Other temperature limits may be used if applicable.

If a unit needs temperature protection, the box to be used for storage and transportation must be lined on all walls, base and lid, using minimum 5 cm thick polyurethane or polystyrene foam.

Most system units can normally be stored in temperatures between -30° C and +70° C. Refer to the relevant technical specifications for details.

Note

Unless otherwise specified, transducers and hydrophones must not be stored in temperatures below −10°C and above +50°C.

HAIN Subsea maintenance

Refer to standard company/vessel safety procedures before commencing maintenance work.

Before you start

Before you start performing any maintenance work make sure the power is switched off and it must be kept off while the maintenance work is being carried out.

1 Switch off all power to the HAIN Subsea system and other systems connected to the HAIN Subsea system.

2 For the other systems, remove the fuses if possible and label the fuse panels with tags stating that maintenance is being carried out on the system.

Maintenance philosophy

On-board maintenance should be carried out by a maintenance engineer, with the assistance of the operator.

The maintenance should include the following:

- Calibrations
- Simulations
- Functional tests
- Traditional troubleshooting based on a good knowledge of the system.

- Replacement of faulty parts should be limited to the line replaceable units (LRUs) recommended in the spare parts list.

Whenever a faulty unit has been replaced, the unserviceable unit should be sent to Kongsberg Maritime, or an appointed dealer, for repair.

Error detection

If a fault is detected, the operator should call the maintenance engineer at the earliest opportunity. The operator should be issued with a standard procedure detailing how he/she is to respond to system errors or faults. This procedure should contain the following (as a minimum):

1 Write down any Alarm message.

2 Write down the parameters currently set in the system.

3 Write down a brief description of the actions currently being carried out.

4 Write down the commands being executed (if any) when the error appeared.

5 Write down the controls carried out (if any) when the error message appeared.

6 Write down any other information that might be valuable to the maintenance engineer during troubleshooting. This also includes events not directly connected to the system (for example bad weather, excessive temperature in operations room etc.).

Verification

The first action to be performed by the maintenance engineer on receipt of a fault message must be fault verification. If the system has been closed down, it should be powered up again (unless the fault has caused serious damage to the system), and an attempt made to make the fault reappear.

- Verify the fault during continued operation.

Maintenance schedule

Maintenance routines must be performed regularly and effectively to ensure that the equipment is kept in top condition.

The chart below states the **maximum** recommended intervals at which the various routines should be performed - the intervals should be decreased if the system is used excessively.

Table 1 Maintenance chart

Unit	Weekly	1–3 Month	6 Months	Reference
All units – exterior	Clean/Check	-	-	-
All cable connections	Check	-	-	-

Preventive maintenance

After retrieving the unit from salt water, it should be thoroughly rinsed with fresh water as usual with this kind of equipment.

When you rinse this kind of equipment, note these general considerations:

Rinse or soak thoroughly with fresh water, the longer the better. Lukewarm water is preferable if available. Pay particular attention to nooks and crannies (around bolt heads, connectors, etc).

If a connector has been disconnected for open face rinsing, leave it to dry properly before reconnecting.

- Replace sacrificial anodes as necessary.
- Make sure pins and threads on connectors are kept clean and greased with suitable lubricants.

Spare parts

Topics

HAIN Subsea 7K spare part

- **Part name**: HAIN Subsea 7K
- **Part number**: 420702

Main cable spare part

- **Part name**: Plug (In-line) 16 pin MCIL16F
- **Part number**: 366798

Pigtail cable spare part

- **Part name**: Plug (In-line) 8 pin MCIL8F
- **Part number**: 370–098042

Technical specifications

Topics

Performance specification

These performance specifications summarize the main functional and operational characteristics of the HAIN Subsea.

HAIN Subsea

- **Depth rating**: 7000 m
- **Material**: Titanium
- **Roll and pitch accuracy**: 0.008° sec lat (with acoustic aiding)
- **Heading accuracy**: 0.08° sec lat (settling time 25 minutes, with acoustic aiding)
- **Connectors**:

  1 x 16 pin SubConn

  3 x 8 pin SubConn
- **Internal storage**: The unit stores the last 20 hours (approx.) of all data
- NavLab compatible

Input formats:

- RDI PD0
- Digiquartz pressure
- Winson pressure format

Output formats:

- Orientation: NMEA, THS, MDL 2 and EM3000
- Seatex binary
- Proprietary full format

Weight and outline dimensions

These weights and outline dimension characteristics summarize the physical properties of the HAIN Subsea.

HAIN Subsea

- **Physical dimensions**:
  - **Height**: 343 mm
  - **Diameter**: Ø 191 mm
- **Weight in air**: 20 kg
- **Weight in water**: 12.5 kg

Interface specification

These interface specifications summarize the main functional and operational characteristics of the HAIN Subsea system.

- 4 x optically isolated bi-directional RS-232
- Ethernet 10/100 Mb
- Numerous Ethernet output ports

Environmental specifications

These environmental specifications summarize the temperature and humidity requirements for the HAIN Subsea system.

HAIN Subsea

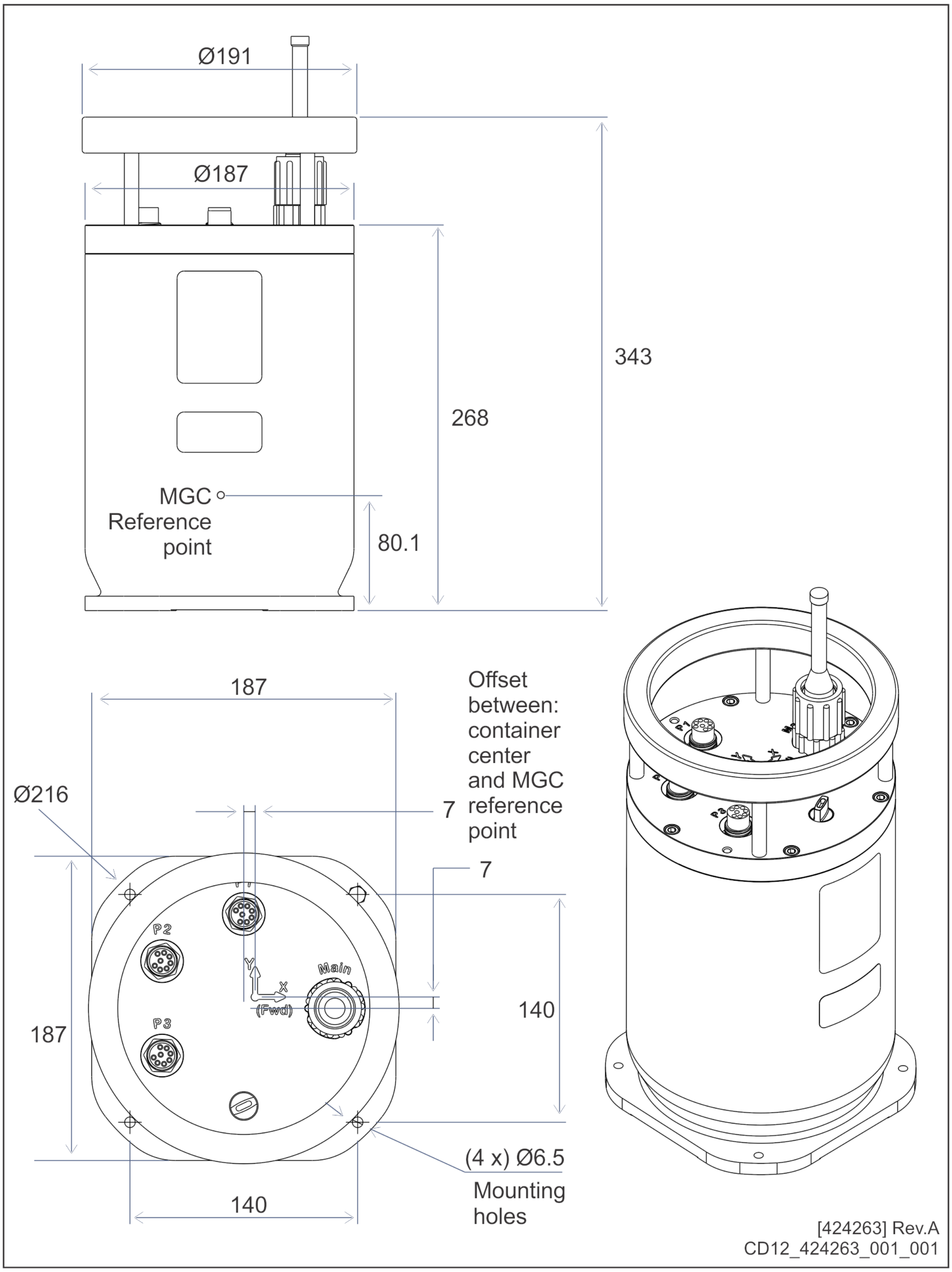
- **Operational temperature**: 0 to +50°C
- **Storage temperature**: –20 to +70°C
- **Relative humidity**: 10 to 90% relative non-condensing

Drawing file

Topics

HAIN Subsea outline dimensions

Drawing 424263



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