Seatex Seapath™ 200

User's Manual

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Revision log

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	12	2006-09-08	Information on export restrictions included	FOS
	13	2006-09-26	Changed roll and pitch specification	FOS

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1. INTRODUCTION

1.1 About this manual

This is a compilation of information on the Seapath 200 product released for the user. The manual is organised into the following chapters:

Chapter 1 **Introduction** - A brief overview of this manual with references and abbreviations.

Chapter 2 **Technical Data** - Presents detailed product specification, physical dimensions, required power, environment restrictions, together with restrictions in use and guarantee.

Chapter 3 **Installation** - Refers to the *Installation Manual*.

Chapter 4 **Technical Description** - A brief description of the theory of an integrated GPS/IMU system and how the Seapath calculates accurate position, velocity, and attitude.

Chapter 5 **Operation Instructions** - Describes system operation following installation.

Chapter 6 **Maintenance** - Describes repair and servicing procedures including a detailed troubleshooting section.

Chapter 7 **Drawings** - Refers to the *Installation Manual*.

Chapter 8 **Parts list** - Lists the parts in the basic delivery and available optional equipment.

In this manual the following notations are used:

CAUTION

Is used to make the user aware of procedures and operational practice which, if not followed, may result in degraded performance or damage to the equipment.

Note A note text has this format and is used to draw the user's attention to special features or behaviour of the equipment.

1.2 References

[1] 38120-GM-002 *Installation Manual, Seapath 200*, rev. 11
[2] *NMEA 0183 Standard for interfacing marine electronic devices*, Version 2.3
[3] *RTCM recommended standards for differential Navstar GPS service*, Version 2.2
[4] *General Conditions for the Supply of Products*, Orgalime S 2000 with one exception sheet

1.3 Definitions, abbreviations and acronyms

1.3.1 Definitions

alignment	Is the process of adjusting the current internal navigation frame (g, h or b-frame) in the instrument to the true external frame.
antenna bracket	Is the arrangement on which to mount the GPS antennas.
antenna holder	Is the arrangement on board the vessel for mounting the antenna bracket to.
attitude	The orientation relative to the vertical axis of a vehicle. Heading is not included. If heading is included, the word orientation for the vehicle is used.
heading	The direction of the main axis (bow direction) of the vehicle as opposed to course, which is the direction of motion of the vehicle. Yaw angle as defined here is the same as heading.
heave	The vertical dynamic motion of a vehicle and defined positive down. Heave position and velocity are dynamic motion variables with a certain lower cutoff frequency.
host system	In this manual defined as Navigation computers, Dynamic Positioning Systems, etc., receiving data from Seapath.
pitch	A rotation about the pitch axis and is positive when the bow moves up. Normally pitch means the dynamic pitch angle motion.
roll	A rotation about the roll axis and is positive when starboard side of the vehicle moves down. Normally roll means the dynamic roll angle motion.
starboard	When looking in the bow direction of a vehicle, this is the right hand side of the vehicle.
yaw	A rotation about the vertical axis and is positive when turning Eastward when the vehicle cruises in North direction. Normally yaw means the dynamic yaw motion.

1.3.2 Abbreviations and acronyms

b-frame	Body frame. An orthogonal frame fixed to the MRU housing or to the vehicle where the MRU is fixed.
CEP	Circular Error Probability.
CG	Centre of gravity. The mass centre of a vessel. This is normally the location with least linear acceleration, and hence the best location for measurements of roll and pitch.
EMI	Electromagnetic interference.
g-frame	Geographic frame. An orthogonal frame having axes pointing North, East, and Down at the current location of the vehicle.
GPS Time	The time in the GPS system. The GPS time is within UTC time ±180 nsec (95 per cent) plus possible leap seconds.
IMU	Inertial Measurement Unit. A system consisting of gyros and accelerometers.
MP	Measurement Point.
MRU 5	Motion Reference Unit, model 5. This is the IMU within the Seapath measuring dynamic linear motion and attitude.
NMEA	National Marine Electronics Association. NMEA 0183 is a standard for interchange of information between navigation equipment.
P-axis	This axis is fixed in the vehicle, and points in the starboard direction horizontally when the roll angle is zero. Positive rotation about this axis is bow of the vehicle up.
PPM	Parts per million.
1PPS	One Pulse Per Second.
RFI	Radio Frequency Interference.
RMS	Root Mean Square.
R-axis	This axis is fixed in the vehicle, and points in the forward direction horizontally when the pitch angle is zero. Positive rotation about this axis is starboard side of the vehicle down.
SBAS	Satellite Based Augmentation System
SAPOS	The German National Survey Satellite Positioning Service SAPOS®
SCC	Seapath Control Centre is a special software used to set configuration parameters in Seapath. The software runs under Microsoft Windows version 95, 98, NT 4.0 or compatible on a PC.
UTC	Universal Time Co-ordinated. This is the official time in the world and has replaced GMT (Greenwich Mean Time) as the official time.
Y-axis	This axis is fixed in the vehicle and points in the downward direction when the vehicle is aligned horizontally. Positive rotation about this axis is turning the bow of the vehicle to starboard.

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2. TECHNICAL DATA

2.1 Health, environment and safety

Operation or troubleshooting of Seapath equipment will not imply any risk for high voltages, explosions or exposure to gas. The Seapath 200 complies with IEC 60950/EN60950 standards regarding product safety (low voltage) and IEC 60945/EN60945 standards on electromagnetic compatibility (immunity/radiation) and vibration.

All Seapath 200 electrical and electronic components have to be disposed 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 preventing 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.

2.2 Restrictions in export

Export of the MRU 5 component within the Seapath 200 product to other countries than EU countries or Argentina, Australia, Canada, Iceland, Japan, New Zealand, Switzerland, South-Korea, Turkey, Ukraine and USA, requires an export license.

<u>Notice to Importer</u>: The MRU product specified in this document has been shipped from Norway in accordance with The Ministry of Foreign Affairs' Official Notification on Export Control and may be subject to restrictions if re-exported from your country.

2.3 Restrictions in guarantee

The liability of Kongsberg Seatex AS is limited to repair of the Seapath 200 only under the terms and conditions stated reference [4], and excludes consequential damages such as customer's loss of profit or damage to other systems traceable back to Seapath malfunction. The warranty does not cover malfunctions of the Seapath resulting from the following conditions:

a) The MRU 5 is not shipped in the original transport boxes.

b) The MRU 5 has been exposed to extreme shock and vibrations.

c) The Processing Unit or the MRU 5 housing has been opened by the customer.

d) Over-voltage or incorrect power connection.

2.4 Performance data

Roll and pitch accuracy[1] for ±5° amplitude: .... 0.02° RMS
Heading accuracy with 2.5 metre antenna baseline: .... 0.075° RMS
Heading accuracy with 4 metre antenna baseline: .... 0.05° RMS
Scale factor error in roll, pitch and heading: 0.15%
Heave accuracy: .... 5 cm or 5% whichever is highest
Heave motion periods: .... 1 to 25 seconds
Position accuracy with DGPS: .... 0.7 m RMS or 1.5 m 95% CEP
Position accuracy with SBAS: .... 0.7 m RMS or 1.5 m 95% CEP
Velocity accuracy: .... 0.03 m/s RMS or 0.07 m/s 95% CEP

The performance figures are valid with a minimum of four visible satellites, HDOP less than 2.5, PDOP less than 6, high quality DGPS corrections, correctly measured offsets and otherwise normal conditions. Excessive multipath, GPS signal obstructions or interference may reduce the performance.

2.5 Restrictions in use

The Seapath 200 function is based on GPS 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 ±30 m/s^2 (±3g) and an angular rate range less than ±150°/s.

Only relative dynamic heave position is calculated and the measurements are limited by the selection of their motion periods available in the range 1 to 25 seconds.

2.6 Physical dimensions

Processing Unit
Width: .... 482 mm (19-inch rack)
Height: .... 132 mm (3 U)
Depth: .... 430 mm
Weight: .... 12 kg
Colour: .... Front anodised black

Connection Box, M410-32
Length: .... 114 mm
Width: .... 89 mm
Height: .... 55 mm
Weight: .... 0.3 kg
Colour: .... Grey

[1] When the Seapath is stationary over a 30-minute period or is exposed to a combined two-axis sinusoidal angular motion with five minutes duration.

Video Display Unit, 17" LCD (Samsung SyncMaster 710n)
Width:.. 380 mm
Height:.. 383 mm
Depth:.. 170 mm
Weight:.. 3.8 kg
Colour:.. Black/Silver

MRU 5
Height:.. 204 mm
Diameter:.. 105 mm
Weight:.. 2.5 kg
Colour:..Blue

MRU Mounting Bracket, MRU-M-MB3
Length: .... 265 mm
Width:.. 119 mm
Height:.. 119 mm
Weight:.. 1.6 kg
Colour:..Black
Material: .... POM-H

MRU Junction Box, MRU-E-JB1
Length: .... 226 mm
Width:.. 126 mm
Height:.. 90 mm
Weight:.. 2.0 kg
Colour:..Black

Antenna Bracket
Length.. 2560 mm
Height:.. 40 mm
Width:.. 75 mm
Weight for the 2.5-metre aluminium version .... 6.6 kg
Colour:.. Grey RAL 7035

2.7 Power

Processing Unit
Voltage: ....85 to 135 and 180 to 265V AC
Power consumption:.. 100 W (max.)
Batteries: ....None, connection to UPS recommended

Video Display Unit, 15" LCD (Philips 150S4FB)
Voltage:.. 100 to 240V AC (50/60 Hz)
Power consumption:..23 W (typical)

2.8 Environmental specification

Processing Unit
Enclosure material:..........Aluminium
Enclosure protection: IP-30
Operating temperature range:.......... 0 to +55ºC
Operating humidity: ....20 to 80% relative
Storage temperature range: ....-20 to +60ºC
Storage humidity:..........Less than 55%
Vibration testing according to:..........EN 60945

Connection Box, M410-32
Material: ....Aluminium
Enclosure protection: IP-20

Video Display Unit, 15" LCD (Philips 150S4FB)
Operating temperature range:.......... 5 to +40ºC
Relative humidity:..........20 to 80%

MRU 5
Enclosure material:..........Anodised aluminium
Enclosure protection: IP-66
Operating temperature range:..........-5 to +55ºC
Operating humidity (max.):..........100%
Storage temperature range: ....-20 to +70ºC
Storage humidity (max.):..........100%
Max. allowed vibration operational (10-2000 Hz continuous):.......... 0.5 m/s^2
Max. allowed vibration non-operational (0-2000 Hz continuous):.......... 20 m/s^2
Max. shock non-operational (10 ms peak):.......... 1000 m/s^2

MRU Junction Box, MRU-E-JB1
Material: ....Aluminium
Enclosure protection: IP-65

GPS Antennas (L1)
Enclosure material:..........Weatherable Polymer
Operating temperature range:..........-40 to +70ºC
Operating humidity (max.):..........100%

2.9 Other data

Data I/O
Configuration: .... External PC connected to the Processing Unit
Data outputs: .... Up to eight RS-232/RS-422 serial lines and Ethernet UDP/IP
Data update rate: ....Up to 100 Hz
Data delay:... All data in real-time (0 ms) plus transmission delay
Analog outputs: .... Three user configurable channels, ±10 Volts
Data inputs: .... Up to five RS-232/RS-422 serial lines
DGPS corrections:................................. RTCM 104 vers. 2.2, SAPOS®EPS and Trimble CMR
Optional external gyro compass:..............................NMEA 0183 HDT, Robertson 4 byte BCD
Baud rate: ....Max. 38.4 kBaud
1PPS signal accuracy: .... 220 nsec

Data output formats:

- NMEA 0183 ZDA, GGA, GLL, VTG, HDT, GST, GSA and GRS messages and the proprietary PSXN,20, PSXN, 21, PSXN, 22 and PSXN, 23 messages.
- Simrad EM1000 (Simrad EM950 and EM1000 compatible).
- Seapath binary format 3.
- Simrad EM3000 (Simrad EM3000, EM300 and HiPap compatible).
- Calibration format.
- Echo sounder format.
- RD Instrument ADCP proprietary NMEA format, "PRDID".
- Seapath binary format 11.
- Lehmkuhl gyro repeater format.
- 1PPS time tag, NMEA ZDA message.
- 1PPS time tag, Trimble compatible messages.
- Atlas Fansweep format.
- Echo sounder format 18, TSS1.
- The Submetrix format.

Note The system has up to eight output serial lines and up to five input lines. However, the total number of serial lines is limited to twelve.

Other data
Lifetime of the lithium battery within the MRU:..>10 years
MTBF:.. 18500 h

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3. INSTALLATION

For description of installation of the Seapath, please see the *Installation Manual*, reference [1].

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4. TECHNICAL DESCRIPTION

4.1 Introduction

The Seapath 200 provides a real-time heading, attitude, position and velocity solution by integrating the best signal characteristics of two technologies, Inertial Measurement Units (IMUs) and the Global Positioning System (GPS). Seapath utilises the proven and reliable Seatex MRU 5 inertial sensor and two GPS carrier phase receivers as raw data providers. The raw sensor data are integrated in a Kalman filter in the Seapath Processing Unit. The Kalman filter is a proven and effective filtering technique for integration of various sensors in a real-time environment, and the filter output provides heading, attitude and position data required in survey applications.

Seapath is developed specifically for the professional survey market where gyros, motion sensors and GPS are critical sensors in order to achieve optimal surveying capability. The Seapath is developed to replace three instruments; the gyro compass as heading reference, the motion sensor for roll, pitch and heave, and GPS for positioning and velocity determination. The result led to major improvements for the customer:

- No interfacing problems and timing errors. All Seapath data are referred to the same time stamp.
- Reduced investments and maintenance costs.

4.2 Design principles

Seapath 200 is a stand-alone system, which does not require input of data from any other sensors in order to provide accurate heading, roll, pitch and heave. However, Seapath requires input of DGPS corrections or reception of SBAS corrections in order to achieve optimal position performance. In addition, heading input from a gyro compass can be used to increase system redundancy. By interfacing the gyro compass to Seapath, calibration data for the gyro compass is automatically generated.

Heading, determined from GPS phase measurements between the two GPS antennas, velocity and position from GPS together with angular rate and linear acceleration measurements from the MRU, are input into a Kalman filter. This filter outputs position and velocity in three axes together with precise roll, pitch, heading and heave measurements. The outputs from the Processing Unit are available on up to eight RS-232/RS-422 individually configurable serial lines and on Ethernet. All the data are output in real-time, at high update rate, including the position data.

To ensure accurate time tagging, the one Pulse Per Second (1PPS) time pulse from the GPS sensor is used as a common time reference for both the central processing unit and the MRU.

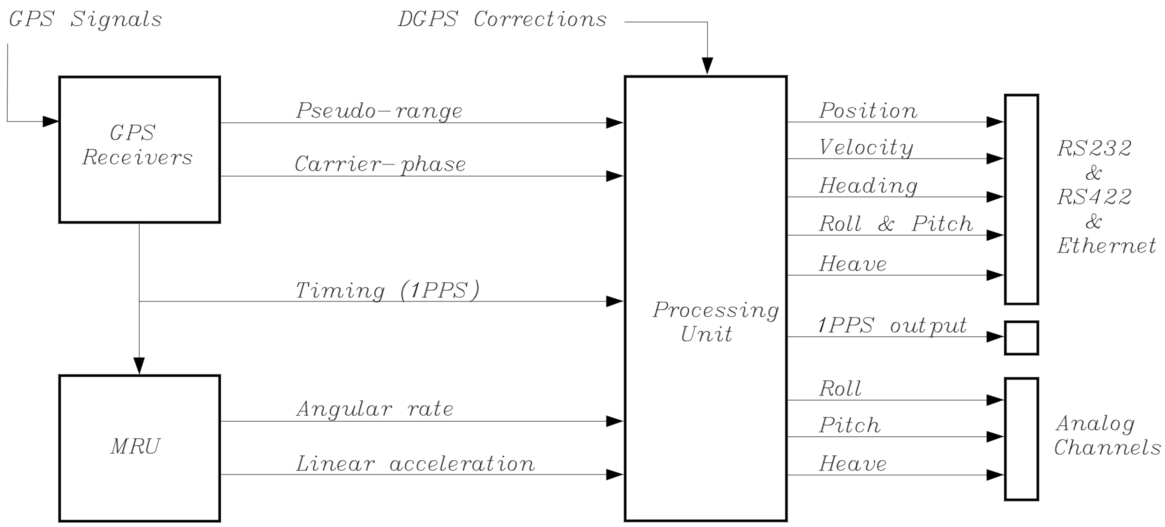


Figure 1 Seapath data flow

4.2.1 Heading determination

True heading is provided by integrating the best signal characteristics of the MRU 5 yaw rate and differential carrier phase measurements between two GPS antennas. On rare occasions where GPS heading may be unavailable due to poor GPS conditions, an external gyro compass can be used as a secondary heading reference to increase reliability.

The GPS part of the system measures direction from antenna no. 1 to antenna no. 2. In order to output ship’s heading from Seapath, the angular offset between the Antenna Bracket and the ship's centre line is entered as a parameter. The angular offset is determined during calibration by comparing heading measured by GPS with ship’s heading measured by a reference system.

In order to maximise heading performance, Seapath continuously calibrates gyro compass versus GPS heading. This gives the best result, if gyro heading must be used, because the GPS heading is more accurate and does not need re-calibration regularly. Seapath calculates a long-term gyro bias, which is the average difference between the gyro compass and the GPS heading since system start-up. Assuming that Seapath has been correctly calibrated, the long-term bias can be used directly as a calibration value for the gyro compass. In addition, a short-term gyro bias is calculated as a filtered value of the difference between the gyro compass and the GPS heading with a 15-minute time constant. The intention with the short-term bias is to measure dynamic errors in the gyro, e.g. after manoeuvres. When gyro compass heading is used in Seapath, the short-term bias is applied as correction to the gyro heading. If GPS heading for some reason is missing for a longer period, the short-term bias converges towards the long-term bias with a 15-minute time constant. As a result, the best available correction is always used for the gyro heading.

Gyro re-calibration can be done at any time without affecting the use of a gyro compass as a backup heading sensor in Seapath, because of the continuous calibration routine in Seapath. The Seapath heading does not need re-calibration unless the Antenna Bracket has been moved.

4.2.2 Roll and pitch determination

Roll and pitch output from Seapath is based on highly accurate linear accelerometer data and angular rate sensor data from the IMU. By tightly integrating these IMU data in the Kalman filter with data from the GPS receivers, Seapath provides accurate roll and pitch under all conditions. With this feature, horizontal accelerations are observable, making the run-ins needed to stabilise conventional vertical reference systems unnecessary.

4.2.3 Position and velocity determination

The two, fixed baseline GPS antennas and their receivers are used as redundant GPS position and velocity sources. In case of missing data from one GPS receiver, the other (remaining) receiver provides position and velocity. The Seapath 200 is robust against GPS dropouts by using the IMU for dead reckoning navigation in order to provide position, velocity and also heading measurements when GPS is not available.

Position and velocity are measured by differential GPS using phase-smoothed pseudo-range and Doppler observations. Differential corrections from up to six reference stations can be combined in order to obtain the best solution. If data from more than six stations are available, the six nearest stations are used. This automatic selection can be overridden if needed.

The GPS data are lever arm compensated to the vessel's centre of gravity. Acceleration data from the MRU are also lever arm compensated to the centre of gravity and integrated with the GPS data in a Kalman filter.

The resulting position, velocity and heave measurements are then compensated for the lever arm from centre of gravity to the user measurement point before output.

4.2.4 Heave position and velocity computation

Heave is the vertical position or height relative to a zero mean level and positive downwards. The vertical acceleration is high pass filtered and integrated twice over time to heave position. Heave velocity is computed with one integration over time of filtered vertical acceleration. The heave filter removes static and slowly varying errors.

The user must tune this filter according to these requirements. The heave filter parameters should be selected according to the expected average wave period T_o for the vessel. The expected average wave period T_o can be selected in the range 1 to 25 seconds. If a too long period is selected, the velocity and position outputs will have a slowly varying error. If a too short period is chosen, the estimated heave will have a phase error for long period motions.

A low damping factor ε reduces the short-term error for long period motions close to the selected average period T_o, since the phase error is reduced. However, ringing in the output at T_o may cause some problems. The damping factor ε can be set in the range 0.3 to 1.0.

In the software two different types of filter structures are implemented. The filter mode "General purpose" is implemented to achieve optimal amplitude performance, whereas the "Hydrographic survey" mode provides optimal phase performance. For the "Automatic" filter mode the hydrographic survey filter structure is used. This algorithm estimates the sea conditions by computing the dominating period of the waves seen from ship or vehicle and automatically sets the average heave period T_o in real time during operations.

4.2.5 Selection of heave filter mode

The following selections are available in the Seapath configuration in order to achieve the optimal heave performance:

- **Heave filter mode**. Selection between different filter structures.
- **Period**. The average heave period for the vessel, T_o.
- **Damping**. The heave damping factor ε to be used in the filter.

The heave filter damping and average period should be chosen in order to obtain the best possible correspondence between the estimated heave motion and the real heave motion. These parameters can be set to a constant value or the automatic adaptive filter may be chosen in case of varying sea states. The following should be considered when selecting the different heave filter modes and parameters:

Heave filter mode:

- **Automatic**. To be selected when the vessel is operating in various sea states or when the average heave period is unknown.
- **General purpose**. Is selected when optimal heave amplitude is to be measured and the heave phase is of no importance. This mode is typically selected when the Seapath is to be used for measuring the heave height and period on oceanographic buoys.
- **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 Seapath is to be used for heave compensation of echo sounders, hydro acoustic positioning systems and offshore crane systems.
- **Off**. To be selected if heave is not to be used and the status indication of heave in the Seapath Display Window and the Processing Unit front panel is confusing for the operation. In this mode the status indication for heave on the output formats will be invalid and the LED indicator on the front panel will be turned off.

Period:

- An expected average heave period has to be set to the heave filter.
- The settling time for the heave measurements from power-on or after a turn will be about 10 times the selected period, T_o. By selecting an unnecessary high heave period the settling time will be longer than optimal. For vessels performing surveys with frequent turns, the period should be set as low as possible to minimise the heave settling time after turns.

Damping:

- The heave damping factor shall usually be set to 0.7. Only for particular operations this parameter should be changed. In operations with heave periods of more than 25 seconds, the damping factor should be reduced to 0.6 in order to achieve correct phase measurements. In operations with heave periods of less than 2 seconds, the damping factor should be increased to 0.8.

Figure 2 and Figure 3 below should be used as a guideline for selecting the correct average heave period (T_o) in the "Hydrographic survey" filter.

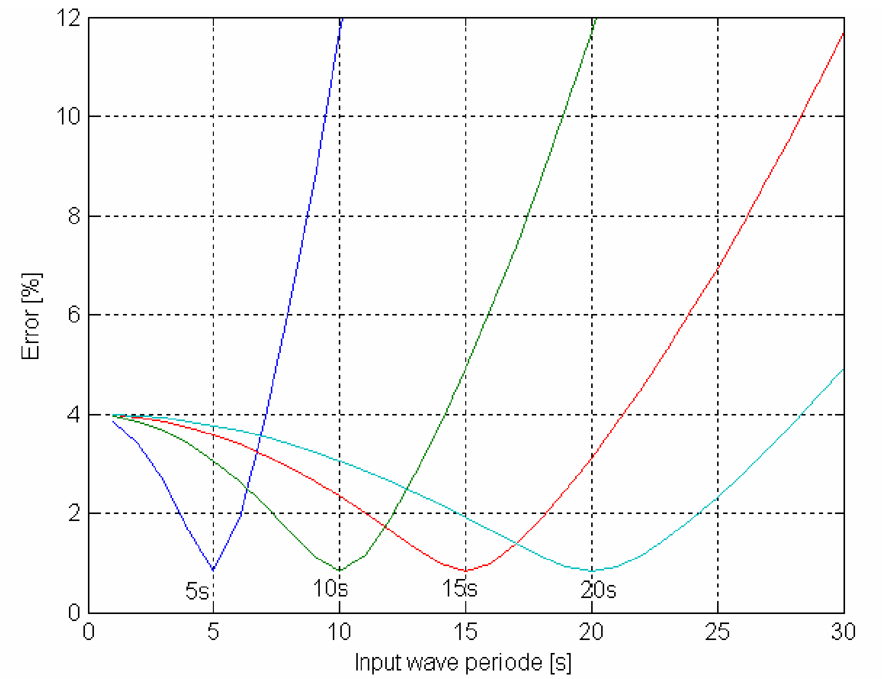


Figure 2 Relative heave residual in percentage of amplitude for "Hydrographic survey" filter with damping 0.7 and various average heave periods 5, 10, 15 and 20 seconds

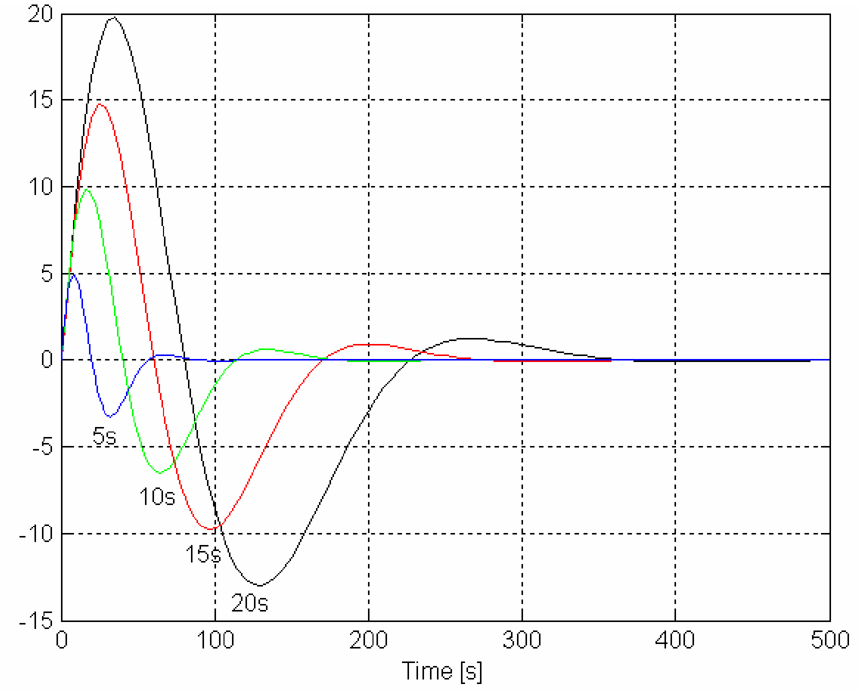


Figure 3 Heave step response with corresponding settling time for "Hydrographic survey" filter with damping 0.7 and various average heave periods 5, 10, 15 and 20 seconds

The selection of heave filter settings is a trade-off between low heave error over a wide range of heave periods and the settling time after an occurrence introducing a step response in the heave filter, such as after a turn if the MRU has not external input of the vessel speed. Input of vessel speed to the MRU is important to reduce the heave errors after a turn or changes in speed.

For an MRU without external input we recommend the following selections:

- The selection T_o =5 or lower is recommended for vessels performing surveys with a lot of turning on rivers or within harbours. The settling time in heave will be about 50 seconds.
- The selection T_o =10 is the default setting for this heave mode and covers most surveys, unless long period heave motions.
- The selection T_o =20 is recommended used for vessels operating in oceans with deep waters or vessels that frequently operates with following sea.

Figure 4 shows the change in the "Hydrographic survey" filter performance when changing the damping factor. We recommend that the damping factor is set to 0.7.

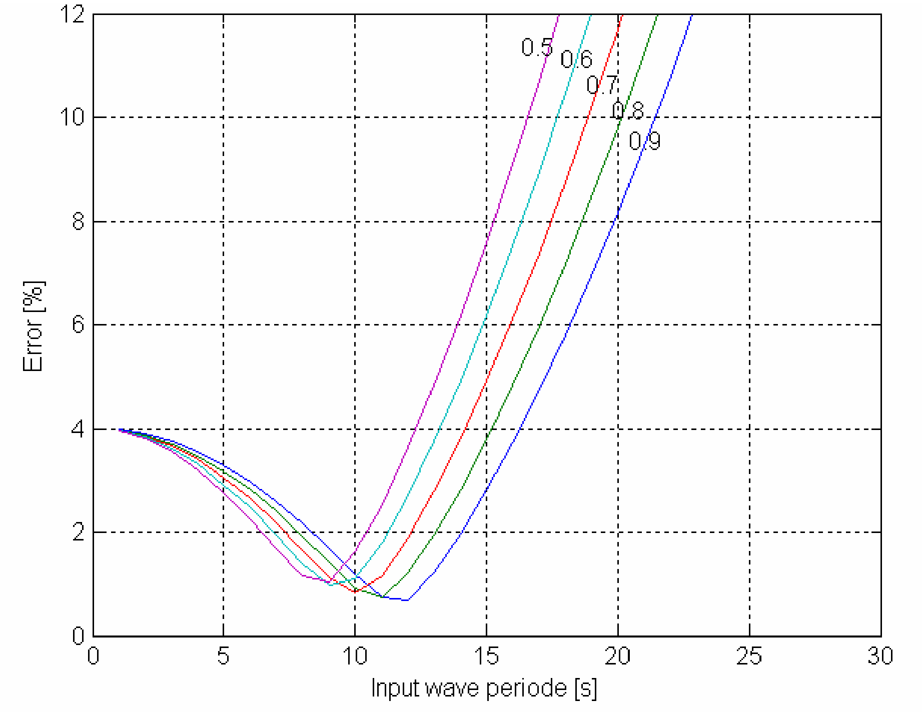


Figure 4 Relative heave residual as percentage of amplitude for "Hydrographic survey" filter with average heave period set to 10 seconds with various damping factors 0.5, 0.6, 0.7, 0.8 and 0.9

4.2.6 High speed data in real-time

By the integration of motion data with GPS positions in the Kalman filter, a 100 Hz update rate of heading, roll, pitch and position is achieved. All Seapath data are output in real-time, including the position data, due to internal processing predicting the data to real-time. This eliminates delays due to processing.

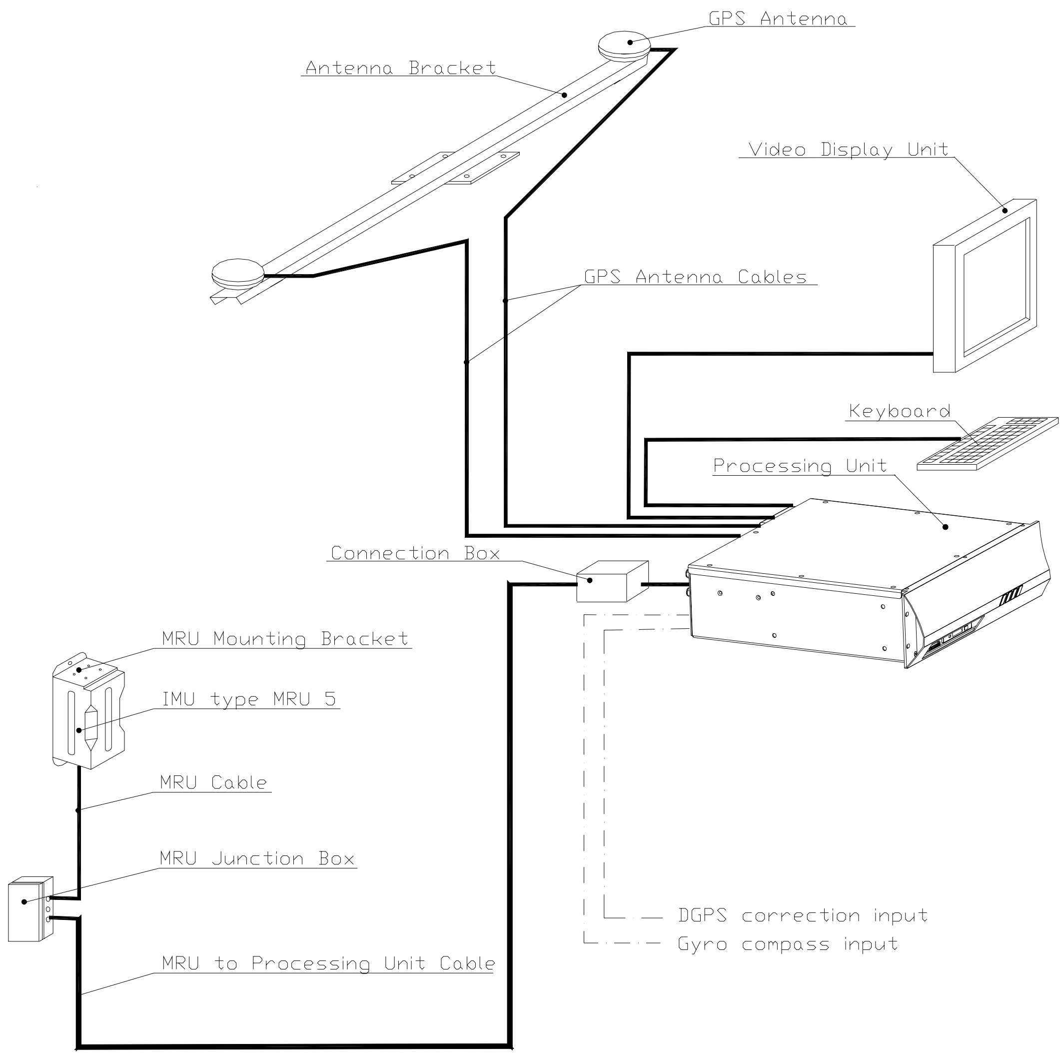
4.3 System components

The Seapath comprises three main components, which are physically separated. These are:

- The Processing Unit.
- The MRU 5 motion sensor.
- The Antenna Bracket with two GPS antennas.

In addition comes:

- The Processing Unit connection box with 1.5-metre cable.
- VDU monitor and keyboard for table mounting.
- The MRU mounting bracket.
- A junction box with three metres of cable for interfacing to the MRU.
- GPS cables, power cable and the cable between the Processing Unit and the junction box.
- Configuration software, configuration cables and documentation.



4.3.1 Processing Unit

The Seapath Processing Unit is designed to fit standard 19-inch racks and is typically installed on the bridge or in the instrument room. The Processing Unit comprises the following main parts:

- Hard disk
- 3.5-inch floppy disk
- Serial and analog I/O boards
- Computer main board
- Two GPS receivers
- 110/230V AC power supply

The front panel contains a communication port for configuring Seapath. The four status lights on the front panel indicate whether the quality of data is normal, reduced performance or invalid. The front panel includes the following items:

- On/off switch
- RS-232 communication interface for configuration
- USB connection (not in use)
- A 3.5-inch floppy disk for software installation and upgrade
- Four status indicator lights

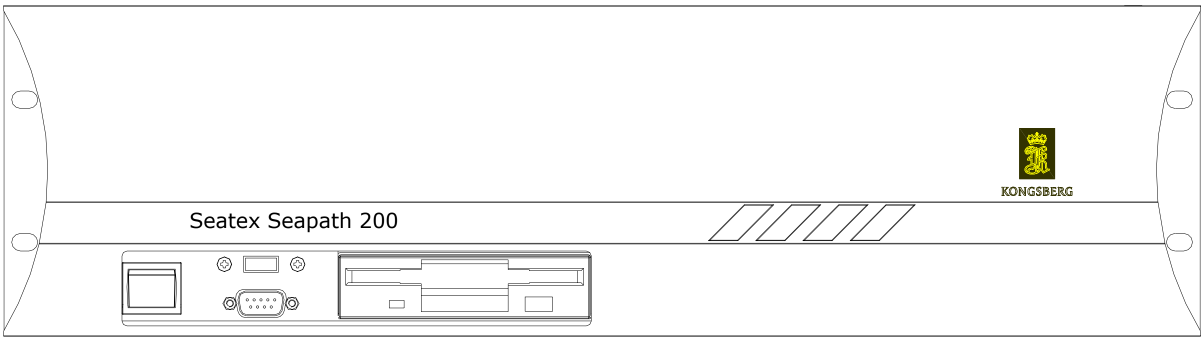


Figure 5 Front panel of the Processing Unit

The rear panel of the Processing Unit contains communication interface ports for interfacing to external systems as well as interface of the MRU 5. These ports are individually galvanically isolated, except for the AUX - Serial port which is not isolated.

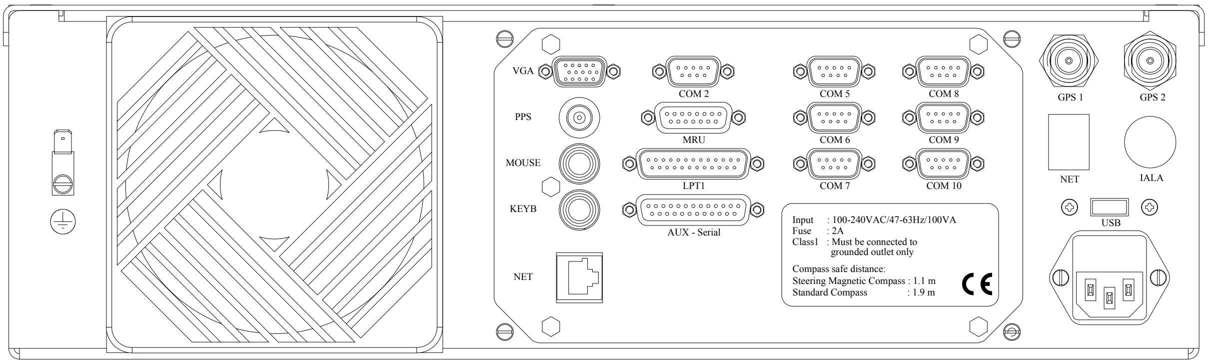


Figure 6 Rear panel of the Processing Unit

The use of the different connectors:

Connectors	Type	Connected to
VGA		Video display unit
PPS	1 pulse-per-second	External equipment
MOUSE		Not in use
KEYB		Keyboard
NET	Ethernet output	External equipment
COM 2	RS-232	User configurable input or output (default output)
MRU	RS-422	MRU 5
LPT1	Parallel port	Not in use
AUX - Serial	Analog output channels and additional serial lines (com13 to com16)	User configurable
COM 5	RS-232 or 422 (default 232)	User configurable input or output (default output)
COM 6	RS-232 or 422 (default 232)	User configurable input or output (default output)
COM 7	RS-232 or 422 (default 232)	User configurable input or output (default output)
COM 8	RS-232 or 422 (default 232)	User configurable input or output (default output)
COM 9	RS-232 or 422 (default 232)	User configurable input or output (default gyro compass input)
COM 10	RS-232 or 422 (default 232)	User configurable input or output (default DGPS corrections input)
GPS 1	N-Connector 50 ohm	GPS antenna no. 1
GPS 2	N-Connector 50 ohm	GPS antenna no. 2
NET		Not in use
IALA		Not in use
USB		Not in use
100/240VAC	Power	Input of 85 to 135 and 180 to 265V AC

Optional

The comports available on the AUX - Serial connector may be used if more serial input or output lines than those described above (Com 5 to 10) are required. The AUX-Serial port makes it possible to increase the number of communication ports. On the 25-pin DSub male connector, six comports are available. These ports are default RS-232 serial lines. The pin layout is described below.

Pin no.	Signal	Line	Description
1	GND		
14	RX	Com4	RS-232, not galvanically isolated
2	TX		
15	GND		
3	RX	Com14	RS-232, not galvanically isolated
16	TX		
18	GND		
6	RX	Com15	RS-232, not galvanically isolated
19	TX		
7	GND		
20	RX	Com16	RS-232, not galvanically isolated
8	TX		
21	GND		
9	RX	Com17	RS-232, not galvanically isolated
22	TX		
10	GND		
23	RX	Com18	RS-232, not galvanically isolated
11	TX		

Note The AUX - Serial ports are limited in use since these ports are not galvanically isolated. They can only be used to distribute signals to/from other systems mounted in the same rack and use the same power reference, unless addtional electronic equipment which provides isolation is connected in between.

In order to galvanically isolate these lines and maybe convert them to RS-422, the Kongsberg Seatex product HMS 100 Converter Box (part no. M410-30) can be used. However, for the Seapath product we recommend that the product Seatex EXT 6 unit (part no. M320-41) is used for this purpose. The Seatex EXT 6 unit is a 1 U rack module including isolation and conversion to RS-422 on all the AUX - Serial comports.

4.3.2 MRU 5

The Seatex MRU 5 is specifically designed for motion measurement in marine applications. The unit incorporates 3-axis sensors for linear acceleration and angular rate, along with complete signal processing electronics and power supply. The MRU 5 outputs absolute roll and pitch. Dynamic acceleration in the MRU axes direction as well as velocity and relative position, are also provided. The MRU achieves high reliability by using sensors with no rotational or mechanical wear out parts.

When the MRU is used within the Seapath product, only raw angular rate and linear acceleration data is output from the unit. All processing of these signals to roll, pitch, heave and velocity measurements is performed in the Kalman filter in the Processing Unit. The analog output channels from the MRU, as indicated in Figure 7, are therefore not used when the MRU is used within the Seapath product. Instead, three analog channels are available on the rear panel of the Processing Unit.

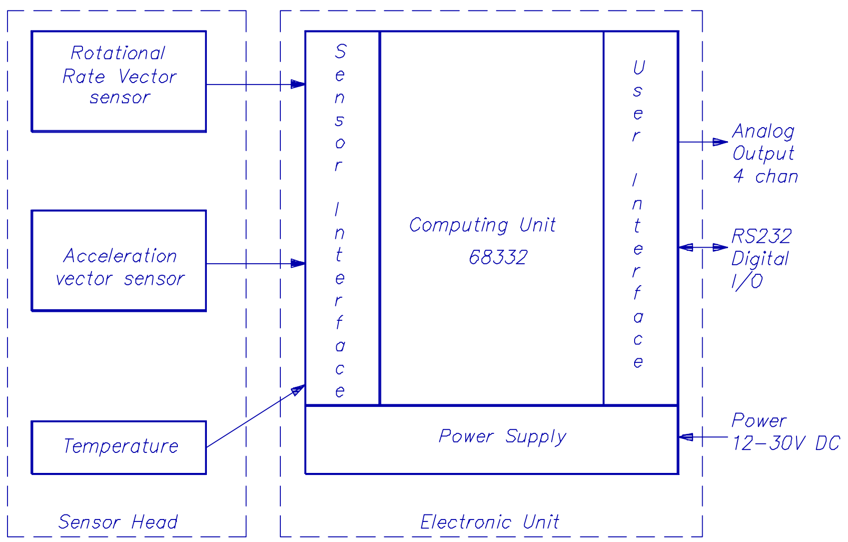


Figure 7 MRU 5 functional modules

The interior of the MRU is divided into two sub-assemblies consisting of an electronic unit and a sensor unit. The electronic unit consists of plug-in circular multi-layer boards. Extensive use is made of surface mounted components. The unit is divided into nine separate mechanical parts, which may be exchanged very quickly by plug in boards when the housing cylinder has been removed. The housing cylinder should, however, not be removed by anyone else than Seatex.

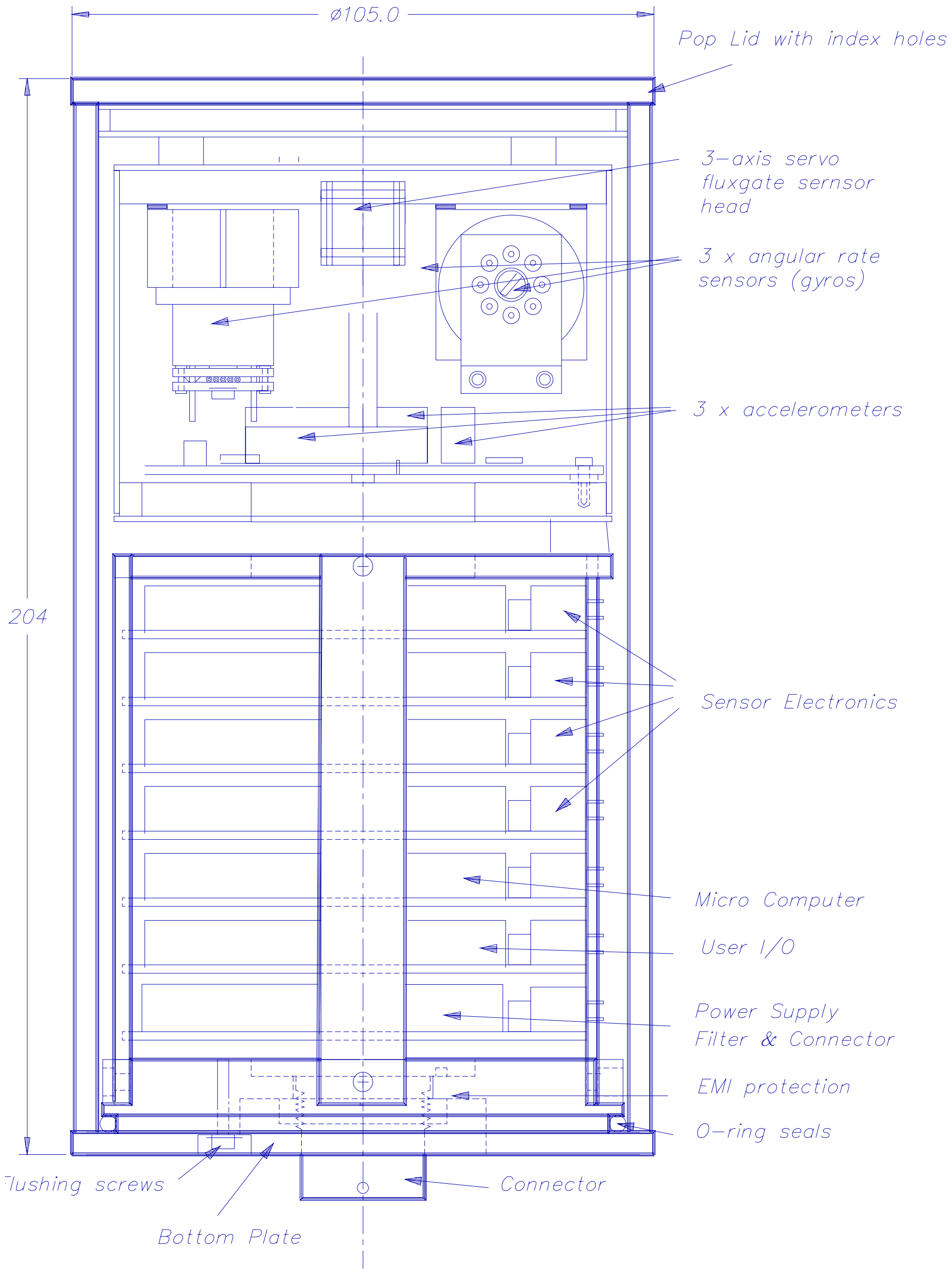


Figure 8 Mechanical layout of MRU (MRU 5 does not include shown fluxgate compass)

The MRU is integrated in Seapath, and all digital data are routed through the Processing Unit.

4.3.3 GPS antennas and antenna bracket

In a standard Seapath delivery, the Antenna Bracket is 2.5 metres. However, in order to achieve maximum heading accuracy of 0.05 degrees, a 4-metre Antenna Bracket is available. The Antenna Bracket is delivered in aluminium. On customer request, the Antenna Bracket can be delivered in steel.

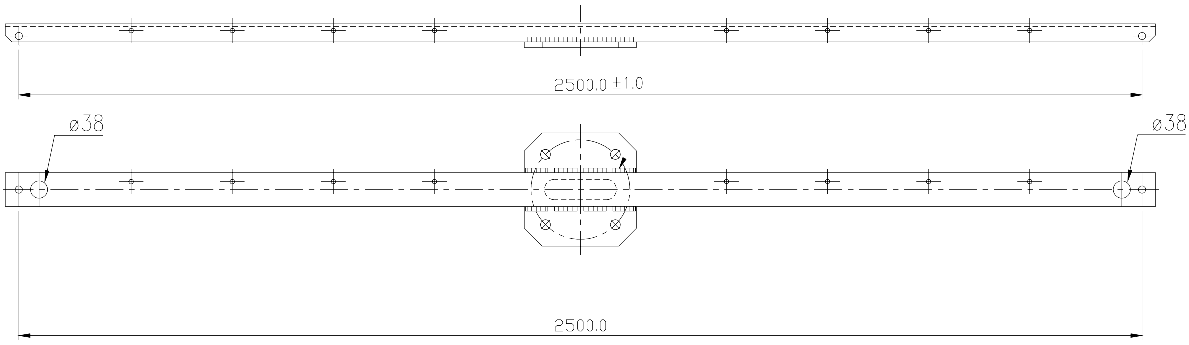


Figure 9 The Antenna Bracket

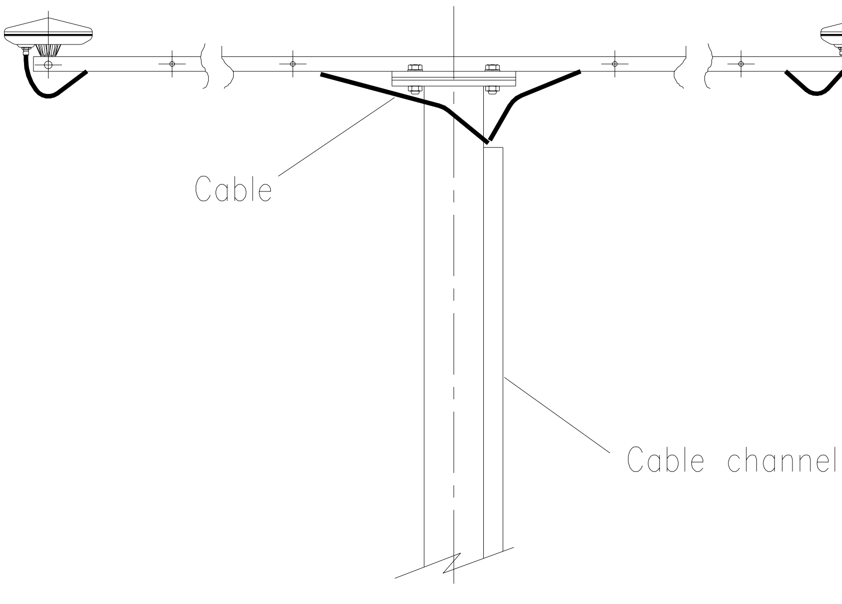


Figure 10 Side view of the GPS antenna installation

5. OPERATING INSTRUCTIONS

5.1 Start procedure

Once installed, calibrated and started, the Seapath needs no manual intervention during operation.

After power on, up to 30 minutes is needed to obtain full accuracy on all data. Since there normally is no reason to turn off Seapath, it should be left running continuously.

Note Seapath can get problems initially if the vehicle has high dynamics during start-up. At worst the alignment must be redone by turning the power off and on by use of the on/off switch in the front panel of the Processing Unit. High dynamics during start-up means that the Seapath components are moved up to ±10 degrees in all the orientation axes.

5.2 Operation

Normally the Seapath outputs signals on the serial lines without any involvement from the user. However, the following should be taken into consideration during operation:

5.2.1 Height aided GPS position

In periods with weak satellite geometry, the position can be made more accurate by using height aiding. The height aiding improves the solution by using the knowledge that a vessel at sea has only small short-term variations in height caused by heave. The long-term variations caused by tide are taken care of in the system. The height value used, as input to the GPS solution is a low-pass filtered value of the measured height.

A start value for the low-pass filter should be specified for use at system start-up. The value to use is the height of the vessel's centre of gravity above the WGS-84 ellipsoid when the sea level is at its mean value. This height can be found by running the system without height aiding and logging the height output on a serial line. If the measurement point selected for the serial line is not centre of gravity, the difference must be accounted for.

Height aiding is enabled by changing GPS processing configuration parameters in the SCC software, see reference [1]. Parameters to set are:

- **Aid Mode**. The selections are "Off" or "Filter". If "Filter" is selected, the Aided Height should be specified.
- **Aided Height**. The height of CG in metres above the WGS-84 ellipsoid at mean sea level (tide) to be specified when Aid Mode "Filter" is selected.

Note The height difference between mean sea level and the WGS-84 ellipsoid can be significant. Values between +/- 100 metres can be encountered.

Example

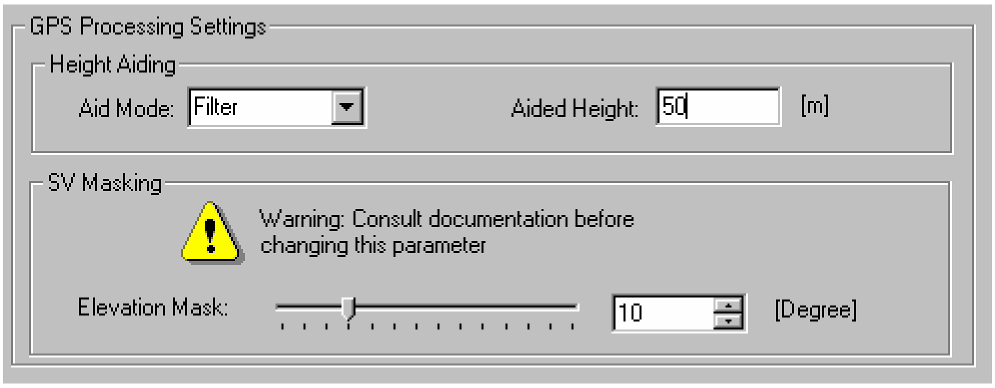


Figure 11 Height Aiding set to Filter and the Aided Height found to be 50 metres

Height aiding is active only with input of differential GPS.

5.2.2 Gyro calibration

If a gyro compass is connected to Seapath, calibration data for the gyro is continuously calculated by Seapath and output to the host system. Because the accurate Seapath heading is used as reference, gyro calibration can be performed while the vessel is in motion.

The calibration value output to the host system is the mean value of the gyro's offset from the Seapath heading calculated since last time Seapath was switched on. A calibration time of at least two hours is recommended to eliminate errors caused by multipath effects. The manoeuvre pattern during calibration should be carefully selected to avoid introducing systematic errors to the gyro readings.

5.2.3 Differential GPS corrections

If data from more than one reference station are available on the links, Seapath combines data from up to six reference stations to obtain the best solution. If data from more than six stations are available, the six nearest stations are used.

In some cases, it may be desirable to override the automatic selection of the six nearest stations. If one of the six stations is known to produce poor data, the system can be told to ignore that station (the system itself has no routines to ignore poor stations since it selects the stations based on distance and not on quality of the signal). The six nearest of the remaining stations will be used. Alternatively, if you want to use a station, which is not automatically selected, you can force the system to use it. In addition, the five nearest stations will be used. If you want full control, you can enter a list of reference stations to use, thereby disabling the automatic selection.

Use the SCC software to change the selection of reference stations, see reference [1]. Configuration parameters for reference stations selection are:

- *Only Stations List*. Only the DGPS corrections from the station IDs listed are used to determine position and velocity. The automatic selection is turned off.
- *Force Stations List*. The listed station IDs to be forced used in addition to the automatically selected stations.
- *Ignore Stations List*. All the station IDs listed to be ignored in the automatic selections of stations.

Note Initially, all the lists contain the word <Empty>, giving automatic selection which is the normal operational setting.

Example

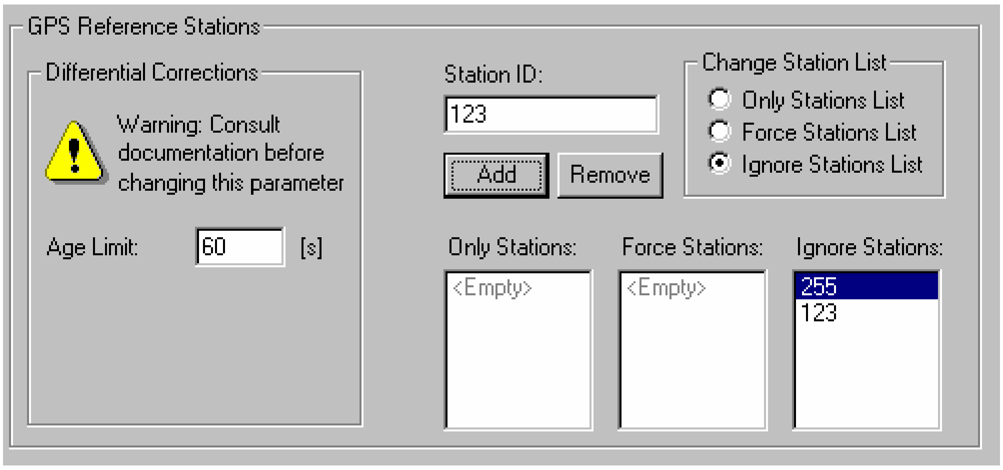


Figure 12 The stations 255 and 123 are ignored in the automatic selection of stations

5.2.4 SBAS corrections

Figure 13 below illustrates a typical configuration of SBAS satellites for WAAS.

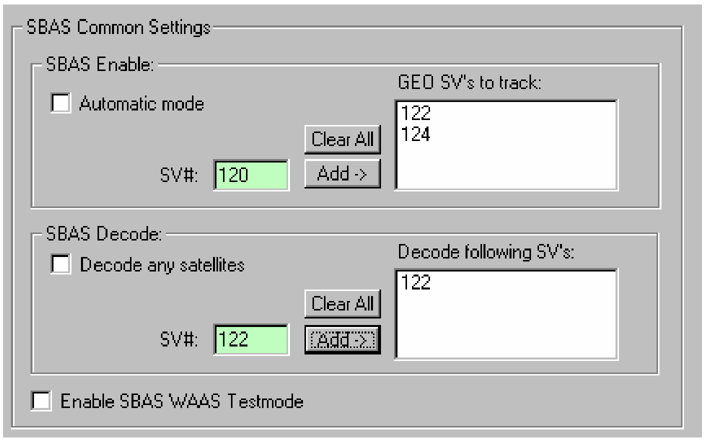


Figure 13 SBAS Common Settings for WAAS satellites

5.2.4.1 Selection of satellites

The current satellite status (January 2004) is:

Satellite no. PRN	**SBAS system**	**Status**
122 and 134	WAAS	WAAS is commissioned and approved for flying down to 350 feet. Launch of more satellites are planned during the next years.
120, 124 and 126	EGNOS	EGNOS will not be fully operational before the second half of year 2004. Until then only test signal is available.
131	EGNOS TESTBED	Is transmitting corrections, but only for test purpose.

Be aware that EGNOS and EGNOS Test Bed are not using the same reference stations and transmitting the same corrections. Corrections from EGNOS and EGNOS Test Bed should not be mixed.

The first MSAS Geo satellite is to be launched this year. MSAS is supposed to be operational within the second half of 2005.

5.2.4.2 Use of SBAS corrections

It is possible either to specify which Geo satellite to track or to let the receiver choose which Geo satellites to track using Automatic mode. However, it is recommend to specify which Geo satellites to track. This enables the receiver to keep better track of the specified satellites without starting to search for PRN numbers every time it looses track of the satellite.

In Automatic mode the receiver will select which two satellites to track. Be aware that occasionally the chosen satellites might be from two different SBAS systems.

If the receiver is set in Automatic tracking mode, you must select which satellite to decode. It is possible to decode data from two satellites, but you must be sure they are from the same SBAS system sending the same SBAS corrections. Seapath can only use data from one SBAS system at the time. Any mixture will give an unpredictable result.

The recommended setting is to select one or two Geo satellites for tracking. Select only one satellite for decoding.

5.2.4.3 Use of Geo Ranges in position solution

In addition to send corrections, most Geo satellites can be used for ranging. This might improve the geometry significantly in periods of few satellites. Ranging signals from the Geo satellites are noisier than the signals from a normal GPS satellite. Generally, we therefore do not recommend to use Geo satellites for ranging at the time being but this might change in the future when more experience with Geo ranges is gained. Anyway, Geo satellites should not be used for ranging without differential corrections such as SBAS.

5.2.5 Heave measurements

When using the Seapath for heave measurements it is important to tune the heave parameters (heave period and damping) to the vessel size and motion characteristics for the actual weather conditions. Since the configuration window **MRU Heave Filter** only enters the default values of the heave period and damping according to the selected filter mode, these values have to be tuned for the actual vessel and weather conditions in order to achieve optimum heave performance. Therefore, before a survey and/or during operation check the heave performance of the Seapath and tune the heave parameters until the best heave performance is achieved on the echo sounder. An alternative is to select **Automatic** as the heave filter mode and let the Seapath automatically choose the best settings.

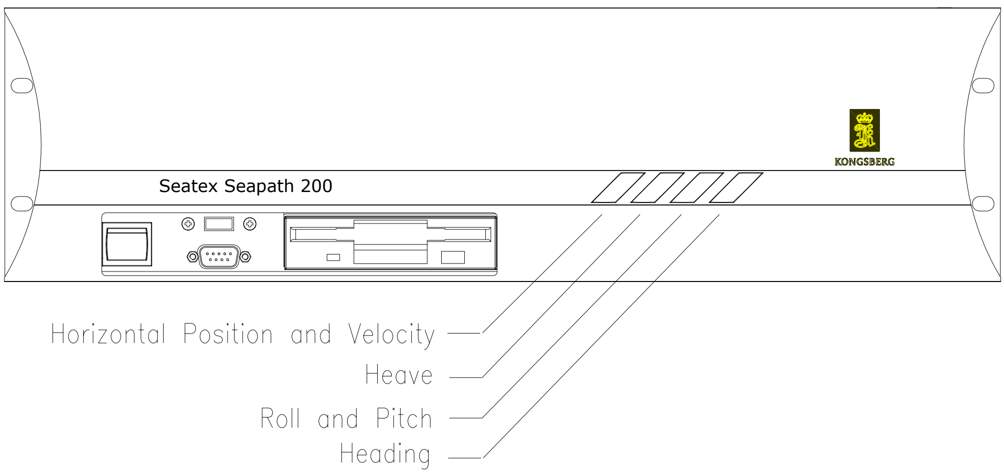
5.3 Stop procedure

When power to the Processing Unit is cut, the Seapath system will automatically stop in a controlled way. The configuration of the Seapath system is stored on the hard disk.

5.4 Performance monitoring

The data quality status output on the serial lines is also displayed on four LED indicators on the front panel. The indicators represent from left to right:

- horizontal position and velocity
- heave
- roll and pitch
- heading



The colour codes are:

- Green; normal
- Orange; reduced performance
- Red; invalid data

A full overview of the performance of the Seapath system connect a VGA screen to the port marked "VGA" and a keyboard to the port marked "KEYB" on the rear panel of the Processing Unit. Then use the arrow keys to navigate in the screen menu to find the Seapath window that shows the figures to be monitored. A description of the different screen pictures is found in appendix A.

6. MAINTENANCE

6.1 General

Seapath consists of both a software and a hardware part. The software part can be reinstalled or upgraded to the latest version in the field by connecting a PC to the MRU or loading a floppy disk into the Processing Unit. Service on the Seapath hardware in the field can consist of:

- Replacing damaged GPS antenna cables.
- Replacing failed GPS antennas.
- Replacing failed Processing Unit.
- Replacing failed MRU 5 unit.
- Checking fuse in the MRU junction box or replacing the whole junction box.
- Checking fuses within the power connector on the Processing Unit.

The Processing Unit and the MRU 5 are not designed for service in the field and opening the housing will result in damage or degradation of the units and void the warranty. A failed MRU unit has to be shipped back to Seatex in the original transportation box for service. The return address is provided in the first pages of this manual.

During the time the Seapath Processing Unit or the MRU 5 is in service, Seatex will be helpful by renting the user a spare component if needed. The user can then load his own configuration file into the spare unit making it ready to operate. Seatex will also assist the user with the configuration.

6.2 Periodic maintenance

The periodic maintenance of the Seapath 200 can be divided into five categories:

6.2.1 Software upgrades

Seatex will regularly offer software upgrades for the Seapath 200 with improvements and new functionalities. It is up to the user to decide whether he will upgrade his unit to the latest version.

6.2.2 Cleaning of air inlet

The air inlet at the rear of the Processing Unit needs to be cleaned at least twice a year, to avoid overheating of the unit. One cleaning method is to blow it clean by use of a compressed air tool.

6.2.3 Recalibration of the Antenna Bracket

The direction of the GPS antenna baseline relative to the vessel's heading has to be recalculated only if the Antenna Bracket has been moved or dismounted from the Antenna Holder. Then the calibration procedures described in the *Installation Manual* [1] have to be followed for recalibration of the heading and antenna baseline.

6.2.4 Recalibration of the MRU

After two years in operation a recalibration of the MRU is recommended. A recalibration is recommended due to changes in the characteristics of the internal sensors over time and is therefore necessary in order to achieve the specified performance. Exactly when a recalibration is required, will depend on the use of the unit and the actual model number. An indication that recalibration is needed is oscillations in the roll, pitch and yaw measurements that cannot be related to the vehicle motions. The MRU has to be returned to Seatex for recalibration.

To reduce the need for recalibration, try to install the unit in an environment with constant and low temperatures.

6.2.5 Changing the internal lithium battery

The lifetime of the internal lithium battery within the MRU should be at least 10 years, unless the unit has been stored unused for many years. An indication of a discharged battery will be that the MRU loses its configuration when the unit is unpowered. The MRU has to be returned to Seatex for changing of the lithium battery. A discharged battery will not have any influence on the MRU as long as it is connected to an external power source, like the Seapath Processing Unit.

6.3 Repairs and modifications

Repair of the Seapath consists of replacement of damaged GPS antenna cables, exchange of GPS antennas, replacement of the Processing Unit, the MRU 5 or the MRU junction box.

6.3.1 Replacement of GPS antenna cable

First power off the Processing Unit and dismount the damaged antenna cable. The new antenna cable must be as straight as possible. Do not crush or crimp the cable with tie-downs, as this will affect the electrical properties of the cable. The connection between the GPS antenna and the antenna cable should be sealed against water penetration, preferably by using waterproof self-vulcanising tape. Strap the antenna cable inside the Antenna Bracket.

CAUTION

Attach the antenna cables to the GPS antennas on the Bracket before attaching the antenna cables to the Processing Unit. If the antenna cables are attached to the Processing Unit, do not attach the antenna cables to the GPS antennas with the Processing Unit powered on. If the antenna cables are short-circuited with power on, the GPS receivers within the Processing Unit will be damaged.

6.3.2 Replacement of GPS antenna

First power off the Processing Unit and dismount the failed GPS antenna. Then mount the new antenna on the Antenna Bracket in the same direction as the other antenna (the connectors on the antennas are pointing in the same direction). The screw for mounting the GPS antenna to the Bracket has to be secured with washers.

CAUTION

If the antenna cable is attached to the Processing Unit, do not attach the antenna cable to the new GPS antenna with the Processing Unit powered on. If the antenna cable is short-circuited with power on, the GPS receiver within the Processing Unit will be damaged.

Connect the antenna cable to the antenna. The connection between the GPS antenna and the cable should be sealed against water penetration, preferably by using waterproof self-vulcanising tape.

After a replacement of GPS antennas, it is recommended to perform a recalibration of the antenna baseline length and heading. The procedure for performing a recalibration of the antenna baseline is described in the *Installation Manual* [1]. If the Antenna Bracket has been dismounted during exchange of the GPS antenna, a full recalibration of both heading and antenna baseline has to be performed.

6.3.3 Repair of the Processing Unit

The Processing Unit is not designed for service in the field. All repairs and modifications of the unit, except for changing the fuse in the power inlet, installation of new software versions and setup of the system, have to be done by Seatex. The fuse in the power inlet is of type T2A 250V with size 6.3x20 mm and there are two of them. A failed Processing Unit has to be shipped back to Seatex for repair.

6.3.3.1 Installing spare Processing Unit

If a spare unit is rented while your unit is repaired, use the following procedure to install your setup file in the received spare unit:

1) If your Seapath setup file is not already available on your PC or backup diskette, connect a null-modem cable from a free serial port on an external PC to the front panel connector on the Processing Unit and power on the Processing Unit. Start the SCC program on the external PC. In the SCC start-up window select **Connect** in order to establish connection between the external PC and the Processing Unit. Check if correct **Port** and **Baud rate** are selected if no contact with the Processing Unit is achieved. Then select **Save to file**. Save the parameter values on a directory on the external PC disk with e.g. the vessel name as the file name. Exit SCC.

2) Disconnect the unit to be repaired from its cables and the rack, and replace it with the spare Processing Unit.

3) Connect the external PC to the front panel connector on the spare Processing Unit and power on the Processing Unit. Start the SCC program on the external PC. In the SCC start-up window select **Connect** in order to establish connection between the external PC and the Processing Unit. Check if correct **Port** and **Baud rate** are selected if no contact with the Processing Unit is achieved. In the SCC configuration folder list, select **Load from file** under the **Parameter Management** folder. Select the parameter file saved under item 1) above. Then select **Download** in order to download the parameters from the failed unit to the spare Processing Unit. Exit SCC and disconnect the external PC. The spare unit should now be fully operational.

If it is not possible to get hold of the setup file from the failed Processing Unit, the spare unit has to be set up from start as described in the *Installation Manual*, [1].

6.3.4 Repair of the MRU 5

All repairs and modifications of the MRU except for installation of new software versions and user configuration, have to be carried out by Seatex.

CAUTION

Opening the MRU housing will result in permanent damage and the user should under no circumstances make any attempt to do so.

6.3.4.1 Installing a spare unit

If a spare unit is rented while your unit is in for repair, use the following procedure to exchange the units:

1) Power off the Processing Unit and disconnect the MRU cable. Unscrew the unit from the mounting bracket.

2) Insert the spare MRU into the mounting bracket. Ensure that the MRU is mounted in the same orientation in the mounting bracket as the failed MRU. Connect the MRU cable to it and power on the Processing Unit.

3) Put the failed MRU in the MRU transportation container and ship it to the nearest Seatex office for repair.

6.3.5 Repair of the MRU junction box

First check that the fuse within the box is not blown and replace it if it is. The fuse used is of type F1AH 250 V with size 5x20 mm. Second, check if any of the cable wires have loosened from the terminals. If the box is functioning correctly the LED1 light diode should shine green indicating that the MRU receives power. A yellow light in LED2 indicates that digital data are sent from the MRU on TX+. The LED3 for analog signals from the MRU should not shine, since analog signals are not sent out of the MRU when used in Seapath. If the LED light diodes indicate that the junction box is still not working, the box has to be returned to Seatex for repair.

6.4 Troubleshooting

A good start for troubleshooting the Seapath 200 is to check the colour of the four LED indicators located on the front panel, see chapter 5.4.

For a more in-depth troubleshooting of the system ensure that the VDU monitor is connected to the port marked "VGA" and the keyboard to the port marked "KEYB" on the rear panel of the Processing Unit. Then use the arrow keys to navigate in the screen menu. A description of the different screen windows is found in appendix A.

The next sections contain some hints for troubleshooting.

6.4.1 All "four lights" are black

In normal operation it takes a minute from the Processing Unit is powered on to the four LED indication lights turn red. If all the indicator lights are still black after three minutes from power on, do as follows:

- Check the power connection to the Processing Unit. Is the Processing Unit supplied with 110 to 240 VAC power supply, see power specification in chapter 2.7.
- Check if the fuse within the power inlet of the Processing Unit is blown. If so, change it.
- Turn the power switch on the front panel off and on two or three times in case of poor connection.

If the LED lights are still not turning red, contact your nearest Seatex office.

6.4.2 All data invalid "four red lights"

In normal operation it can take up to 30 minutes from the Processing Unit is powered on to full accuracy on all data is obtained and the LED lights changes colour from red. If all the indicator lights are still red after 30 minutes from power on, then do as follows:

- Check if the GPS cables and the MRU cable are properly connected to the Processing Unit. If not, switch off the power and connect the cables properly and power on the unit again.
- Is the cable from the Processing Unit to the MRU junction box properly terminated and is the cable from the junction box connected to the MRU? Check if the fuse in the junction box is blown and replace it if it is.

If there are still four red lights, contact your nearest Seatex office.

6.4.3 Invalid position/velocity "left light red"

The problem occurs if the Processing Unit does not get data from any of the GPS receivers. Do the following:

- Check that both GPS antenna cables are properly connected to the antenna ports on the Processing Unit. In the Seapath Display Window on **Show Other, Serial,** data from the GPS antenna number 1 shall appear on com11 and com2 from antenna no. 2.

- Check that the both GPS antennas are not damaged and their cables are properly terminated in the connectors. Replace the whole cable if necessary.

- Check that both GPS antennas are functioning properly by dismounting the antennas from their Antenna Brackets and inspecting them. Replace the antenna with a new one if necessary.

If it is still not working after checking all the above items, then the GPS receiver boards within the Processing Unit are most likely broken and the Processing Unit has to be shipped to Seatex for repair.

6.4.4 Reduced position/velocity "left light orange"

The possible reason for reduced position/velocity function could be one of the following:

- No differential corrections are input through com10 port on the rear panel of the Processing Unit. If differential corrections are input through the com10 port, check that the link is properly set up by using the SCC software.

- You can be out of range to a radio reference station and the differential corrections are therefore missing. If the reference station is too far away or it is in the shadow of geographical obstructions or other equipment on board, reception may be unreliable or missing. The location of the reference stations connected to Seapath is shown in the window **Show GPS, Correction** as described in appendix A.

- The reference station can be out of function. Check the status of the reference station with the authorities responsible for it, or contact the nearest Seatex office.

- The antenna or the MRU offset setup can be incorrect. Check the setup in SCC of the lever arms from centre of gravity to antenna no. 1 and to the MRU once again. Check particularly that the sign for each of the vector components are correct.

Please note that the Seapath outputs position in WGS-84 Datum. If the position from Seapath differs from positions from other GPS sensors onboard, check that all systems use the same Datum.

6.4.5 Invalid heave and roll/pitch "two red lights"

The Processing Unit does not receive any data from the MRU 5. Do the following:

- Check that data is coming in to the MRU connector on the Processing Unit, by selecting com12 on the Seapath Display Window **Show Other, Serial**.
- Check that the cable from the MRU is properly connected to the MRU port on the rear panel of the Processing Unit. Also check that the MRU cable is properly terminated in the junction box and that the fuse in the box is not blown.
- If the above is OK, see chapter 6.4.9 below for troubleshooting of the MRU unit.

6.4.6 Reduced heave and roll/pitch data "two orange lights"

These lights indicate that there are some problems with the MRU. The unit may of some reason be unstable. See chapter 6.4.9 below for troubleshooting of the MRU unit.

6.4.7 Invalid heading "right light red"

If a gyro compass is not connected to the Processing Unit, the possible problem can be one of the following:

- Check that the antenna baseline setup parameters in **GPS Antenna Configuration** in SCC are properly configured, and if needed re-measure and perform a new calibration of the antenna baseline.
- The Processing Unit is receiving no data from GPS receiver no. 1 or 2. That can be verified by checking whether data appear on the Seapath Display Window on **Show Other, Serial,** Com11 from GPS antenna number 1 and com13 (com2 for Processing units with s/n less than 2000) from antenna no. 2. If no data are coming in, check that the cable from GPS antenna no.1 and 2 are properly connected to the ANT.1 and ANT.2 connector on the Processing Unit. Check that the cables for GPS antenna no. 1 and 2 are not damaged and the cables are properly terminated in the connectors. Replace the both cables if necessary.
- Check that GPS antenna no. 1 and 2 are functioning properly by dismounting the antennas from the Antenna Bracket and inspecting them. Replace both antennas with new ones if necessary.

If a gyro compass is connected to the Processing Unit, check the items described above, and in addition check that data are coming in from the gyro compass. That can be verified by checking whether data appear on the Seapath Display Window on **Show Other, Serial,** and the communication line the gyro compass data is input on, normally Com9.

If it is still not working after checking all of the above items, then the GPS receiver board within the Processing Unit is most likely broken and the Processing Unit has to be shipped to Seatex for repair.

6.4.8 Reduced heading "right light orange"

The reason for reduced heading performance could be one of the following:

- It may be a problem with the MRU. Check that by troubleshooting the MRU as described in chapter 6.4.9 below.

- Otherwise if the MRU is functioning OK, check that the antenna baseline setup parameters in **GPS Antenna Configuration** in SCC are properly configured, and if needed re-measure and perform a new calibration of the antenna baseline.

- The Processing Unit is receiving no data from GPS receiver no. 1 or 2. That can be verified by checking whether data appear on the Seapath Display Window on **Show Other, Serial,** Com11 from GPS antenna number 1 and com13 (com2 for Processing units with s/n less than 2000) from antenna no. 2. If no data are coming in, check that the cable from GPS antenna no.1 and 2 are properly connected to the ANT.1 and ANT.2 connector on the Processing Unit. Check that the cables for GPS antenna no. 1 and 2 are not damaged and the cables are properly terminated in the connectors. Replace both cables if necessary.

- Check that the two GPS antennas are of the same type and are mounted in the same orientation. If not, the heading could get unstable and switches from normal to reduced heading performance frequently.

- Check that the GPS antenna no. 1 and 2 are functioning properly by dismounting the antennas from the Antenna Bracket and inspecting them. Replace both antennas with new ones if necessary.

If it is still not working after checking all of the above items, then the GPS receiver board within the Processing Unit is most likely broken and the Processing Unit has to be shipped to Seatex for repair.

6.4.9 Problems with the MRU 5

The tool available for troubleshooting the MRU is the Seapath Display Windows described in appendix A.

If the heave and roll/pitch indications show invalid "Red", then the Processing Unit most likely does not receive any data from the MRU 5. Then do the following:

- Check that data are coming in to the MRU connector on the Processing Unit by selecting com12 on the Seapath Display Window **Show Other, Serial**.

- Check that the cable from the MRU is properly connected to the MRU port on the rear panel of the Processing Unit. Also check that the MRU cable is properly terminated in the junction box and that the fuse in the box is not blown. Replace it if it is.

If the heave and roll/pitch indications show reduced "Orange", then the data from the MRU are most like unstable. Then do the following:

- Check if the "Status" in the **MRU** window in **Show Other** indicates "SY". Then the 1PPS pulse from the Processing Unit is probably sent correctly to the MRU. In order to be sure, check also the **Debug / Timedelay** window. The timedelay shown on the parameter "RawMruData" should be 20 ms or less. If the timedelay is larger than 20 ms, then the PPS signal from the Processing Unit in not properly connected. Check that the shield around each pair in the cable between the MRU and the Processing Unit is individually isolated in the DB-15 connector. The outer shield is connected to pin 1 (screen) in this connector, and this pin is not connected further to earth (open end). In the MRU junction box both the shield around each pair and the outer shield are terminated in pin 1 (chassis) on the x3 side.

If it is still not working after checking all of the above items, then the MRU has most likely failed and the MRU has to be shipped to Seatex for repair. Contact your nearest Seatex office.

6.4.10 Reduced roll or pitch performance

Reduced roll or pitch performance may occur when:

- The MRU +R arrow is not properly aligned with the vehicle's longitudinal axis. A misalignment of only one degree will reduce the performance when exposed to heavy motions due to cross-coupled roll and pitch measurements. If not already done, ensure that the MRU yaw offset according to the vehicle's longitudinal axis is accurately measured and entered into the MRU configuration.

- It has been several years since the MRU was last calibrated. Contact Seatex to check whether the MRU needs recalibration.

- If DGPS corrections are input to the Seapath and range rate corrections are used, check that these corrections are not noisy. This is done by entering the Seapath Display

Window, Show GPS Correction, and reading the **dPrc** values under L1. None of these **dPrc** values should be higher than a few centimetres (.02). If high values occur (like .10), disable the use of range rate correction by deselecting the checkbox **Enable Range Rate Corrections** in the SCC software under the Configuration Folder List, **Sensor \ GPS \ Processing**. Disabling range rate corrections will reduce velocity and attitude noise when receiving DGPS corrections from a reference station with noisy range rate.

Depth errors in the outer beams on a multi-beam echo sounder may occur when:

- The oscillations in the depth of the outer beams are correlated with the pitch angle of the vessel. Check the mounting angle around the Y-axis. The MRU R-axis has to be parallel with the ship's longitudinal axis as long as the sounder transducer is aligned with the ship axes.

- The oscillations in the depth of the outer beams are correlated with the roll angle of the vessel. Check that the lever arm vector from the ship's centre of gravity (CG) to the MRU is input correctly both when it comes to the length and the sign. Check also that the vector from CG to GPS antenna no. 1 is input correctly both when it comes to the length and sign. Check specially the sign in the z-axis, which always shall have a negative sign.

6.4.11 Reduced heave performance

Reduced performance in heave or depth errors in the centre beam of an echo sounder may occur when:

- There are oscillations in the depth of the centre beams. Check that the correct heave filter mode and heave period are selected in **MRU Heave Config** in SCC.

Be aware that the Seapath outputs heave measurements in the centre of gravity, and not in the transducer location, unless the vector from centre of gravity to the transducer head (Measurement Point, MP) is entered into the Seapath configuration and defined on the output data string. Please note that the horizontal vector components from the CG to MP are defined positive forward, to starboard and down.

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7. DRAWINGS

For outline drawings of the mechanical dimensions of the different Seapath parts, see the *Installation Manual* reference [1].

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8. PARTS LIST

The standard Seapath 200 consists of:

Part no.	No.	Description
M320-10	1	Seapath 200 Processing Unit
M410-32	1	Processing Unit connection box with 1.5-metre cable
M320-21	1	Antenna Bracket in aluminium, 2.5 metres baseline
G060-02	2	GPS antennas (L1)
MRU-5-E	1	MRU 5 sensor
MRU-M-MB3	1	MRU 5 mounting bracket
MRU-E-JB1	1	MRU Junction box for flexible connection of MRU to Seapath
MRU-E-CS1	1	3 metres heavy duty screened cable with 14 twisted pairs
MRU-M-SC1	1	MRU transportation box
G032-10	1	2 metres power cable to Computing Unit
G060-32	1	VDU 17" standard LCD monitor, table mount
G062-11	1	Standard keyboard (US layout)
M320-40	1	Interconnection cable (null modem cable, 3 metres)
M320-51	1	Seapath Control Centre Software
M320-70	1	Seapath 200 Product Manuals

The Seapath 200 can be delivered with following optional equipment:

Part no.	Description
G070-01	GPS antenna cable, ½" Superflex or similar, length on request
G071-03	Connector kit for GPS antenna cable, ½" Superflex or similar
M310-44	Bend kit (90 deg) for GPS cable connector, ½" Superflex or similar
M310-41	Flexible GPS antenna cable type RG214 Hiflex (max length 40 metres)
M310-42	Connector kit for RG214 Hiflex cable
M310-60	Processing Unit to Junction box cable, length on request
90.076	Connection box to MRU Junction box cable, length on request
M310-50	RS-232/-422 cable to external systems, length on request
M320-41	Seatex EXT 6, a serial extension unit for the AUX - Serial lines
M320-42	Analog output cable with DB-25 connector, 3 metres
G071-21	Processing Unit cabinet, 6U height

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Appendix A – Seapath Display Windows

By connecting a VGA screen to the port marked "VGA" and a PC keyboard to the port marked "KEYB" on the back plane of the Processing Unit, you are able to display the performance of the Seapath for troubleshooting or for monitoring its performance. In this appendix the different display windows are shown and the information on the screen described.

The Seapath display windows consist of:

- On the top a menu for selection of the wanted display window.
- A middle part where the actual information is shown. This part can in some windows be divided into two parts where the left part will be the same for all windows.
- In the bottom of the window are four lines with the latest Seapath messages.

Use the arrow keys to navigate in the window menu.

Note To freeze the data on the screen, type the "F" key on the keyboard. Type any key to cancel the freezing of the screen.

Show GPS, Solution

```
Show GPS  Show corrections  Show Other  Debug
Solution  Satellites  Heading  Tracking
```

```
17 Oct 2000,  08:12’31.962      17 Oct 2000, 08:12’31.000
Position N 63°26’31.356         Position N 63°26’31.356   Satellites   7
         E 10°24’12.196                  E 10°24’12.196   HDOP         0.9
Height            76.44         Height           76.44    PDOP         1.9
Heave              0.00         Velocity North    0.00    ΔPOS H: 0.2  V: 0.4
VelN -0.00  E -0.00 D -0.00              East    -0.00    ΔVel H: 0.00 V: 0.0
Course  346.2  Speed   0.00              Down    -0.00
Attitude Roll          0.87
         Pitch        -0.91     Mode RTK      L1/l2       Corr. age    1.0
         Heading    336.86      Used GPS      BOTH        Accuracy     0.02
Pos/Vel:            Normal
Heave  :            Normal      17 Oct 2000, 08:12’31.000
Roll/pitch:         Normal      Heading 336.31            Satellites   7
Heading:            Normal      Valid                     Meas. err    0.65
Sys time 8:12:31    Valid                                 Baseline err 0.22
```

```
TIMECHECK          0.3560
08:25’59:   [7000]
TIMECHECK          0.3570
TIMECHECK          0.3740
```

The left part of this window is common for all windows that are divided into two parts. This left window part shows the integrated navigation data and status:

- GPS time of last data sample as date and time.
- Position (centre of gravity).
- Height above WGS-84 ellipsoid and heave (centre of gravity).
- Velocity in north-east-down components (centre of gravity).
- Course and speed over ground (centre of gravity).
- Attitude with roll, pitch and system heading.
- Status indicators.
- Current time with status indicator.

The right window part shows GPS data:

- GPS time of last position/velocity data.
- Position (antenna no. 1).
- Height above WGS-84 ellipsoid (antenna no. 1).
- Velocity in north-east-down components (antenna no. 1).
- Number of satellites, HDOP and PDOP for position/velocity solution.
- Positioning mode: differential (DGPS) or non-differential (GPS).
- Used GPS: The normal situation is that both GPS receivers are used. If only one GPS receiver is used, the other GPS receiver or its antenna or antenna cable has failed.

- Corr. age: Indicates the age of differential corrections. If Seapath receives no differential correction, the displayed correction age will be high. To show the actual reference stations utilised in the position solution, select the windows **Satellites** or **Correction**. In the upper left of the screen a menu with the actual used reference stations will appear and you are asked to select for which station to show the information.
- Accuracy: Shows the estimated RMS accuracy on the position solution.
- GPS time of last heading data.
- GPS heading with status indicator.
- Number of satellites, measurement error and baseline error for heading solution. The measurement and the baseline error figure shown on the screen **Show GPS, Solution** are only normalised figures and are not the errors measured in metres. If these figures are less than 1, then the system works perfect. A figure less than 2 is normal. If the figure is higher than 2 a significant part of the time this indicates that there are some problems.

Show GPS, Satellites

```
Show GPS  Show corrections  Show Other  Debug
Solution  Satellites  Heading  Tracking
```

```
17 Oct 2000,  08:12’31.962 
Position N 63°26’31.356
         E 10°24’12.196
Height           76.44
Heave             0.00
VelN -0.00  E -0.00 D -0.00
Course  346.2  Speed   0.00
Attitude Roll         0.87
         Pitch       -0.91
         Heading    336.86
Pos/Vel:            Normal
Heave:              Normal
Roll/pitch:         Normal
Heading:            Normal
Sys time 8:12:31    Valid
```

```
GPS1:8 SV 17 Oct 2000,08:12’31.0 GPS RefID50
                 ┌─── L1 ───┐ ┌─── L2 ───┐
SV OK Az El URA T SN UDRA c-o T SN UDRA c-o
18[11]D342↓15.2↓32 Ca 5 2.3 -.50
22[11]D281↓48.6↑32 Ca15 2.3 -.04
30[11]D136↓15.8↓32 Ca 8 2.3 -.66
25[11]D222↓28.2↓32 Ca12 2.2 -.68
17[11]D171↓38.9↑32 Ca18 2.2 -.18
.6[11]D 98↓58.4↓32 Ca15 2.2  .45
24[1] Dm37↓ 5.5↓32 Ca 8 16    14
10[11]D 60↓27.7↑32 Ca12 2.2 -1.1


3   256↑ 1.8↑ —Not tracked —
```

The left part of this window is common for all windows and is described under "Show GPS Solution". The right part shows GPS position fix details:

- Shows the number of satellites used and time of last position/velocity data.
- The following lines show the data for each satellite used in the position/velocity calculation. The first number in each line SV is the satellite identifier. The up and down arrows indicate increasing or decreasing azimuth and elevation.

With the keys PgUp and PgDn you can switch between all combinations of receivers (1 or 2) and reference stations.

Show GPS, Heading

```
Show GPS  Show corrections  Show Other  Debug
Solution Satellites  Heading  Tracking
```

```
MODE: DGPS  Ref Id: 50  Ref Age: 1.0   MRU: OK      Head: -0.03 Hgt:-0.09
RTK Attitudes   17 Oct 2000, 08:12'31.000 GPS       Cog :  0.00 Sog: 0.01
---------------- dn -------------- cnt rms brms slow fast head  hgt (avg)
 18 22 25 17 6   10  3
  9  0-10-12 -7   0 -1             381  5   1   830  815 671  339.05-0.09
  9  0-10-12 -7   0 -1             412  5   1   841  812 957  339.10-0.09









   Baseline  28163  Mean:  2.5025  Std:  0.005
```

This screen picture shows the GPS heading fix details, which are only of interest to service personnel.

Show GPS, Tracking

```
Show GPS  Show corrections  Show Other  Debug
Solution Satellites  Heading  Tracking
```

```
GPS 1 avg S/N 44/33 (filt. 44/31)       GPS 2 avg S/N 45/ 0 (filt. 45/ 0)
                  ┌──────GPS 1 ─────┐ ┌───────GPS 2 ───────┐ ┌─RefID 50─┐
                   S/N   Track time   S/N    Track time Track time
SV   AZ    El    L1   L2   L1   L2   L1   L2   L1   L2   L1   L2
 1   164   69.0  50   36   8134 8125 49        8971      8264 8264
 4   280   52.3  50   34   5881 5880 48        7598      6888 6886
 7   236    8.4                      35        9999
13   217   36.2  46   31   3690 3397 45        4364      3652 3652
19   168   13.0  39   28    427  147 38        1347       587  587
20   117   48.4  47   35   9999 9999 48        9999      9999 9999
24   310   26.5  45   25   2704 2569 39        3421      2488 2487
25    50   29.0  43   31   9578 8613 46        9999      9517 9517
30   352   10.9  40   30   5358  268 40        3381
```

- The first line on this page shows average signal-to-noise level on all satellites for L1 and L2 on both GPS receivers.

- The following lines show track time (continuous time of track without cycleslips) and signal noise ratio for each satellite on both receivers. If a Searef RTK reference station is used, tracking information from the reference station is also shown. If another RTK reference station is used, the track time information will have heading RTCM 18/19 instead of RefID 50.

Show corrections, Rtcm

```
Show GPS  Show corrections  Show Other  Debug
Rtcm  Sbas
```

```
17 Oct 2000,  08:12'31.962       DGPS 4 SV 17 Oct 2000, 08:12'31.0 GPS (RTK)
Position N 63°26'31.356          Station ID50 Status [0] Normal
         E 10°24'12.196          Pos: N 63°26'31.356 E 10°24'12.196 A 49.291 m
Height            76.44              ┌── Iode ──┐┌──── L1 ───┐┌─── L2 ──┐ΔTrop
Heave              0.00          SV Mob Ref Dcc Udre Prc dPrc Udre Prc Dcc
VelN -0.00  E -0.00 D -0.00      18 184 184     4.0 -18.3 .00          -.1 0.0
Course  346.2  Speed   0.00       3  96  96     4.0  11.0 .01          -.0 0.0
Attitude Roll          0.87      22 111 111     1.0 -38.5 .00          -.0 0.0
         Pitch        -0.91      10 214 214     4.0   4.5 .00          -.0 0.0
         Heading     336.86
Pos/Vel:             Normal
Heave:               Normal
Roll/pitch:          Normal
Heading:             Normal       3  96   —Not tracked on reference —
Sys time 8:12:31     Valid       18 184
```

The left part of this window is common for all windows and is described under "Show GPS Solution". The right part shows differential GPS correction details:

- Line one shows the number of satellites used and time of last correction data.
- Line two shows the ID for the selected reference station to be monitored and its status and delay.
- Line three shows the position of the selected reference station.
- The following lines show the data for each satellite used in the position/velocity calculation.

You can switch between the reference stations with the PgUp and PgDn keys.

Show corrections, Sbas

```
Show GPS  Show corrections  Show Other  Debug
Rtcm  Sbas
```

Sv	Fast	Udrei	Age	dx	dy	dz	dClock	Age	IonS	Std	Ion	Trop
16	0.00	14	2	0.0	0.0	0.0	0.0	16			4.6	13.5
17	0.00	14	2	0.0	0.0	0.0	-1.4	16			5.1	15.1
20	1.63	5	2	0.0	0.0	0.0	0.1	12	3.3	0.5	4.1	4.6
24	-0.63	4	2	0.0	0.0	0.0	-0.8	4	2.9	0.4	3.6	3.8
25	-1.60	9	2	0.0	0.0	0.0	-1.0	4	4.1	0.7	4.2	10.5
27	-0.88	5	2	0.0	0.0	0.0	-0.7	4	6.2	0.8	8.2	11.8
131	0.00	14	1	0.0	0.0	0.0	0.0	999			0.0	0.0
15	0.00	14	2	0.0	0.0	0.0	-0.8	16			0.0	0.0
18	0.00	14	2	0.0	0.0	0.0	0.0	12			0.0	0.0
21	0.00	14	2	0.0	0.0	0.0	-0.8	12			0.0	0.0
22	0.00	14	2	0.0	0.0	0.0	0.4	16			0.0	0.0
26	0.00	14	2	0.0	0.0	0.0	0.0	8			0.0	0.0

The colour code describes the following:

Green Seapath is tracking these satellites and SBAS has valid corrections for them.
Yellow The satellites are not monitored by SBAS (Udrei=14).
Red The SBAS system does not use these satellites (Udrei=15).
Grey These satellites are not tracked by Seapath.

The figures in the **IonS** column show the ionosphere correction by the SBAS model and the corresponding standard deviation figure (Std).

The figures in the **Ion** column show the ionosphere corrections for the standard GPS model.

You can switch between the pages of satellites with the PgUp and PgDn keys.

Show Other, Filter

```
Show GPS  Show corrections  Show Other  Debug
Filter  Heave  MRU  Gyro  Serial  About
```

```
17 Oct 2000,  08:12’31.962
Position N 63°26’31.356
         E 10°24’12.196
Height           76.44
Heave             0.00
VelN -0.00  E -0.00 D -0.00
Course  346.2  Speed   0.00
Attitude Roll         0.87
         Pitch       -0.91
         Heading    336.86
Pos/Vel:            Normal
Heave:              Normal
Roll/pitch:         Normal
Heading:            Normal
Sys time 8:12:31    Valid
```

```
17 Oct 2000, 08:12’31.962 Rune time 26101.23
Position accu N  0.009 E  0.007 D  0.014 m
Velocity accu N  0.005 E  0.006 D  0.004 m/s
Attitude accu N  0.008 E  0.008 D  0.021 deg

Position inno N -0.005 E  0.030 D  0.067 m
Phase    inno N -0.003 E -0.002 D -0.006 m
Baseline inno N  0.000 E  0.000 D  0.000 m
Attitude inno N  0.003 E -0.004 D -0.000 deg
Velocity inno N -0.001 E -0.000 D -0.002 m/s
```

The left part of this window is common for all windows and is described under "Show GPS Solution". The right part shows system details, which are only of interest to service personnel.

Show Other, Heave

```
Show GPS  Show corrections  Show Other  Debug
Filter  Heave  MRU  Gyro  Serial  About
```

```
17 Oct 2000,  08:12'31.962
Position N 63°26'31.356
         E 10°24'12.196
Height           76.44
Heave             0.00
VelN -0.00  E -0.00 D -0.00
Course  346.2  Speed   0.00
Attitude Roll         0.87
         Pitch       -0.91
         Heading    336.86
Pos/Vel:            Normal
Heave:              Normal
Roll/pitch:         Normal
Heading:            Normal
Sys time 8:12:31    Valid
```

```
Heave CG  =   0.000 m
Heave Vel =   0.000 m/s

Heave MP1 =   0.000 m, (0.00, 0.00, 0.00)
Heave MP2 =   0.000 m, (0.00, 0.00, 0.00)
Heave MP3 =   0.000 m, (0.00, 0.00, 0.00)
Heave MP4 =   0.000 m, (0.00, 0.00, 0.00)
Heave period 4.19s, sign heave height 0.01 m




Hydrographic survey: period 12s, damping 0.7
```

The left part of this window is common for all windows and is described under "Show GPS Solution". The right part shows heave data:

- The heave position and velocity in the defined vessel CG.
- Heave MP: Shows the actual heave position in the different measurement points (MP) configured in the SCC software.
- Heave statistics with computed heave period and significant heave height (Hs).
- The heave filter mode is selected and the corresponding period and damping, which are configured in the SCC, are shown.

Show Other, MRU

```
Show GPS  Show corrections  Show Other  Debug
Filter  Heave  MRU  Gyro  Serial  About
```

```
17 Oct 2000,  08:12’31.962
Position N 63°26’31.356
         E 10°24’12.196
Height           76.44
Heave             0.00
VelN -0.00  E -0.00 D -0.00
Course  346.2  Speed   0.00
Attitude Roll         0.87
         Pitch       -0.91
         Heading    336.86
Pos/Vel:            Normal
Heave:              Normal
Roll/pitch:         Normal
Heading:            Normal
Sys time 8:12:31    Valid
```

```
17 Oct 2000, 08:12’31.962

Status SY                       10a00001
Angular rate R –0.886, P –1.435, Y –0.832
Acceleration R  0.135, P –0.165, Y –9.831

Innovation   R –0.010, P –0.023       [deg]
Attitude Roll       0.870 deg  Normal
         Pitch     -0.913 deg  Normal
```

The left part of this window is common for all windows and shows the integrated system data as described under "Show GPS Solution". The right part shows the raw data coming from the MRU into the system:

- GPS time of last sample.
- MRU status indicator as mnemonic code and hexadecimal status word. SY means that the MRU receives PPS pulse to synchronise the clock. A code not including SY means that the MRU is NOT receiving the PPS signal and that will cause reduced performance on the heave and roll/pitch indications. See the troubleshooting chapter on how to solve this.
- Angular rate and linear acceleration in the R, P and Y-axes of the MRU.
- Innovation and filtered values in the MRU R and P-axes. These values are only of interest to service personnel.
- Attitude in roll and pitch. The values and the status indications shown here are only for the MRU itself and not an indication of the system performance unless both GPS receivers are not operating.

Show Other, Gyro

```
Show GPS  Show corrections  Show Other  Debug
Filter  Heave  MRU  Gyro  Serial  About
```

```
17 Oct 2000,  08:12'31.962
Position N 63°26'31.356
         E 10°24'12.196
Height             76.44
Heave               0.00
VelN -0.00  E -0.00 D -0.00
Course  346.2  Speed   0.00
Attitude Roll         0.87
         Pitch       -0.91
         Heading    336.86
Pos/Vel:            Normal
Heave:              Normal
Roll/pitch:         Normal
Heading:            Normal
Sys time 8:12:31    Valid
```

```
17 Oct 2000, 08:12'31.962

Gyro heading      335.17

System heading    336.86
Deviation          -0.21

Calibration value   1.69
Offset              1.69
```

The left part of this window is common for all windows and is described under "Show GPS Solution". The right part shows external gyro data:

- GPS time of last gyro data sample.
- Gyro heading.
- Seapath system heading.
- Deviation of gyro heading from system heading. The gyro heading is corrected for offset (short-term bias) before calculating the deviation.
- Gyro calibration value. Long term gyro bias calculated since system start-up.
- Offset. Short term gyro bias.

Bias calculations are described in chapter 4.2.1.

Show Other, Serial

```
Show GPS  Show corrections  Show Other  Debug
Filter  Heave  MRU  Gyro  Serial  About
```

```
24 May 2000,  08:12’31.962
Position N 63°26’31.356
         E 10°24’12.196
Height           76.44
Heave             0.00
VelN -0.00  E -0.00 D -0.00
Course  346.2  Speed   0.00
Attitude Roll        0.87
         Pitch      -0.91
         Heading    336.86
Pos/Vel:            Normal
Heave:              Normal
Roll/pitch:         Normal
Heading:            Normal
Sys time 8:12:31    Valid
```

```
    Serial data is printed in this window
    for the selected channel: COMx
```

The left part of this window is common for all windows and is described under "Show GPS Solution". The right part shows serial line I/O. The data are printed as a continuous string. ASCII characters are printed in their normal representation. Other characters are printed in their graphical representation in the IBM PC character set. Non-printable characters are printed as dots. Input and output characters are distinguished with different colours.

Show Other, System

```
Show GPS  Show corrections  Show Other  Debug
Filter  Heave  MRU  Gyro  Serial  About
```

```
Software:
   Seapath 200 v. 2.03.a  2004-03-03      13:20:22
   Options 0020604
MRU:
   MruType 5   SwVer 3.30   SerNo 1403  Modus Normal  VerString MRU_3.30
GPS receiver 1:
   Ashtech G1,GH00,TT0PU-IL-GM_C_
GPS receiver 2:
   Ashtech G1,GH00,TT0PU-IL-GM_C_
```

- This window shows the software version and options on the different parts of the system.

Debug

```
Show GPS  Show corrections  Show Other  Debug
Threads  Async  Log  Timedelay
```

CAUTION

The functions on the Debug menu are for service personnel only, and should not be used unless you are instructed to do so. Changing any of the flags and functions on this menu can degrade the performance of the Seapath 200.

Each of the menu selections include the following functions:

Threads:
Indicates the status of the different processes in the system.

Async:
Outputs the data stream in the system on the screen.

Log:
Logs data to file. By pressing RETURN on this selection logging starts and the indication "^{1}Log" is then shown in the menu. By pressing RETURN once again the following logging stops. The logging option is recommended used only when instructed by Seatex to do so. In Appendix B it is described how to transfer the logged data to an external computer through the Ethernet.

Timedelay:
Outputs the following time delays in the system:

- RawMruData
- SatMeasData [0]
- SatMeasData [1]
- GpsPosition
- GpsHeading

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Appendix B – Logging of diagnostics data

In the Seapath it is possible to log raw diagnostics data to troubleshoot the system. The logged files have to be transferred to service personnel at Kongsberg Seatex for processing.

From version 2.0.3.00 of the Seapath software logged data can be transferred to an external computer through the Ethernet port. This chapter describes how to start logging to file and how to transfer the logged data to an external computer through the Ethernet port by use of FTP.

The procedure for enabling data logging and transfering the data from the Processing Unit is as follows:

1. Before starting transfer of data ensure that the Ethernet port is correctly set up. Connect an external PC with the SCC configuration software installed. In SCC enter the Configuration Folder List and select **Data Interface \ Network Common**. Proceed as follows to set the common network parameters:

- In the **IP Network Address** field, enter the port ID. Default is 192.168.1.10. If the Seapath is already connected to the network on board the vessel, then no change in the IP address is required to use FTP.

- In the **IP Network Mask** field, input the mask. Default is 255. 255. 255. 0. If the Seapath is already connected to the network on board the vessel, then no change in the IP mask is required to use FTP.

- In the **FTP Server Password** field, input wanted password to get access to the FTP server. The default password is "seapath". This password is typically needed when transferring Seapath log files through the Ethernet to an external computer. The FTP client software will ask for this password.

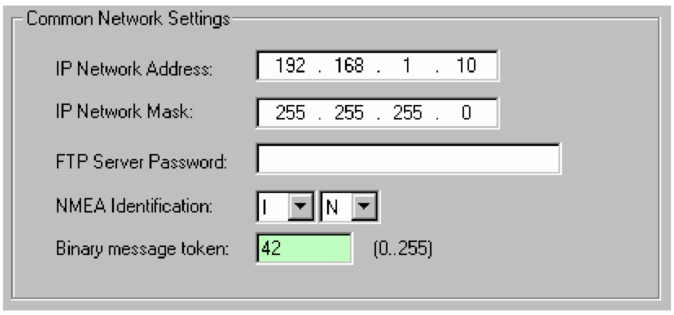

Figure 14 Common Network Settings

Check with the network administrator on board the vessel for the correct selection of network address and mask.

2. In the Seapath Display Window, go to **Debug** menu and move the cursor to Log, as shown in Figure 15 below, and press Enter. This will start the logging, and keep it active until it is stopped by the same procedure, or the system is restarted.

```
Show GPS  Show corrections  Show Other  Debug
Threads  Async  Log  Timedelay
```

Figure 15 The log option in the Debug menu

3. When the logging of data is stopped, proceed as follows to get contact with the Seapath FTP server: The procedure below uses basic FTP command lines in a DOS window. Any FTP server can be used for this purpose e.g. the freeware FTP server called GuildFTPD. This one is available on http://www.guildftpd.com. If no other FTP client is available other than FTP commands from a DOS window, then proceed as follows:

- Start a DOS window on the external PC which is supposed to receive the logged data. Proceed as follows by writing the text in red in the DOS window:

:\>**ftp**
ftp>**open**
(to) **x.x.x.x** (default is 192.168.1.10)
(user) **xxx** (default is "**???**")
(password) **xxx** (default is "**seapath**")

- The logged data is binary files and will be named *.ib. The files typically have the following names:

  mmddhhmm.ib
  monthdayhourminute.ib

- Transfer the logged data from Seapath to the external PC by typing:

ftp>**bin** (to tell the FTP client that the files to be downloaded are in binary format))
ftp>**mget *.ib** (transfers all the log files available in the folder with extension *.ib. It may take som time to transfer all the files).
ftp>**get setup** (transfers the Seapath setup file)

- To ensure maximum storage capacity on the Seapath hard disk, always remember to delete the logged data files after file transfer. This is performed in the following way:

ftp>**mdelete *.ib** (delete transferred log files from the Seapath hard disk)

- Finally, disconnect the FTP connection by writing ftp>**close**.

The logged data files (*.ib files) and setup file are sent to Kongsberg Seatex for analysis.

FTP = File Transfer Protocol (RFC 959)

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