Signature VM Coastal & Ocean - Manual

NORTEK

Contents

1 Introduction

1.1 Introduction

This manual is designed to help users of Signature VM get familiar with the Signature VM system and the accompanying Signature VM Acquisition software

*A Signature sensor marked as 'Signature **VM**' (with bottom track firmware) cannot be programmed with the 'Signature Deploy' software! Use only the Signature VM Acquisition software.*

Nortek online
At our website, http://www.nortekgroup.com, you will find technical support, user manuals, and the latest software and firmware. General information, technical notes and user experience can also be found here.

Nortek FAQ
The Nortek Support website has an FAQ section. Here you can find short articles that answer some common questions about our instruments, and related topics.

Your feedback is appreciated
If you find errors, omissions or sections poorly explained, please do not hesitate to contact us. We appreciate your comments and your fellow users will as well.

Contact Information
We recommend first contacting your local sales representative before the Nortek main office. If you need more information, support or other assistance, you are always welcome to contact us or any of our subsidiaries by email, phone or fax.

Email: support@nortekgroup.com (for technical support questions)
Phone: +31 88 6543700

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                                              2132 XX Hoofddorp
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Table 1: Revision history - Manual N3015-026

Version	Date	Supports software version	Notes
Version 2.10	oct-2024	2.10	Support file; manually check for updates
Version 2.9	jul-2024	2.9	Echosounder functionality reworked
Version 2.8	apr-2024	2.8	Various extra trigger options; NTP as an optional time-source
Version 2.7	sep-2023	2.7	Layer; automatic instrument alignment; mounting offsets diagram
Version 2.6	apr-2023	2.6	Section on measuring a (noise) spectrum; removed details on older hardware (see section "Earlier versions of the hardware" [10] for details).
Version 2.5	dec-2022	2.5	
Version 2.4	jul.2022	2.4	
Version 2.3	23.feb.2022	2.3	
Version 2.2	02.11.2021	2.2	
Version 2.1	25.03.2021	2.1	
Version 1	11.04.2018	1.5	Initial release

1.2 Health and Safety

CE	The system is designed and produced to comply with the council directive of 2014/108/EC relating to electromagnetic compatibility. The design is according to RoHS II directive 2011/65/EU
	The mark on the left is in compliance with the Waste Electronic Equipment Directive 2012/19/EU (WEEE). It is a requirement NOT to dispose of the equipment as unsorted municipal waste but to use the return to collection systems according to local law or return to the Nortek facilities.
7 POM	Relevant plastic parts on the Signature sensor are marked for end-of-life recycling (Directive 2008/98/EC on waste)
⚠	Use the following safety guidelines to help ensure your own personal safety and to help protect your equipment and working environment from potential damage. **Data usage limitations** The Signature VM system is not to be used for navigation or for any purpose relating to safety at sea. **General Power Safety for the 4414 Interface unit and Computer** Observe the following guidelines when connecting your equipment to a power source: • Check the voltage rating before you connect the equipment to an electrical outlet to ensure that the required voltage and frequency match the available power source. • Do not plug the equipment power cables into an electrical outlet if the power cable is damaged. • To prevent electric shock, plug the equipment power cables into properly grounded electrical outlets. Do not use adapter plugs that bypass the grounding feature or remove the grounding feature from the plug or adapter. • Do not operate your equipment with any cover(s) removed. • Unplug this apparatus during lightning storms or when unused for long periods of time. • Do not expose the unit to rain or an environment where it may be splashed by water or other liquids, as doing so may result in fire or electric shock. **System Safety** • The system is designed to be used on a moving vessel. Make sure that all parts are well secured, and nothing can come loose when exposed to heavy vibrations or sudden movements which may occur aboard a vessel. **Safety when installing and operating the Signature VM Sensor** • When mounting the Signature sensor on any vessel or other platform, be careful to follow proper precautions and safe-work procedures as applicable to working with medium-weight, long, unwieldy material (work-gloves, helmet, and if on-board, possibly lifejacket). • Ensure that nothing rests on your equipment's cables and that the cables are not located where they can be stepped on or tripped over.

2   Scope, disclaimer, and pending changes

2.1   This manual

This manual describes the Signature VM product, in particular the Signature VM software.

Please be aware that the Signature VM is a product family. Different products in this family use or can use different versions of the Signature VM sensor.

Many figures in this manual depict a Signature sensor that may be different from the sensor you purchased. In particular, most figures depict a Signature 1000. Other versions of the sensor may have a different number of transducers, a different size of the transducers, and, for some, different connectors and a different number of connectors. In most cases, the details of the sensor are not the essence of the figure. You can check exact details for the sensors on the specific instrument data sheets, available for download from our website[7] (as mentioned in the Introduction[7]).

We keep adding to and improving existing products of the Signature VM product family. We will keep updating the Signature VM manuals in future releases, and from time to time restructure them.

2.2   Earlier versions of the hardware

This manual describes the latest version of the hardware (the processing unit, and the interface box that is part of it) and the latest software.

We do realize that you might have an earlier version of the hardware. Should you need a manual that describes such earlier versions of the hardware, these can still be obtained in PDF format. Please be aware that earlier manuals also describe the corresponding earlier versions of the software. There may be cases where you need an earlier version of the manual for the hardware, and the latest version of the manual for the latest software.

Although we no longer mention the earlier hardware in this manual, the software does still support this earlier hardware.

3 System Overview

The Signature VM system is a highly integrated system with the sole purpose of accurately measuring vertical profiles of the water's velocity and direction from a moving platform.

Velocity of the water is measured using a Signature series sensor. The Signature sensors are advanced four- or five-beam current profiling systems. Built on the advanced AD2CP platform, they are designed for unprecedented performance in high energy turbulent environments. The Signature also measures its own speed and direction across the bottom of the channel using a technique known as 'bottom tracking'.

Position and movement of the moving platform (usually a vessel) is recorded using a high precision Global Navigation Satellite System (GNSS) receiver, which also provides accurate timing. By combining the measured movements from both the GNSS and bottom track it is possible to correct the measured water velocities for the movement of the platform itself.

A dedicated computer system with Signature VM software collects the data, takes care of accurate timing, and continuously monitors the quality of the data. Since no additional data from any external sensors is required and the computer comes fully configured, the whole system is basically 'Plug and Play'.
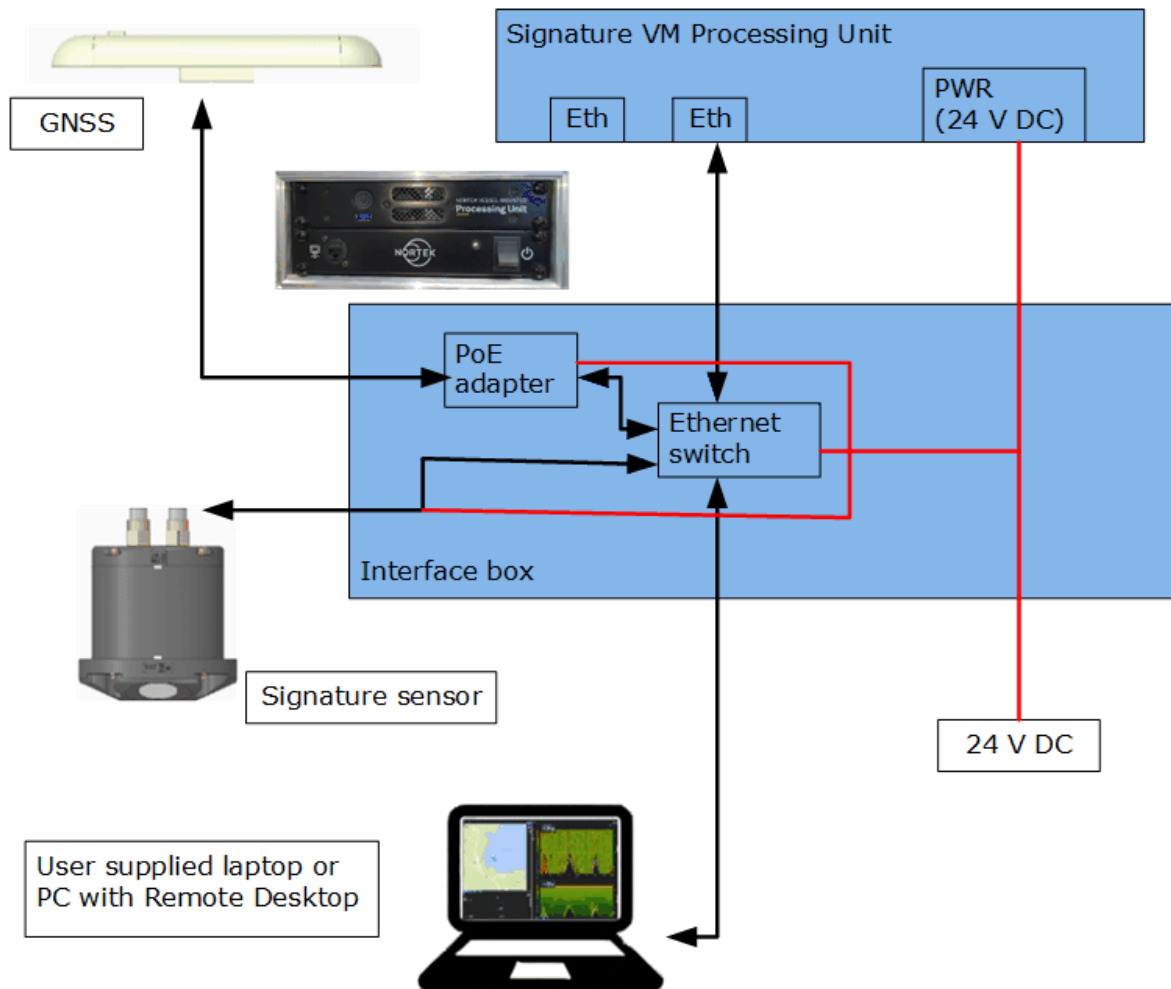
Figure 1: Complete system

3.1 Signature AD2CP Sensor

The figures below show the Signature 1000 system but can be translated easily to any of the Signature sensors like the Signature 500, 250, 100 and 55. The Signature 1000, 500, 250 and 100 sensor heads have five acoustic transducers, four slanted at 25 or 20 degrees from vertical,

and a fifth vertical beam. For dimensions, please refer to the specific instrument data sheet, available for download from our website.

The pressure sensor, temperature sensor and LED light are all visible from the outside. Also note the beam configuration, with beam one pointing in the positive X-axis (see the engraved axis definition on the head)
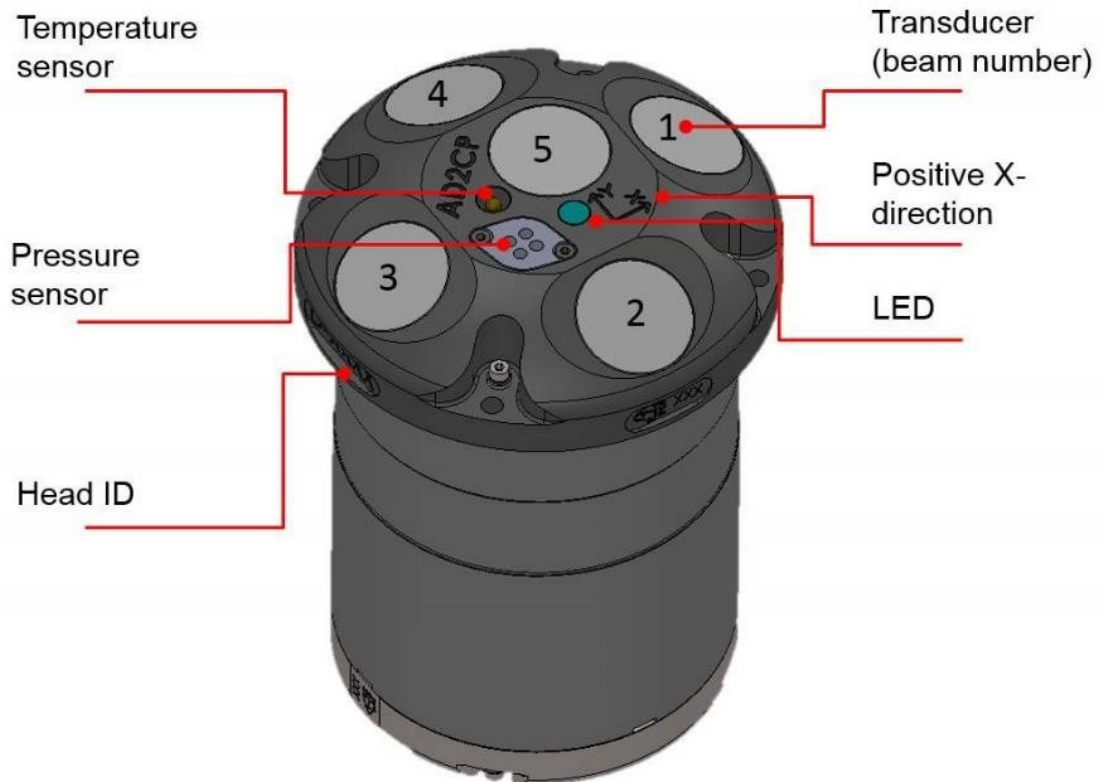
Figure 2: Signature Transducers and sensors

For more details on the Signature Sensor itself, please refer to the Signature Manual, as available on the Nortek group website:
https://support.nortekgroup.com/hc/en-us/categories/360001447411-Manuals

3.2 GNSS Receiver

Figure 3: GNSS - Receiver

The Advanced Navigation Global Navigation Satellite System (GNSS) receiver is a fully integrated, certified navigation and heading solution. It provides high accuracy position, velocity and heading information and does not require any calibrations or setup. It can provide accurate heading even during GNSS outages (for up to 20 minutes). This is possible because of the INS (Inertial Navigation System) integration in the unit. The antenna is equipped with two internal GNNS receivers and its heading is not subject to magnetic interference. The vessel does not have to move to provide an accurate heading.

The built-in PTP (Precision Time Protocol) server provides an accurate timing reference for the whole system. The GNSS is powered through the Ethernet cable. For more details on the GNSS Sensor itself, please refer to the User Manual, as available on the Advanced Navigation Website: https://www.advancednavigation.com/product/gnss-compass. This page also holds the latest firmware release.

3.3   Data acquisition system

Figure 4: Signature VM Data acquisition and interface

Data is collected using a computer running the 'Signature VM' software. The Signature VM interface box provides all necessary connections and power to the individual instruments. The complete system is mounted in a ½ width 19" rack. It can be controlled using a local keyboard and monitor, or from a remote location over Ethernet.

4   Getting Started

This chapter deals with installation of the accompanying software, connecting to the instrument and other information that is important for first time use of the instrument.

4.1   Checking the Inventory

Check the content of the received package against the packing list included in the shipment. Do not hesitate to contact us if you find any part of the delivery missing.

4.2   Signature VM Software

The Signature VM software is under continuous development, so it is advised to check on a regular basis if a new version is available. Note that a decent internet connection is required for checking and possible downloads.

The software automatically checks every 30 days if an update is available. A manual check can be done through the Software section in the Settings menu. The software will check for software, GNSS firmware and Signature firmware updates.

4.3   Interface

The Signature VM interface provides power to the Signature sensor and GNSS and has all necessary interconnections between the different parts. Version 3 of the interface is only available in the 24 V DC version.

4.3.1   24 V DC Version

The 24 VDC version is powered through a 3 Pin XLR connector. Use a suitable power lead with a 3-pin female XLR connector. (Neutrik model NC3FXX-B)
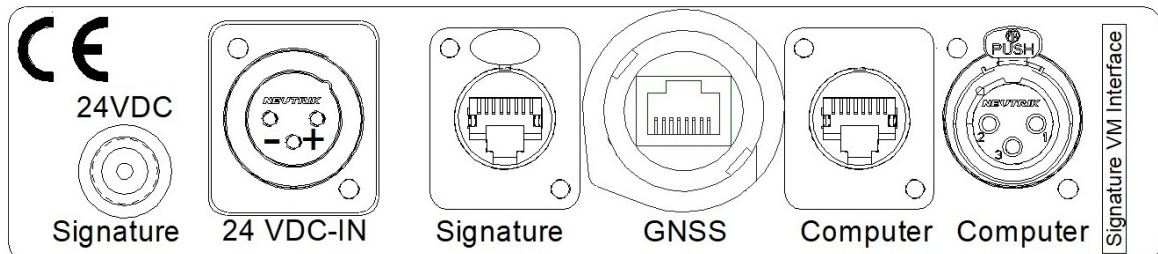
Figure 5: Rear panel connections. 24 VDC version
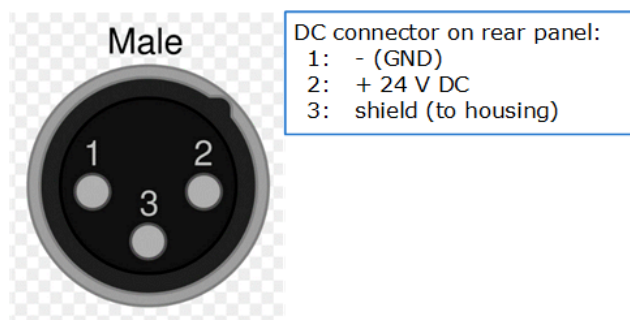
Figure 6: 24 V DC Connector pins

The unit is reverse polarity protected, so reversing the power lines will not damage it. Units built before 2020 have a fuse on the rear-panel, later models have an internal, resettable fuse.

The unit will work with any voltage between 9 and 36 VDC, but 24 VDC is preferred. When using 12 VDC, current surges of up to 1.5 A may occur, so the required power lines should have a low ohm's resistance.

4.4 Connecting the parts

A Signature VM system basically consists of three parts: a Signature sensor, a GNSS and a computer. The interface box contains all necessary interconnections and power supplies for the other parts.
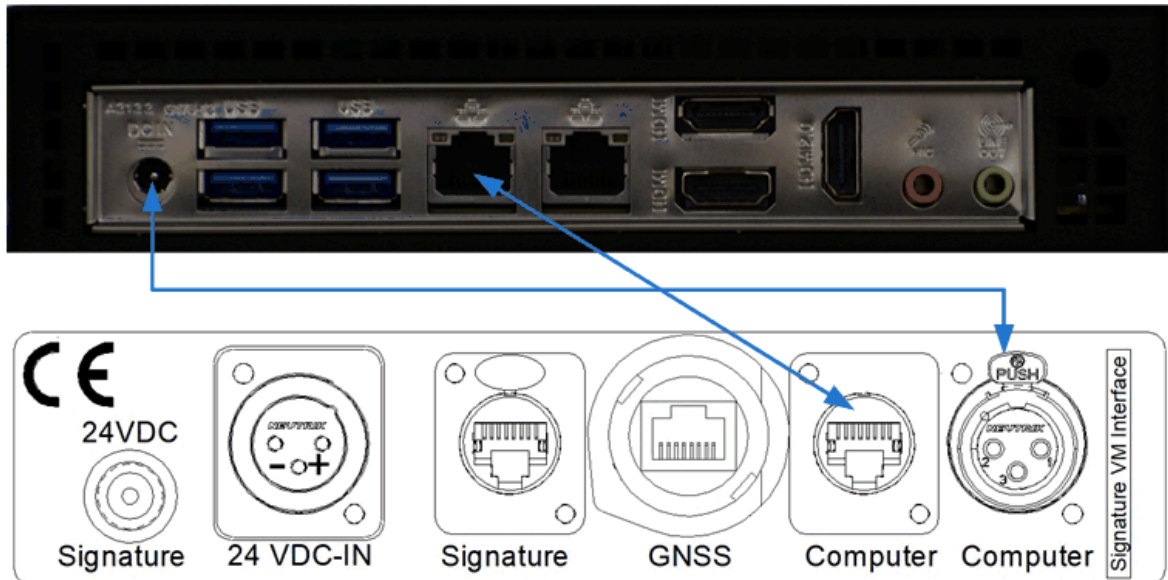
Figure 7: Connecting the interface (Version 3) to the PC

Note that only one ethernet port on the PC is configured to connect to the Signature VM Interface. The system will not work if this is connected to the wrong port!

The second ethernet port may be connected to the local network and is only used to access the internet.

4.4.1 Connecting the Signature Sensor

The Signature sensor is connected through its Ethernet interface. This is the 6-Pin connector on the sensor. The 8-Pin connector is not used in this configuration and should be fitted with a 'dummy' connector.
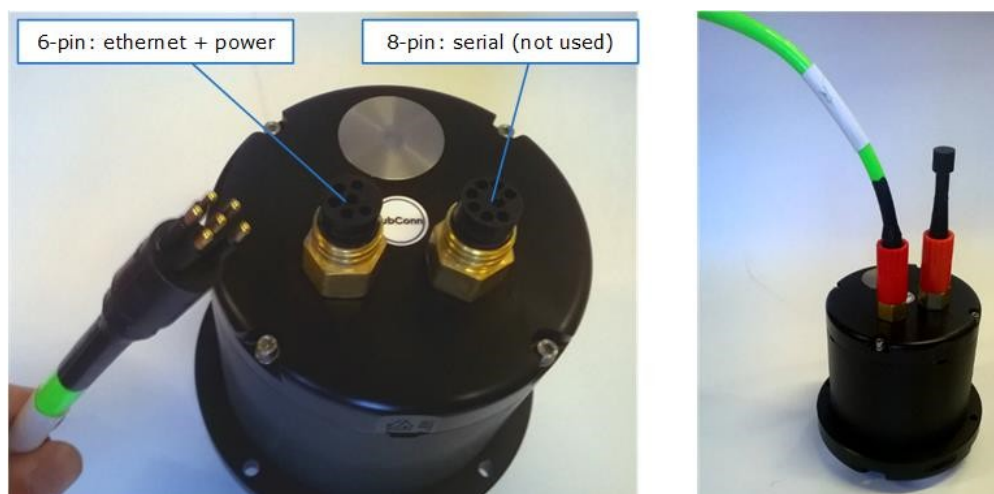
Figure 8: Signature Sensor connections

When mating the SubConn connectors pay attention to the following guidelines:
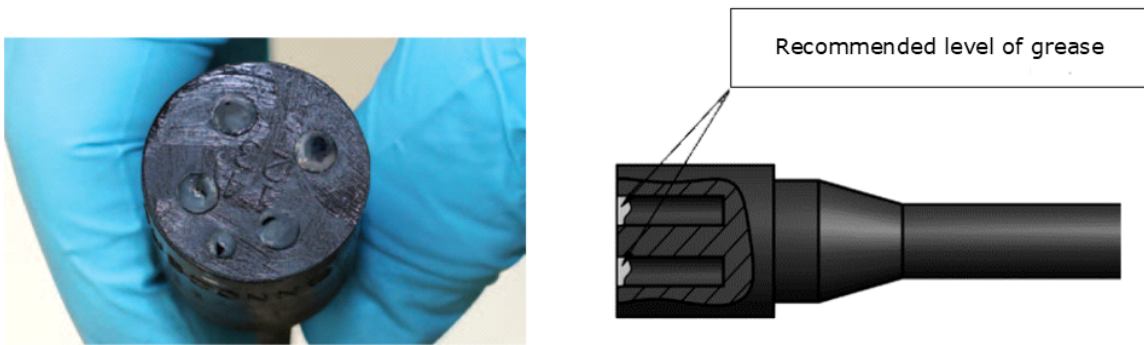
Figure 9: Greasing the connector

- Connectors must be greased with Molykote 44 Medium before every mating. A small amount of grease is supplied with the system.

- A layer of grease corresponding to minimum 1/10 of socket depth should be applied to the female connector

- The inner edge of all sockets should be completely covered, and a thin transparent layer of grease left visible on the face of the connector

- After greasing, fully mate the male and female connector to secure optimal distribution of grease on pins and in sockets

- To confirm that grease has been sufficiently applied, de-mate and check for grease on every male pin. Then re-mate the connector

The other end of the power-signal cable has a metal shield Ethernet connector that fits the connector on the rear of the box. Insert the connector until it clicks into lock. To release the connector, press the 'PUSH' lever and gently pull the connector housing.

The standard Signature cable comes with a simple jack plug. On the interface that power is supplied through a DC-Power plug with locknut. An adapter cable is supplied to connect the standard Signature cable to the interface. Lock it by tightening the nut.

Figure 10: Signature Power and data connection

4.4.2 GNSS Connection

The GNSS is supplied with a 20 m Ethernet cable. One end has a small plastic connector with a bayonet lock which goes to the GNSS unit.

When connecting first check the orientation of the Ethernet connector. Then push in while holding the plastic locking-ring. Push the ring while turning it clockwise until it clicks to lock. It is a bayonet lock, so it should not need more than a 30~40 degrees rotation. This may take considerable force, and it is best to use the supplied 'Connector wrench'.
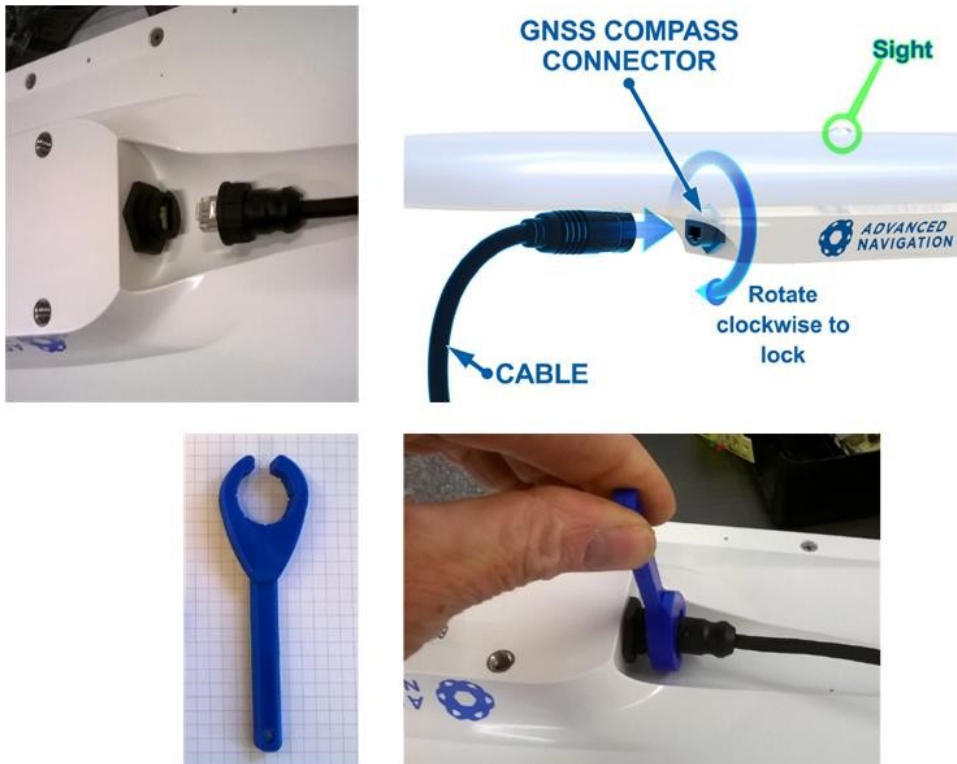
Figure 11: Connecting the GNSS connector

The other end of the cable has a large plastic Ethernet connector that fits the one on the rear of the interface box. This bayonet lock may be difficult to lock when new.
Power to the GNSS is supplied through the Ethernet cable, so no additional power connection is needed here.

Figure 12: Connecting the GNSS to the interface

4.4.3 Computer connections

Next to the GNSS connector is the main Ethernet port and a power connection. Both must be connected to the Signature VM computer.
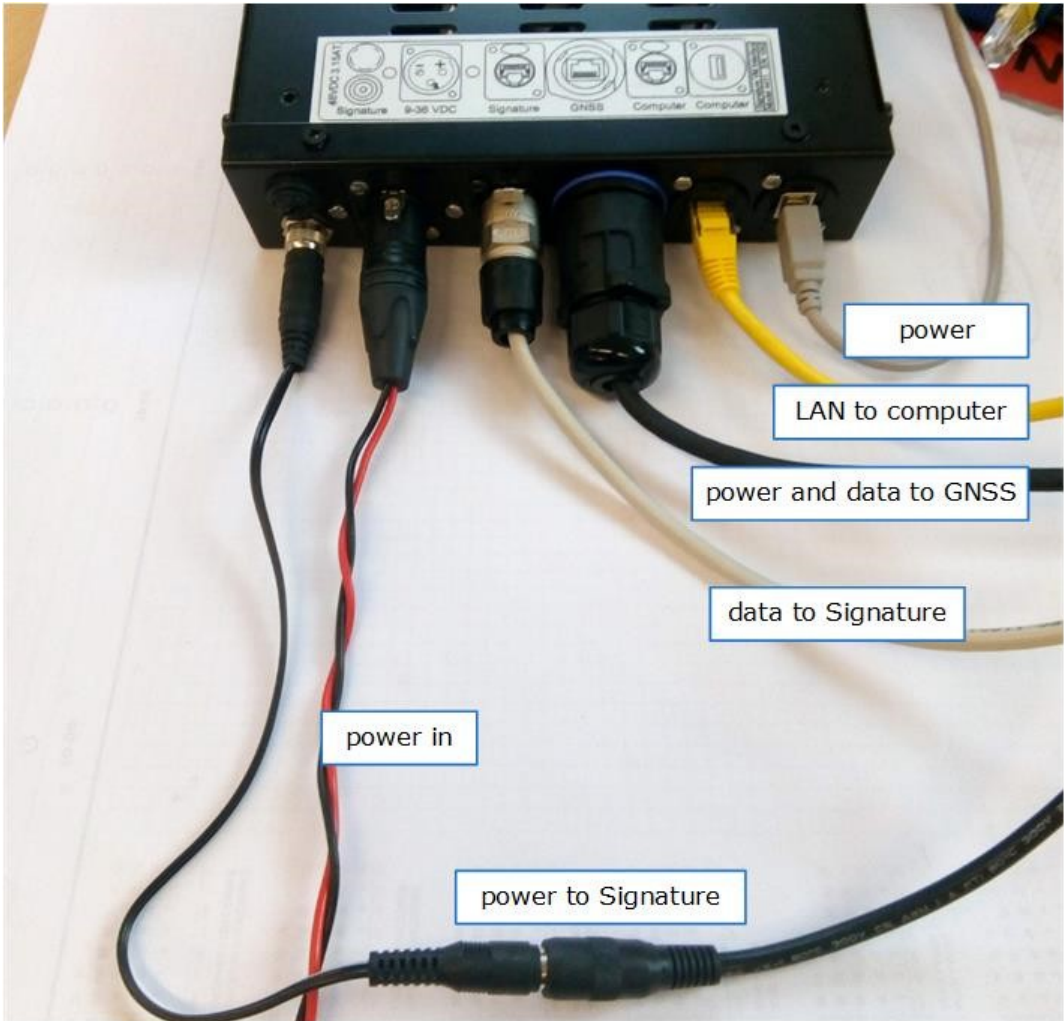
Figure 13: All interface connections.

4.4.4 Power On

Switch on the interface first, then switch on the computer by pressing the main button on the front-panel for a second and then releasing it.

The processing unit is powered from the interface, so the interface should be ON before switching the processing unit on.
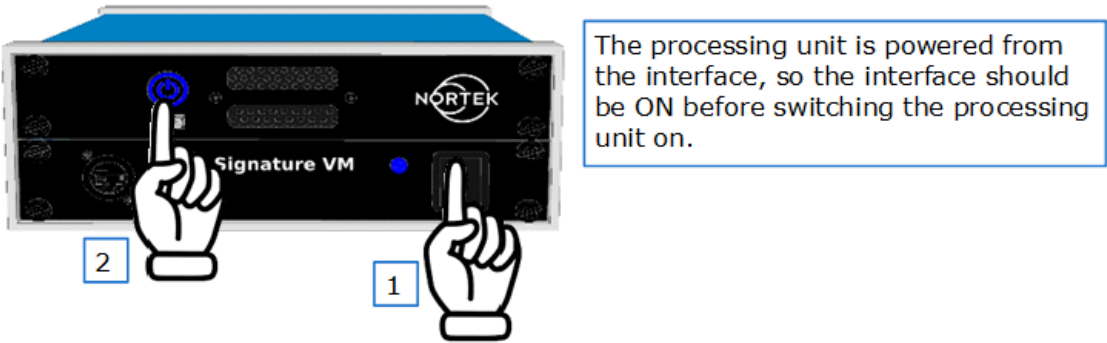
Figure 14: Switching the system on.

4.4.5 Power Off

When powering the system off, first switch off the computer using the 'power down' menu, or by using the switch. Then switch off the interface.

4.4.6 Connecting to the Computer

Though it is possible to connect to the Signature VM PC using a keyboard/mouse/monitor, the general idea is to use a remote desktop connection from a laptop. (Not supplied with the system.)

Any computer that can run the Remote desktop client can be used to connect to the system. Remote desktop clients are available for Windows, Macintosh, and Linux.

The client computer can be connected to the Ethernet connector on the front panel of the interface and configured as follows.
(Note: figure 15 [21] shows a configuration example for Windows 10.)

- First make sure the Ethernet adapter is configured to 'Obtain an IP address automatically'. (Control Panel->Network and Internet->Network Connections; see figure 15 [21].)

- Now connect the client computer to the interface, and then open 'Remote Desktop'. (Hit the 'Windows' key, and just type 'remote desktop'.)

- The address of the Signature VM PC is fixed to 192.168.100.1. The username is 'SurveyVM'. You can now click 'Save As' to save this connection for later. (See figure 16 [22].)

- Click connect. If all is correct, a popup will appear asking for the password. The password is 'SurveyVM'. Once connected the screen of the Signature VM computer will appear (see figure 17 [22]).

- You can select between a 'Light' or 'Dark' desktop by pressing the Windows-Key and typing: themes. In the themes settings menu you can now select the theme you like best. (See figure 18 [23].)
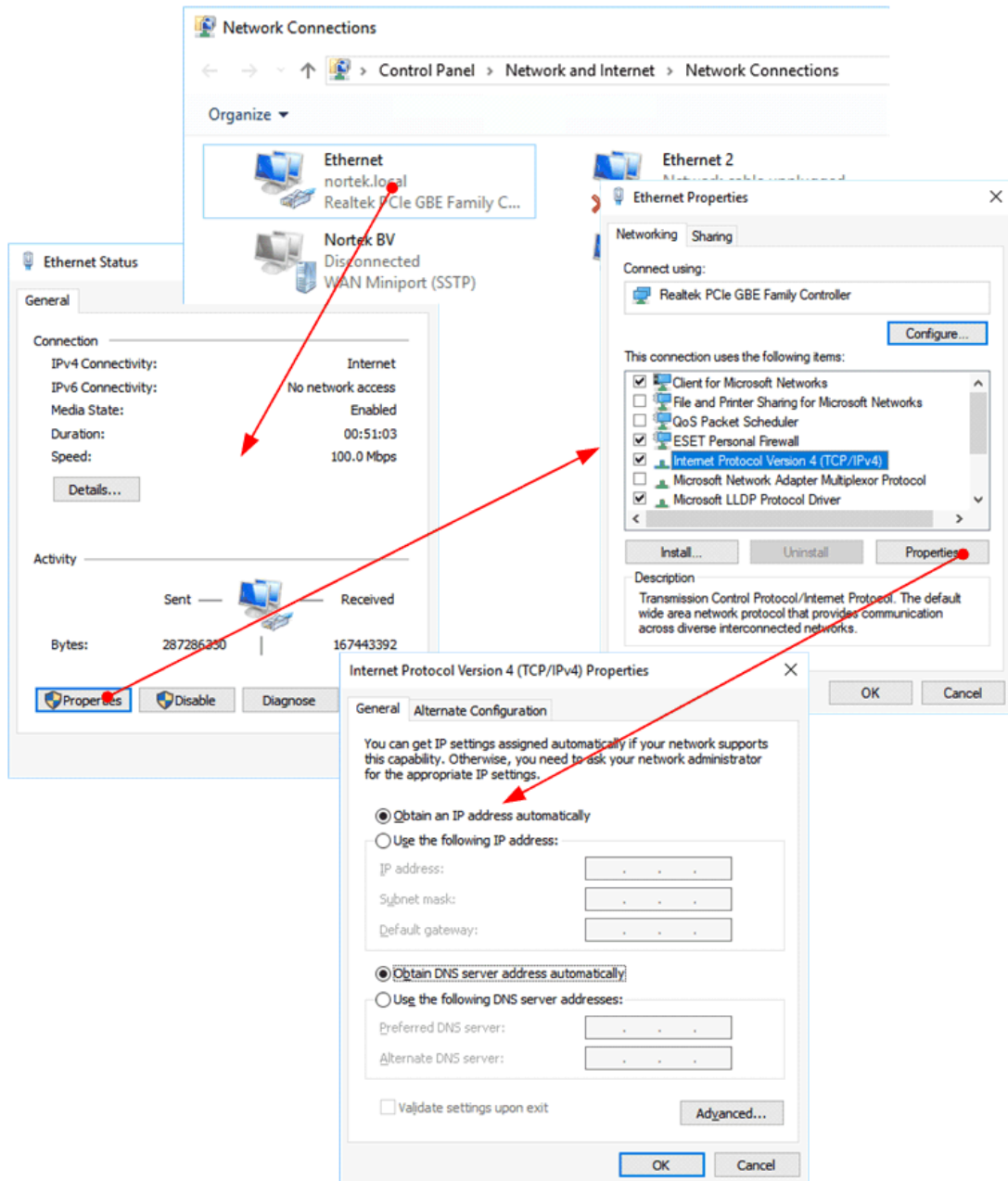
Figure 15: Configuring Windows for use with the Remote Desktop connection
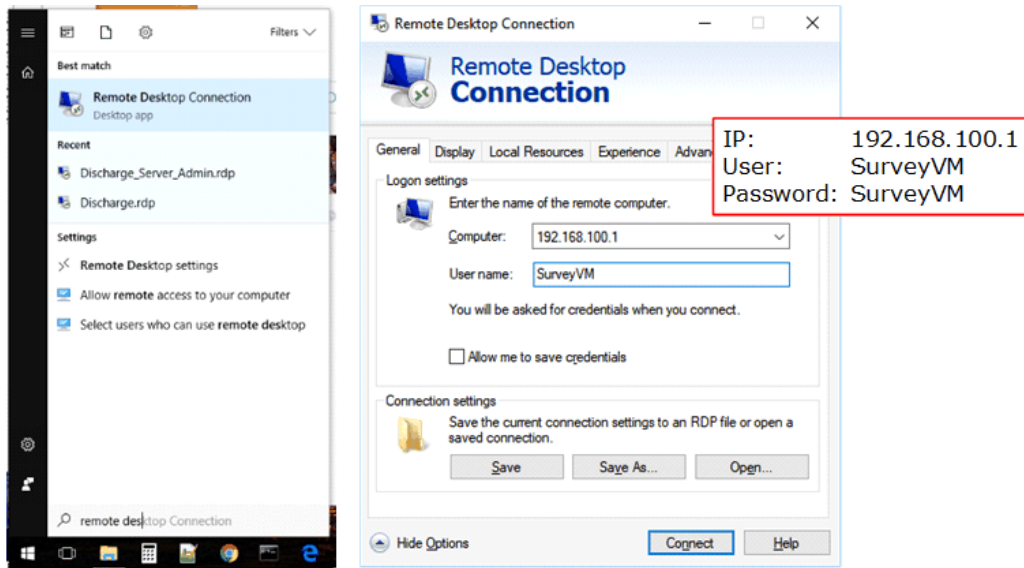
Figure 16: Setting up Remote Desktop
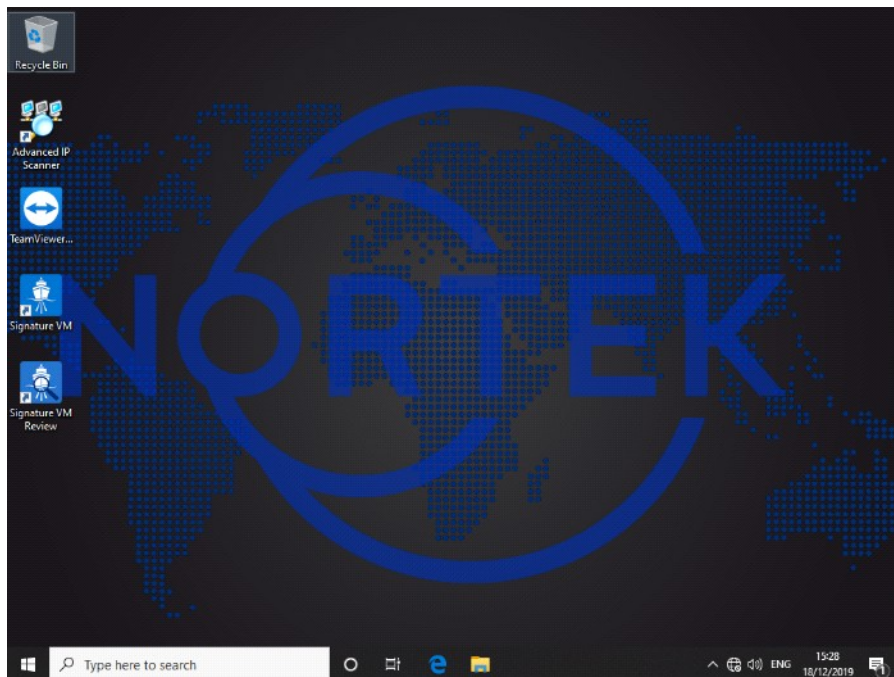
Figure 17: Dark Theme
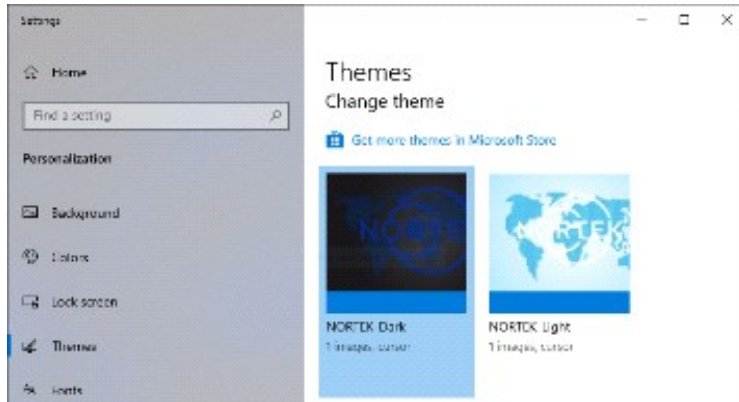
Figure 18: Desktop theme selection

5   Acquisition Software
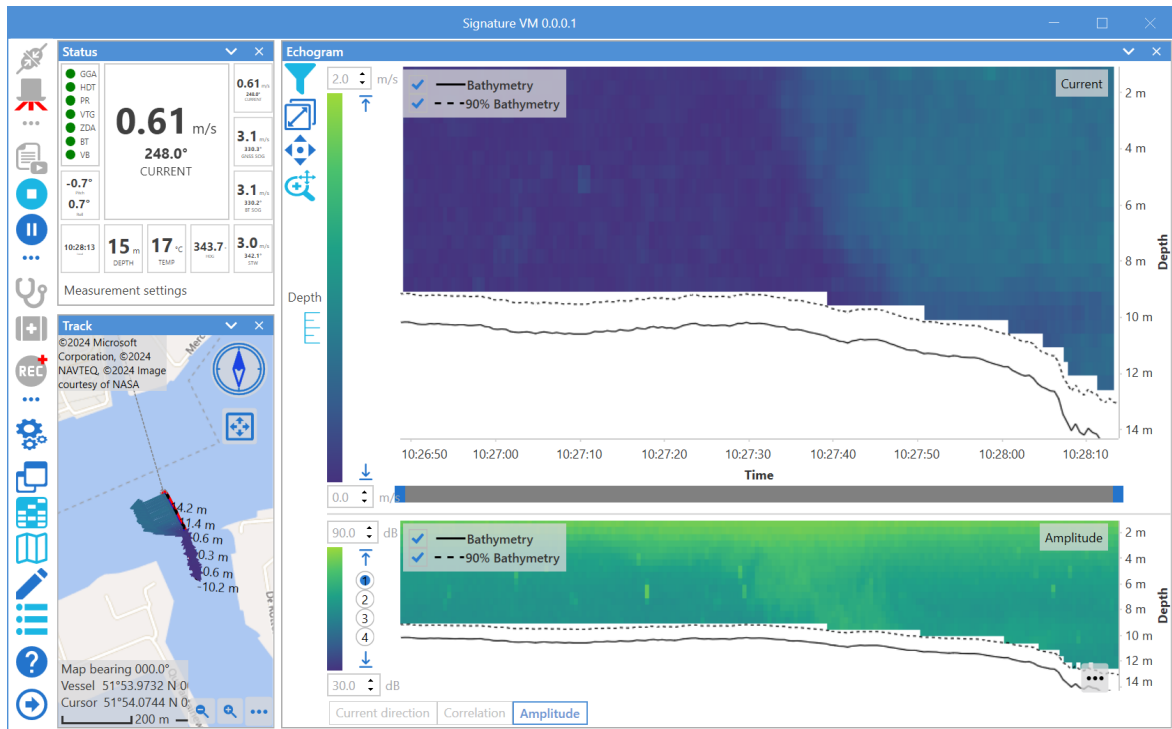
Figure 19: Signature VM software main window

Once everything is connected, start the Signature VM software. Each window may be moved, rescaled, or closed if required. To recover a window, or to reset the screen layout to defaults, click on one of the five window recovery buttons in the lower left. Clicking the appropriate button will bring up the related window, or you can click 'Restore Layout' to get back to default. When a certain window is hidden, the corresponding button has a lighter color.

The main task bar (see the close-up in figure 20 [25]) is on the left. This contains the controls for starting and stopping the measurement, changing the settings, replaying data, as well as buttons to show and hide windows.
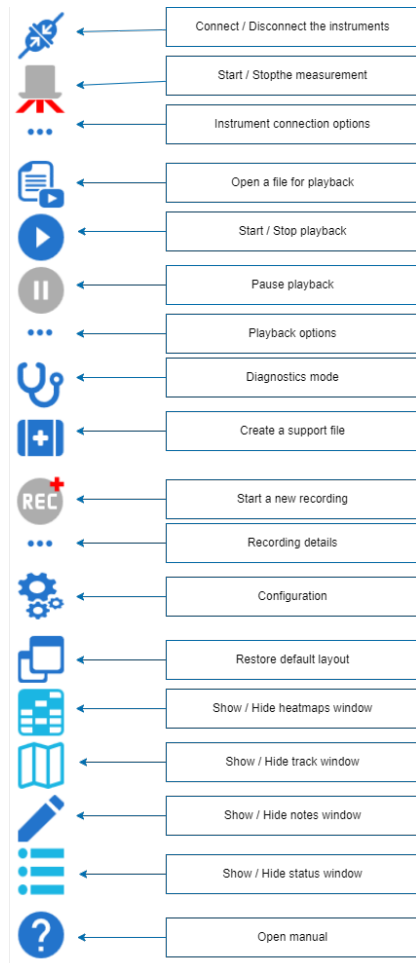
Figure 20: Taskbar explained

5.1   Connecting the GNSS

The instrument connection options appear when clicking the 'three dots' button in the instruments section of the task bar.

Make sure the adapter shows 'SurveyVM Interface' .

Click 'Connect' to start reading the GNSS data. The IP Address and Port box will turn grey and the button text will change to 'Disconnect'.
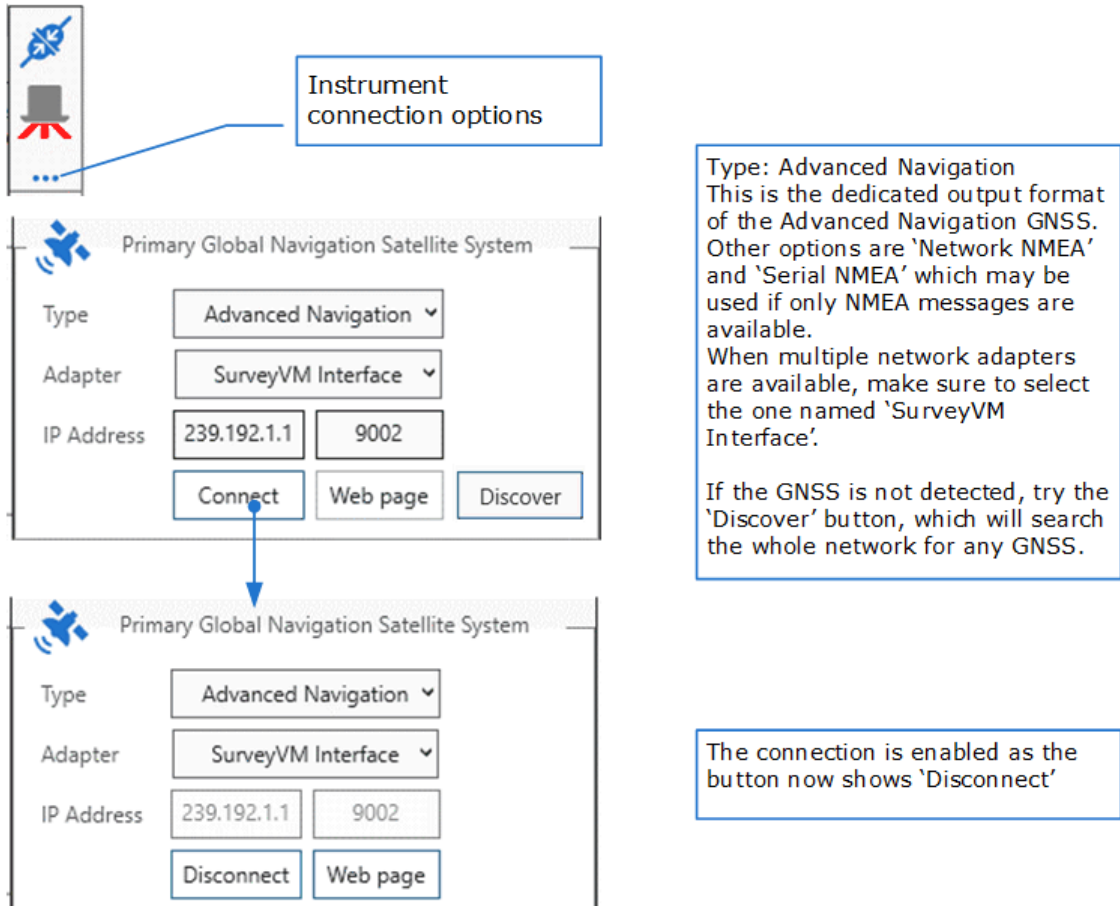
Figure 21: GNSS Connection

5.2 Checking the GNSS

Once the GNSS is connected, click on 'Web page'. This will open the internal web-interface page of the GNSS Sensor (see figure 22[26]).
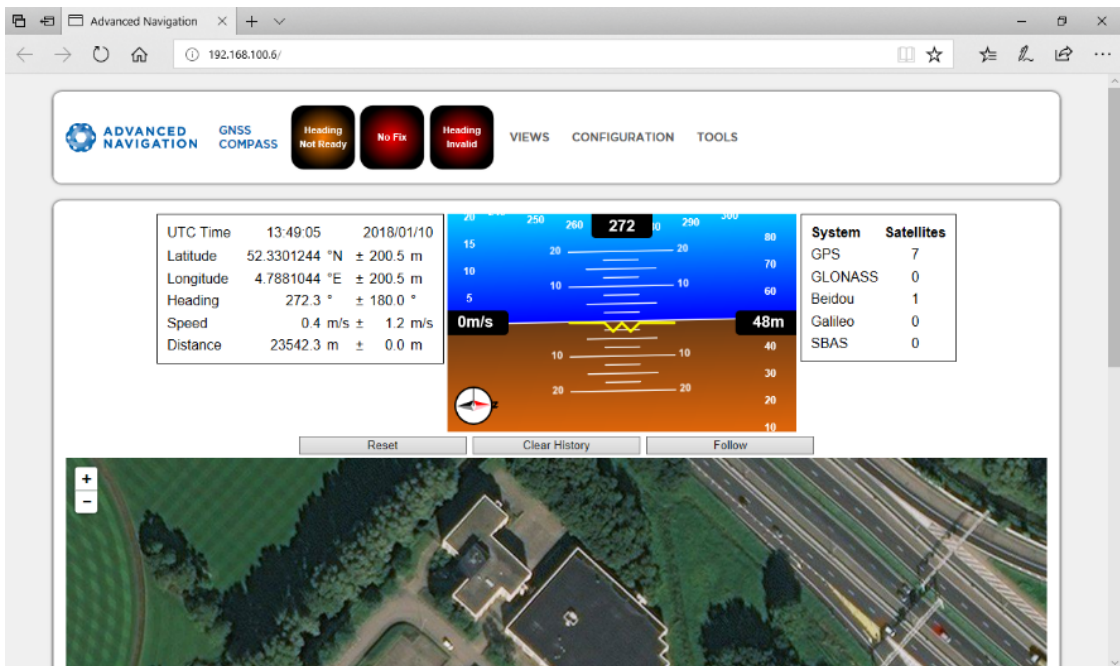
Figure 22: GNSS WEB interface

It is important that the GNSS is fully functional and has a correct position and heading, so make sure all markers in the top row are green.
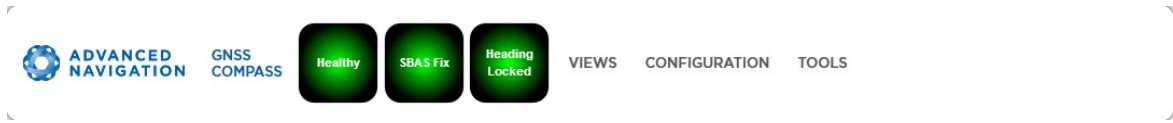
Figure 23: GNSS indicators should be all green

Note that this may take a while, especially after the system has been moved to a different location. Also, the antenna should have a real clear view of the sky to achieve a faster lock. Refer to section "GNSS Mounting"[76] for details on mounting the GNSS antenna. The map is only visible if the computer is also connected to the internet.

5.3   Connecting the Signature

Next select the Nortek Sensor Communication (see figure 24[28]). When the program is started it will automatically search for any Signature Sensors on the network. In general, there will be only one, so when the sensor settings appear it will show the serial number of the attached sensor.

Click 'Connect' to start the Nortek sensor. The address / serial number box will turn grey and the button text will change to 'Disconnect'.

The contents of the dialog box will change: options for triggering and clock source will appear, as well as a checkbox "Use default deployment".

For details on triggering and clock source, see the section Triggering and time-synchronization[81] .

As for deployment: the measurement configuration of the Signature VM sensor is stored in a deployment file. If this checkbox is ticked, the software will use the default deployment file that comes with the installation. If unchecked, the software will ask the user to select a custom deployment file instead. (For further information on custom deployment files, and how to use the "deployment details" from section Start measuring[40] , see the Nortek VM Frequently Asked Question "Custom deployment with raw bottom track" on the Nortek Support web-site.)

The example above assumes only one Nortek sensor is connected to the network. If multiple sensors are connected it is important to know which sensor is in use. The 'Discover' option fills in the list of serial numbers of the instruments found, but the drop-down box only shows the first one of this list. This may not be the instrument you want. In that case it is important to check that the model and serial number as shown here match the correct instrument. You can use the drop-down box to select a different instrument.
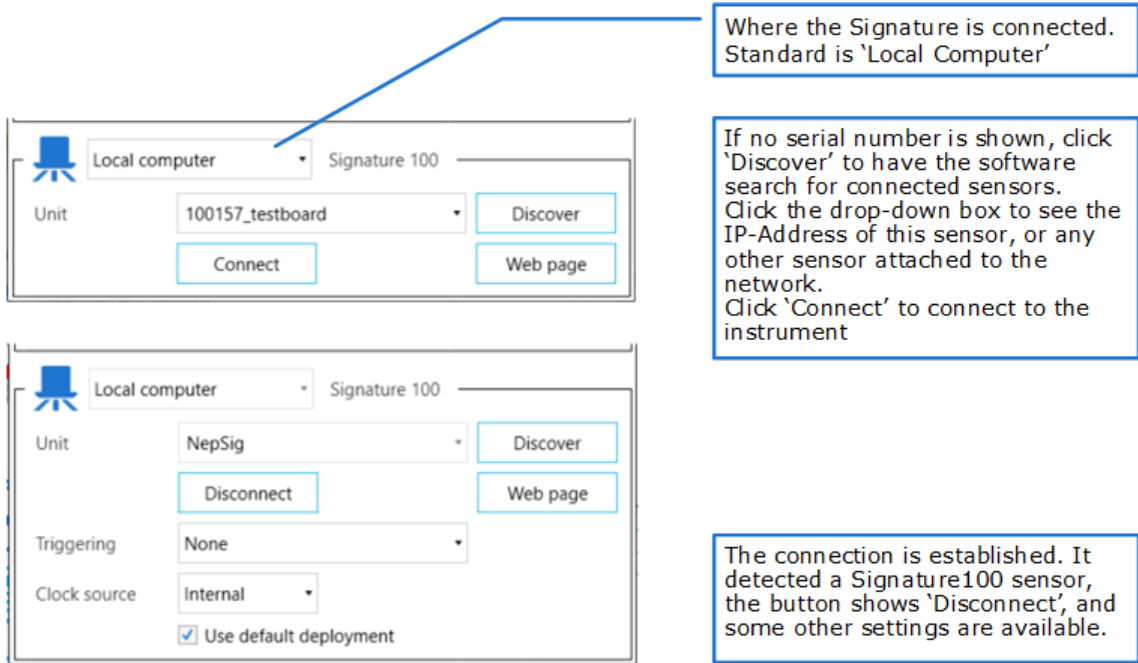
Figure 24: Signature connection

5.3.1 Additional Options

Optionally, the Signature can send out extra data on it's serial output (but note that not all Signature models have this option). This data can then be processed by other navigation instruments.

The option will give the Signature a similar functionality as a Nortek DVL.

This option is only available with a special license, the DF21 an DF22 output options will not be visible if this license is not present.
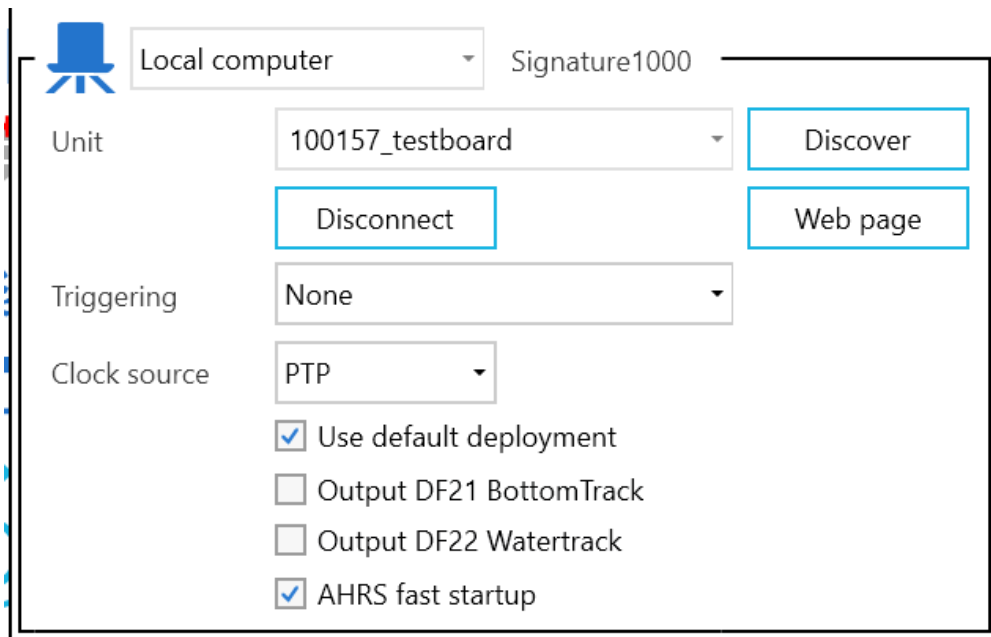
Figure 25: Special output options

The DF21 and DF22 format are output on 115.2 KBaud.

For additional information on the DF21 and DF22 formats see the Integrator's Guide, N3015-008_NortekDVL-IntegratorsGuide.

AHRS fast startup skips hardware initialization of the AHRS. Hardware initialization can cause invalid pitch and roll values when not done in a static situation. In most cases, AHRS fast startup without hardware initialization should be sufficient.

5.4 Checking the Signature

Once connected, click on 'Web page'. This will open the internal web-interface page of the Signature Sensor (figure 26[29]). This allows a number of low-level tasks, in particular a firmware update. (The software will check the instrument firmware, and will issue a warning if a firmware update is required.)
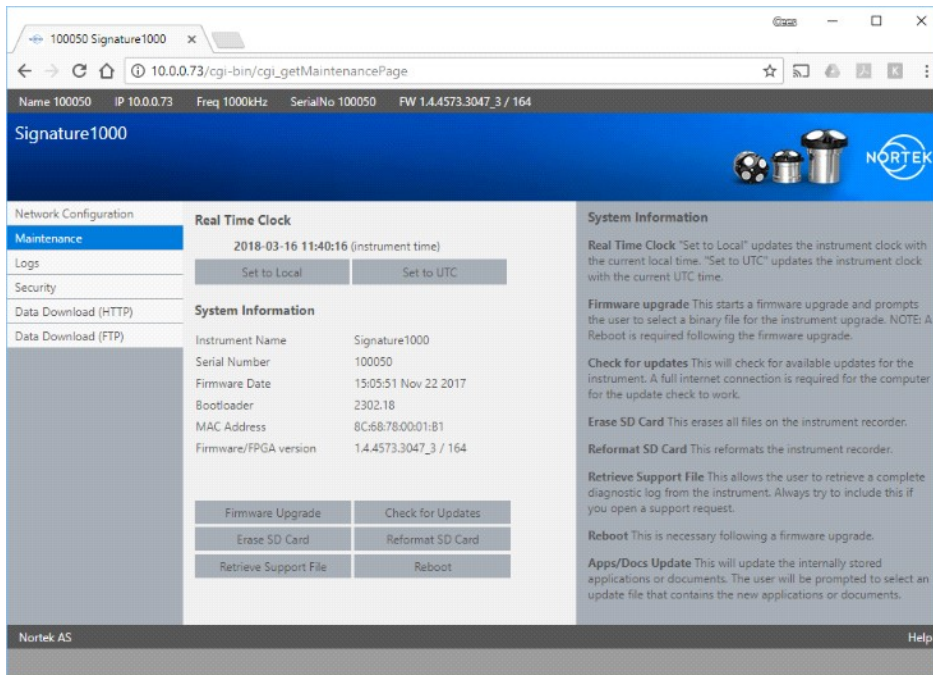
Figure 26: Signature web interface

5.5 Status panel

The 'Status' panel shows a quick overview of what is received and what is not.
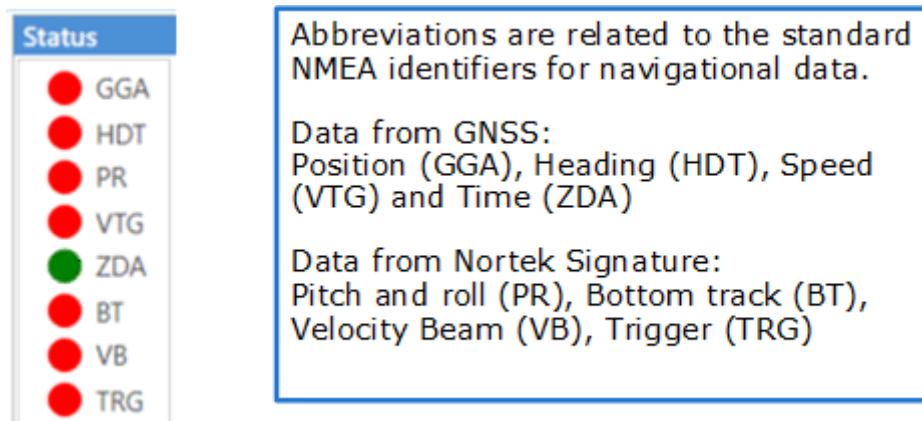
Figure 27: Status panel with status indicators

The Position, Heading, Speed and Time are provided by the GNSS. If they are all marked red there is no GNSS data. If only Heading information is missing, there might be a problem with the GNSS measurement due to bad environmental conditions. When there is data, but the data may be unreliable the indicators will go Yellow. Table 2[31] gives a bit more information on the different indicators and their meaning.

Note that the trigger indicator (TRG) is only visible if the trigger option has been selected in Connection options.

For details of the status panel, other than these status indicator 'lights', see section [Status] 41 .

Table 2: Meaning of the colors of the status indicators

	RED	*YELLOW*	*GREEN*
Position (GGA)	No Data from GNSS	2D Fix (degraded accuracy)	3D GNSS Fix
Heading (HDT)	No Data	Heading from internal gyro sensors.	Heading from the Dual antenna.
Pitch and roll (PR)	No data	Degraded data	Good pitch and roll data
Speed (VTG)	No Data	(N/A)	Speed from the GNSS
Time (ZDA)	No Data	(N/A)	Time from the GNSS
Bottom Track (BT)	No Data	Degraded: data is coming in, but there's something wrong with it	Bottom track data from the Signature
Velocity Beam (VB)	No Data	(N/A)	Water velocities as determined by the beams of the Signature instrument.
Echosounder (ES) (if an echosounder is available and switched on)	No Data	(N/A)	Echosounder data as measured by the Signature instrument
Trigger (TRG)	Waiting for trigger	Data received outside expected trigger time-window	Data received within expected interval

6   Measuring

If everything is configured correctly and working as described in the previous section, the measurement may be started.

6.1   ADCP Measuring Essentials

Before starting your measurements and setting up the system, it is important to understand the essentials of an Acoustic Doppler based measurement system.

A full overview and thorough background information regarding these types of sensors can be found in the Signature operation manual:
https://support.nortekgroup.com/hc/en-us/categories/360001447411-Manuals.

Following is a list of the most important issues that should be kept in mind when configuring the Signature VM system.

- Larger cells provide more range and have a better velocity precision. Always choose the largest cell possible for your application. Smaller cells my seem to give a better layer resolution, but the accuracy per cell quickly decreases.

- Broadband pulses provide a better precision in time or space.

- Narrowband provides more range and may perform better in environments with background noise.

- Try to set the blanking distance at least equal but preferably larger than the cell size.

- Additional pings, such as echosounder or bottom track pings, reduce the number of velocity pings in time and thus reduce the velocity precision in time. So, you may want to switch off the echosounder if it is not needed. And if the depth is too large for the bottom track to work anyway: switch that off, too. (Note: not all instruments support this.)

- The maximum range depends on the acoustic scattering conditions. In very clean water your range may be limited due to a lack of acoustic scatterers, while very sediment rich water can dampen the acoustic waves.

- Maximum range can be limited by nearby acoustic noise like motors or other acoustic measurement equipment like echosounders.

- To limit the influence of electrical noise the instrument must always be fully submerged.

- Stratification in sound velocity does not influence the measured velocity, but it will influence the estimated measurement location.

- The performance of the bottom tracking is a function of the vessel speed, depth and type of bottom. In general:

  - Hard, sandy bottom works better than soft and muddy or with lots of vegetation.

  - Its harder to track the bottom at higher speeds.

  - To an extent: it is harder to track on a soft layer on shallower water. Deeper is better, up to the maximum range of course.

6.2   Configuration

Start by checking the configuration and adjust the necessary variables. Click the 'Configuration' button to bring up the settings. Initially, the different categories of settings will be collapsed (see figure 28 33).

Click the small triangle to the left of a category of settings to switch between the collapsed and the expanded view.

The button "Restore factory defaults" will reset all settings to their defaults.

The button "Save configuration" will store all settings (including various settings that are not part of this window), so they will use these same values when the software is restarted. Note the implication: any configuration changes that are not saved, will not survive a software restart.
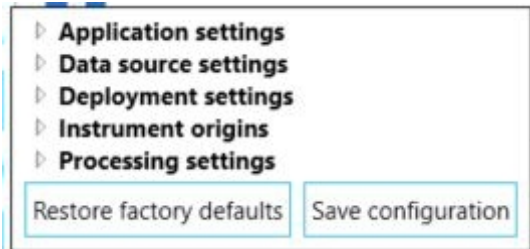
Figure 28: Configuration settings, collapsed view

FIgure 29 [34] shows the full list of configuration settings.

Table 3 [35] lists the default values, and gives an explanatory description of each configuration setting.

◢ **Application settings**

Display units	Metric ▾
Theme	Nortekblue light ▾
Layout	Default ▾
Max recording length	01:00:00
☐ Internal Recording	
Note qualifiers	▾
☐ Show Time in UTC	
Recorder file location	C:\Users\Nortek\OneDrive - Nort 📁

◢ **Data source settings**

Clock source	Primary channel ▾
Correction source	Bottom-Track ENU ▾
Depth source selection	Automatic ▾
Heading source	Primary channel ▾
Heading type	THS ▾
Navigation source	Primary channel ▾
Pitch Roll source	Internal ▾
Speed over ground source	Primary channel ▾
☐ Use output channel	
☐ Use secondary channel	

◢ **Instrument origins**
   ▷ **Diagram**
   ▷ **GNSS mounting** 0 m,0 m,0 m,0 °
   ▷ **Signature mounting** 0 m,0 m,0 m,0 °

Water line	0.00
☑ Lock gyro orientation	Auto align Signature

◢ **Processing settings**

Amplitude limit	
Average interval [s]	10
Correlation limit	50

   ◢ **Echosounder 1 Settings**

Noise level	

   ▷ **Echosounder 2 Settings**
   ▷ **Echosounder 3 Settings**

FOM max	1000
Sensor timeout	

   ▷ **Layer**

◢ **Software**

Version	2.10.0.0

Check for updates

Restore factory defaults		Save configuration

Figure 29: Configuration pop-up window

Table 3: Configuration details

Setting	Default	Description
Application Settings		
Display Units	Metric	Distance and speed on the screen in m/s or Knots and feet
Theme	Nortekblue dark	Display theme, the application colors, background and heatmap color palettes change with the selected theme.
Layout	Default	Change between saved layouts or save the current layout.
Max Recording length	1 hr (01:00:00)	Maximum length of a single recording. If left blank everything is recorded in a single continuous file. Else it is split in files of the specified length. The length should be specified in dd:HH:MM:SS format. Dd is the number of days, but if not used the time is just entered in hours minutes seconds. The minimum recording length is 10 minutes; values less than this are automatically changed to this minimum.
Internal Recording	No	Enable recording on the Signature's internal disk
Note qualifiers		Predefined 'qualifiers' that may be inserted from a drop-down box when creating a note. See section "Adding Notes[⌂ 49]" for details.
Show time in UTC	Off (Local time)	Show time and date on the screen in UTC. Does not change the recorded data which is always recorded with UTC time tags.
Recorder file location	..\Documents\Nortek\ Signature.VM	Where the recorded data is stored.
Data source settings		
Clock Source	Primary channel	Where the clock as used for synchronisation is taken from. 'Primary' or 'Secondary' channel refer to the GNSS output channel.
Correction Source	Bottom-Track XYZ	Which velocity measurement is used to correct the measured water-velocities.
Depth Source Selection	Automatic	What data is used for measuring the depth.
Heading Source	Primary Channel	If multiple sources of heading information are available, you can select a specific one here.

Setting	Default	Description
Heading type	Advanced Navigation	You can select the type of heading information available on the channel you selected as Heading Source (the Advanced Navigation format, or a NMEA format, either HDT, THS, or NTHPR)
Navigation source	Primary Channel	If multiple sources of navigation are available, you can select a specific one here. Not necessary if the system is only used with the standard GNSS.
Pitch Roll source	Internal	If other sources for pitch and roll data are available, you can select a specific one here.
Speed over ground source	Primary Channel	If multiple sources of navigation are available, you can select a specific one here.
Use output channel	No	Enable data output. See section Data output [60] for details.
Use Secondary Channel	No	Enable the use of a secondary source for navigation information.
Instrument Origins		
Diagram		Diagrams showing the offsets and orientations of the instruments in the XY and XZ plane. See chapter Offsets [53] for details.
GNSS Mounting	0m,0m,0m,0 º	Offsets of the GNSS from a reference point on the vessel. Check chapter Offsets [53] for details.
Signature Mounting	0m,0m,0m,0 º	Offsets of the Signature from a reference point on the vessel. See chapter Offsets [53] for details.
Water line	0	The water line with respect to the reference point.
Auto align Signature		Automatically set the Signature mounting orientation, see section "Automatic alignment [56] " for details.
Processing Settings		
Amplitude Limit	(blank)	Any measured cell where the amplitude is lower than this limit is discarded. If left blank, no limit is applied.
Average Interval [s]	1	Measurements are averaged over this interval.

Setting	Default	Description
Correlation limit [%]	50	Any measured cell where the correlation is lower than this limit is discarded. If left blank, no limit is applied.
Echosounder Settings[1] Noise level dB	(blank)	Base noise level of the echosounder. The data of the echosounder as shown is the volume backscatter strength. Part of the returned signal is caused by the inherent noise of the echosounder itself. If known, it can be used to correct the absolute reflection values. If left blank this value is not used. See section "Noise level"[51] for details.
FOM threshold	1000	Any measured cell where the FOM (figure of merit) is higher than this limit is discarded.
Sensor timeout	(blank)	Time interval for bottom track or velocity ping. Leave blank for instrument default.
Layer	1-2m	Options for enabling and adjusting the layer for current velocity data. See section "Layer[47]" for details.
Software		
Version		Installed software version
Check for updates		Manually check for updates

Notes:
[1]: If two echosounder channels are used, they can be configured independently. The third channel is for future expansion.

6.2.1 Save Configuration during Acquisition or during Playback

Any change made to the configuration is implemented in the processing and display immediately. Only when you click 'Save Configuration' are these values written to the configuration file and therefore can be read later by the Review software or when replaying the data. This is also true when replaying the data. You can change the configuration during playback, but this is only stored in the file that is being replayed when you click 'Save Configuration'.

6.3 Start measuring

When every sensor has been checked and found to be working, as described in the previous section, the system can be started by first clicking the 'Connect' button. When the instruments are connected, click the 'Start measurement' button. There will be a pop-up window where you can set or verify the main measurement settings (see figure 30[38]). The contents of this window may vary, depending on the type of sensor that is connected or the available options within that sensor.
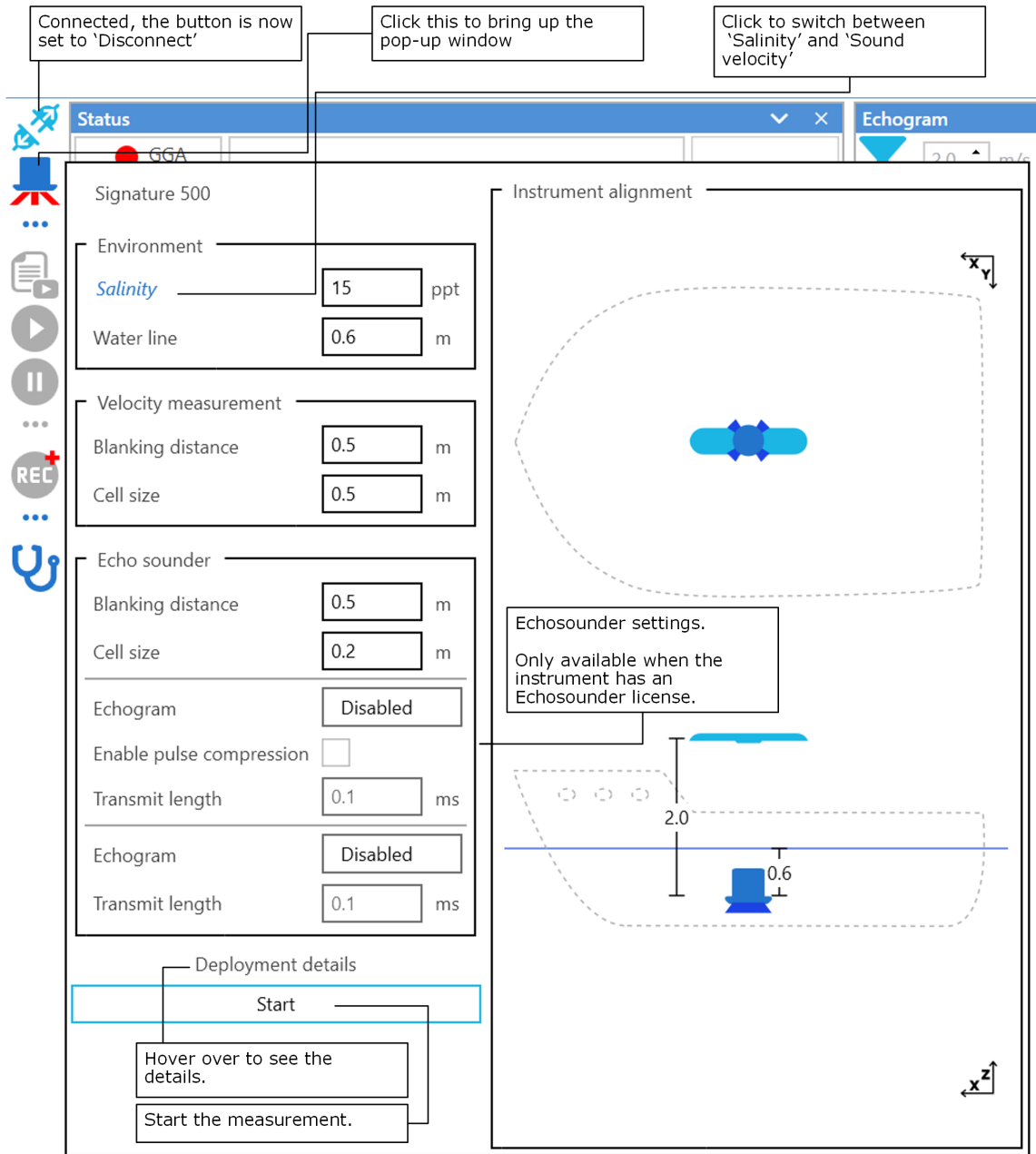
Figure 30: Start measurement pop-up window

When entering new values in the edit boxes they are automatically checked (when leaving the box), and if a setting is not compatible with the connected sensor the edit box will be marked red and the 'Start' button will be disabled.

Table 4: Measurement settings details

Setting[1]	Default[2,3]	Description
Environment		
Salinity / Sound Velocity	35 / 1500	Click on this field to switch between 'Salinity' or 'Sound-Velocity'

Setting[1]	Default[2,3]	Description
		The salinity is 0 for fresh water and typically 35 ppt for the ocean. This is used for automatic calculation of sound-velocity.
		If Sound Velocity is selected, a fixed speed of sound in water has to be entered. In general, this is around 1500 m/s in seawater.
Water line[4] [m]	0	The distance between the reference point (for the instrument offsets) and the water line.
Velocity Measurement		
Blanking distance [m]	0.5	Distance to the start of the first measuring cell.
Cell Size [m]	0.5	Size of each measuring cell. A larger cell size will improve the accuracy per cell, at the cost of losing vertical resolution.
		The total number of cells that is recorded is limited by the selected cell size. The total measured distance (Nr of Cells * Cell size) cannot exceed the maximum range of the instrument.
Enable Bottom track	ON	Applies only to the Signature 250, 100 and 55.
		Enable or disable the use of bottom track when calculating the velocities. If disabled, the velocity corrections are taken from the GNSS.
Enable Altimeter	ON	Allow the use the Altimeter to measure depth. (The way the depth is determined depends on the setting for 'Depth source', in the Configuration[32])
Use broadband	ON	Applies only to the Signature 250, 100 and 55.
		If disabled, the sensor uses the narrow-band doppler technique for measuring velocities. Narrowband may give more range, but it is less accurate.
Echosounder		Echosounder specific settings. Only available if the instrument has an echosounder licence. Two echosounder measurements are available, each can be enabled or disabled.
		For details refer to section Echosounder details[50] .
Blanking distance [m]	0.1	Distance to the start of the first measuring cell.
Cell Size [m]	0.5	Size of each measuring cell. This basically sets the vertical resolution of the echosounder.

Setting[1]	Default[2,3]	Description
Echogram		If disabled, this echosounder mode is not used. (echosounder is NOT recorded!). Select a frequency from the dropdown box to enable the echosounder. Most Signature sensors only have one frequency available, which is the base frequency of the sensors itself (e.g. 1000 kHz for a Signature 1000). On a Signature 100 with echosounder option it may be possible to select different frequencies.
Enable Pulse compression	ON	Only available for the first echosounder.
Transmit length (ms)	0.1	Length of the transmit pulse in ms.

Notes:

[1]: The presence of some settings depends on the connected sensor.

[2]: Some defaults depend on the connected sensor.

[3]: If you change these values and want to store them for future measurements, open the 'Configuration window' and click 'Save configuration'.

[4]: This value was previously called "mounting depth", this was valid when using the Signature instrument itself as the reference point, but can be confusing if the Signature is not the reference point.

When you hover the mouse cursor over 'Deployment details' a box will pop up showing the configuration as it will be sent to the instrument at start-up (see figure 31[□40]). These can be inspected or saved to file and used as a basis for constructing custom deploy files. Creating and using custom deploy files is an advanced feature. Please refer to the 'Nortek Signature Integrators Guide' for details.
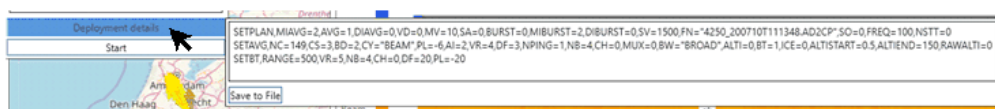
Figure 31: Deployment details

Click 'Start' to start the actual measurement. When any of the settings in this window is invalid for this specific sensor the Start button is not enabled and the measurement cannot be started.

The system will now start recording the measurement data. When it is recording this is indicated by the two progress bars that are visible in the details pop-up, when clicking "…" at the bottom of the 'Recording' group of buttons (see figure 32[□40]). Use 'Next recording' to create a new file. This may be useful to start a new file when a specific area or track is started.
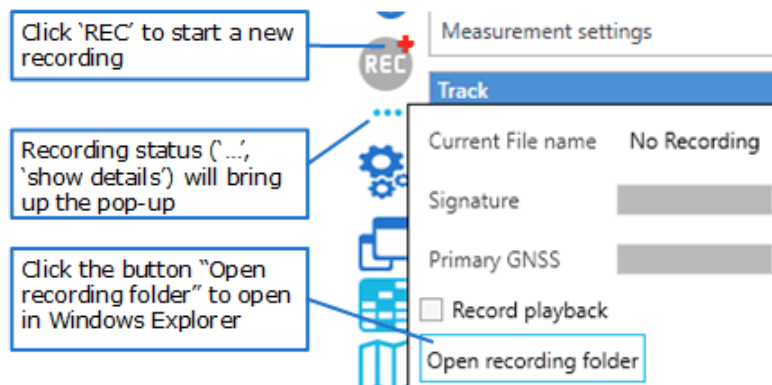
Figure 32: Recording and recording status

6.4 Measuring and Display

6.4.1 Status

The status panel shows a set of panels with various metrics for insight in the status of the connected instruments and the data recorded.
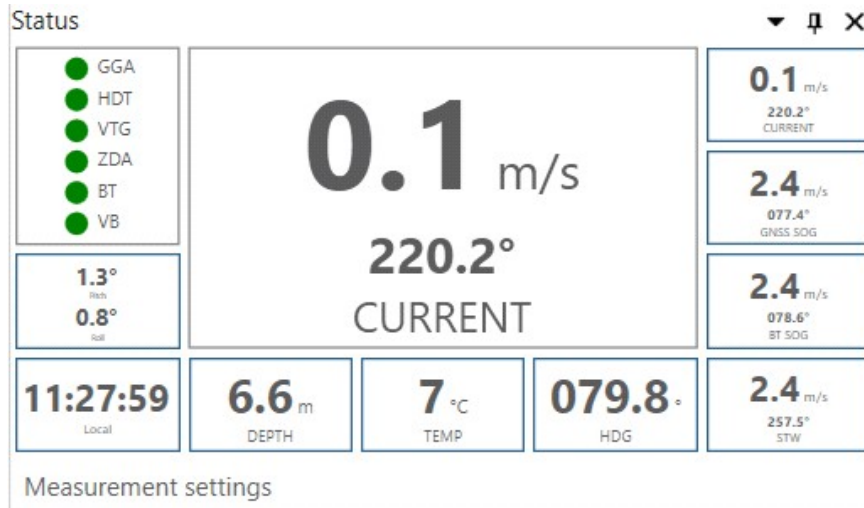
Figure 33: Status panel overview

The different parameters are (in figure 33, clockwise from top right):

Table 5: Status display parameters

Parameter	Meaning	Description
Current		Averaged current speed and direction referenced to earth.
GNSS SOG	Global Navigation Satellite System Speed Over Ground	Vessel Speed and Direction over Ground as measured by the GNSS.
BT SOG	Bottom Track Speed Over Ground	Vessel Speed and Direction over Ground as measured by the Signature.
STW	Speed Through Water	The speed of the ship through water, i.e., the speed and direction of the ship relative to the water.
HDG	Heading	Heading of vessel as measured by the GNSS.
TEMP	Temperature	Water temperature as measured by the Signature.
Depth		Depth as measured by the central acoustic beam in the Signature.
Local / UTC		Time

Parameter	Meaning	Description
Pitch, Roll		Pitch and roll, measured by the instrument, converted to ship's axes.
Status lights		See section Status panel 🗋 29 for information on the status indicators.
Measurement settings		Hover your mouse over this text (just below the Status panel itself) to see the active settings. (Also see figure 36 🗋 43 and accompanying text.)

As the various small sub-panels around the edges can be difficult to read, there are two options to help with this.

Hovering the mouse (without clicking) over one of the edge sub-panels results in a pop-up balloon explaining the contents of that sub-panel, while at the same time the center panel temporarily shows the contents (and especially the values) of that same sub-panel. Figure 34 shows an example.
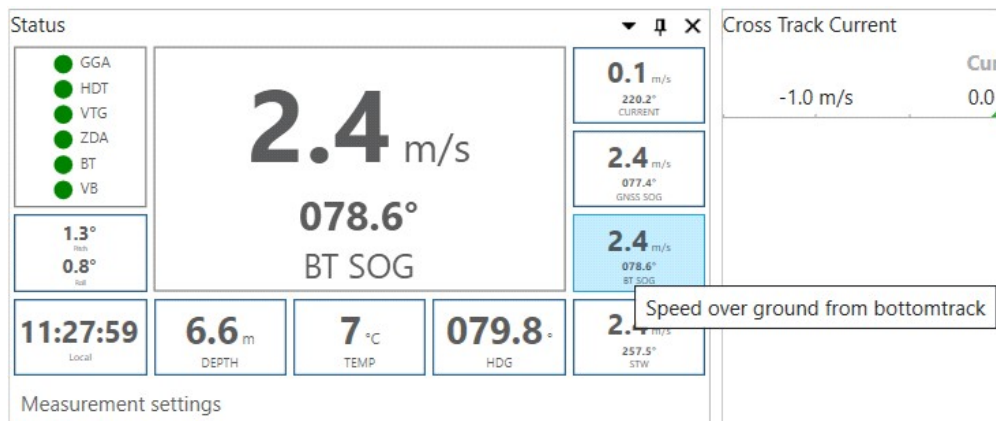
Figure 34: Hover over a sub-panel to show its values in the center panel and show an explanatory pop-up balloon

The other option is to click on a sub-panel. This will switch the center panel to display the contents of that sub-panel, even when you move the mouse away from that sub-panel. This way it is possible to have the center panel display the most important parameter continuously and prominently. Figure 35 shows an example.
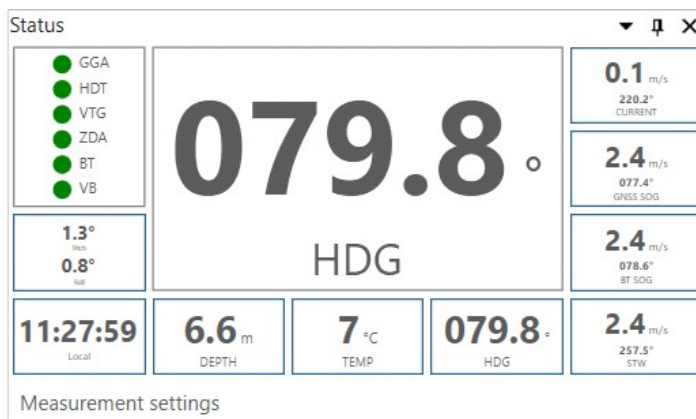
Figure 35: Click on a sub-panel and the center panel will display that panel's contents permanently

The bottom line of the status panel contains the text "Measurement settings". Hover the mouse over this text, and a pop-up will show a list of detailed settings as configured for the

measurements. Figure 36 [43] shows an example. Note that if you do not move the mouse the pop-up will stay visible for a short time only; if you move the mouse away from the text "Measurement settings" the pop-up will disappear immediately.
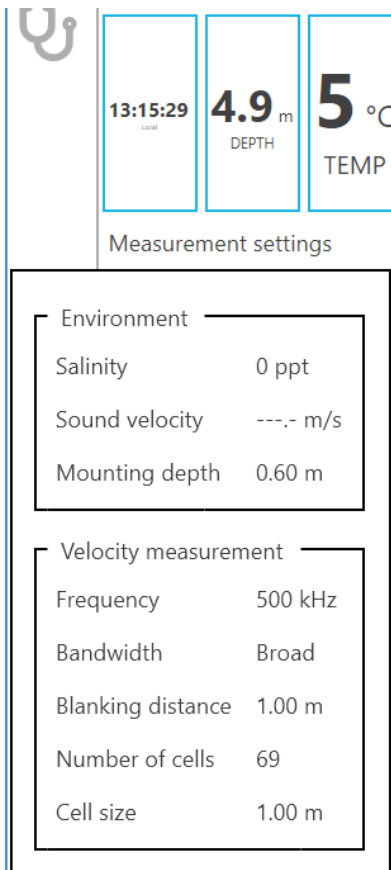
Figure 36: Hover over "Measurement settings" for a list of details

The values related to the water velocity (Current and STW) are averaged over the full water column by default. When a depth layer [47] is used, average values from this layer are displayed.

Note that the details shown may vary, depending on which instrument is connected.

6.4.2   Track display
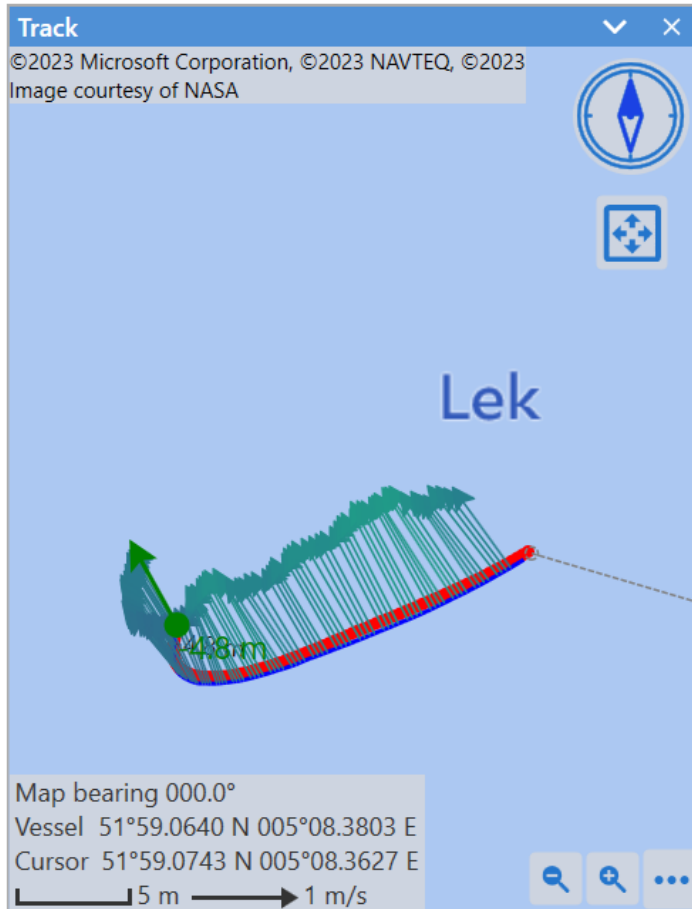
Figure 37: Track display

The track display shows the track as sailed by the vessel, and recorded by the GNSS, as a blue line. The calculated track from the bottom track data is shown as red dots. Note that the background map may only be visible if there is a live internet connection since these maps are loaded from the internet (see map source selection[45] .)

Interaction with the map can be done using the mouse. Next to this the map can be rotated by clicking and dragging on the edge of the compass. There is also an option to fit the GNSS track to the dimensions of the track window.

Clicking the […] button at the bottom right of the map opens the map options menu.

When the calculated track starts to drift away from the actual track you can reset it by clicking 'Bottom track-> Reset' or press <Ctrl>-R on the keyboard.

The following five items each have a toggle box (□◉) to switch display of that option on or off; the color of the dot in the toggle box (indicating "on") is the same as the corresponding feature as drawn on the map.

The other items have a regular toggle box (□☒), see table 6[45] for details on each option.

Table 6: Map display options

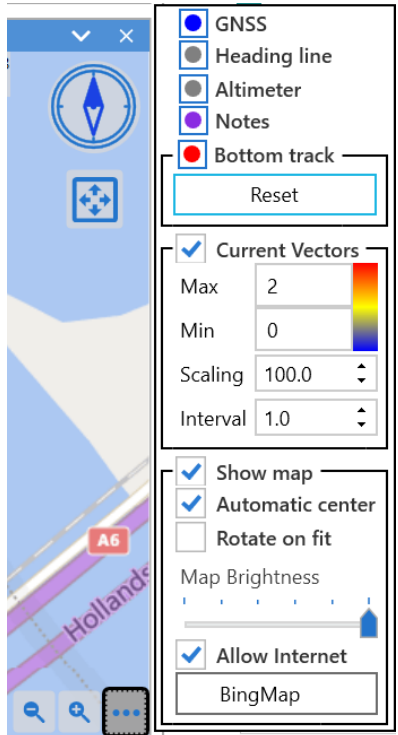| Options	Description	
GNSS	Show the track as recorded by the GNSS positions.	
Heading line	Show a straight line that marks the heading according to the GNSS compass.	
Altimeter	Show the depth value at regular intervals.	
Notes	Show the notes as they are recorded (will not update on deletion or modification in Notes[]49 window).	
Bottom track	Show the course as calculated from the bottom-tracking.	
Current vectors	If selected, show the average velocity over the measured depth as a velocity vector. The colour of the vector depends on the setting of the Max and Min on the colour scale. Scaling may be used to draw the length of the vectors larger or smaller, if required. The 'interval' sets the spacing between drawing of the vectors. For example: if Interval is set to 6, only every sixth vector is shown.	*Figure 38: Map display options*
Show map	Select to show a background map. The 'Map Brightness' slider can be used to set the visibility of the background map.	
Automatic center	The map will automatically shift the ship track to the center if it gets too close to the edge.	
Rotate on fit	Automatically rotate the map to make best use of the available space when the 'Fit to screen' button is used, keeps north up if disabled.	
Allow internet	If a map is not already available on this computer, use the internet connection to collect it. This could be disabled if the computer is connected to internet over low bandwidth connection.	
Map selection	The last item in the list is a drop-down box where you can select the source of the map. OpenSeaMapHybrid discourages use of its servers; you may want to use Google or Bing maps. If available (see next section), this can also be a user supplied image in GeoTIFF format.	

6.4.3 User defined background map

It is possible to use other images as map background. This requires an image that is stored in either the GeoTIFF or MBTiles format. This file should contain, apart from the image data, details on the geographic location, map projection and the coordinate system. Images as

created in Signature VM Review via the Map/track 'Save as GeoTIFF' right-click context-menu comply to this standard so they may be used as a basis for creating custom maps.
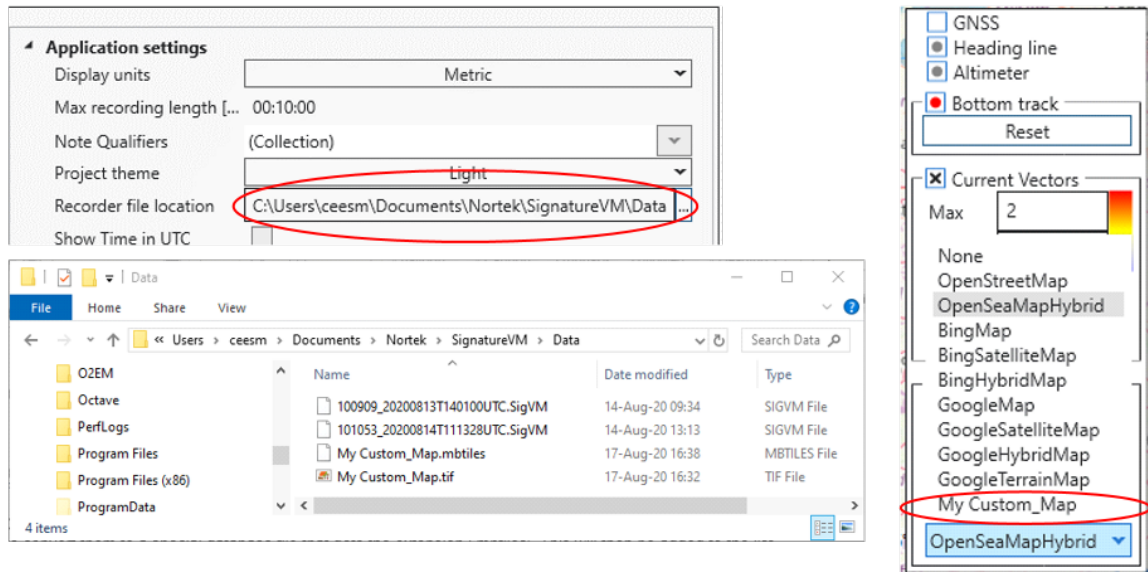
Figure 39: Custom map

The custom maps will be read from the same folder that is specified for saving the recordings.

On start-up the software will look at this folder, check if there are any GeoTIFF images in there and if so, try to convert them to a special database file that gets the extension '.mbtiles'. This will then be added to the list of possible map sources in the dropdown box so it can be selected.

As a shortcut, MBTiles files can also be added directly. This has the added benefit that the MBTiles files can have a set of zoom levels and cover a larger area than GeoTIFF images.

Note that after selecting a new folder for the data, it might take a while before the new maps become available.

6.4.4 Echograms

Figure 40: Echograms with displaying options

The chart at the top shows the magnitude (absolute value) of the current velocity. The lower chart can show either 'Direction', 'Correlation' or 'Amplitude' for one of the four beams, or, if available and switched on, one of the 'Echosounder' channels.

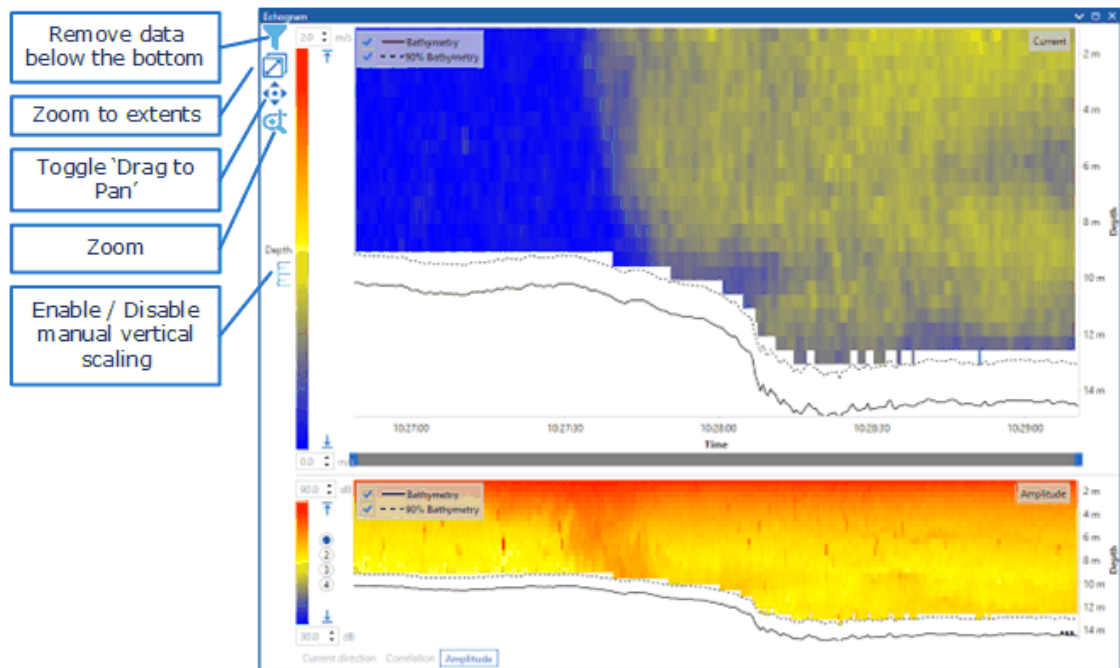The 'filter' icon will show either all data up to the detected bottom, or all data down to the maximum depth.

Default scaling for the vertical axis is automatic. The program tracks the bottom and adjusts the scaling, so all relevant data is in view. If you want to focus on a specific section or just want to see all, click the 'Depth' button (so it shows a hand over the scale, to indicate 'manual'). Now adjust the depth scale by clicking and dragging it with the mouse.

6.4.5 Layer

By default the water velocity data used throughout the application is averaged over the full water column. There is however also an option to create a horizontal layer for water velocity data. This layer can be enabled and modified in the 'Processing settings' section of the 'Configuration'. See figure 41 below.

Figure 41: Layer settings

The 'Layer' settings shown in figure 41 allow turning the layer on or off and changing the upper and lower depth limits of the layer. The upper and lower limits can also be changed using the sliders in the current echogram, these are only visible when the layer is enabled.
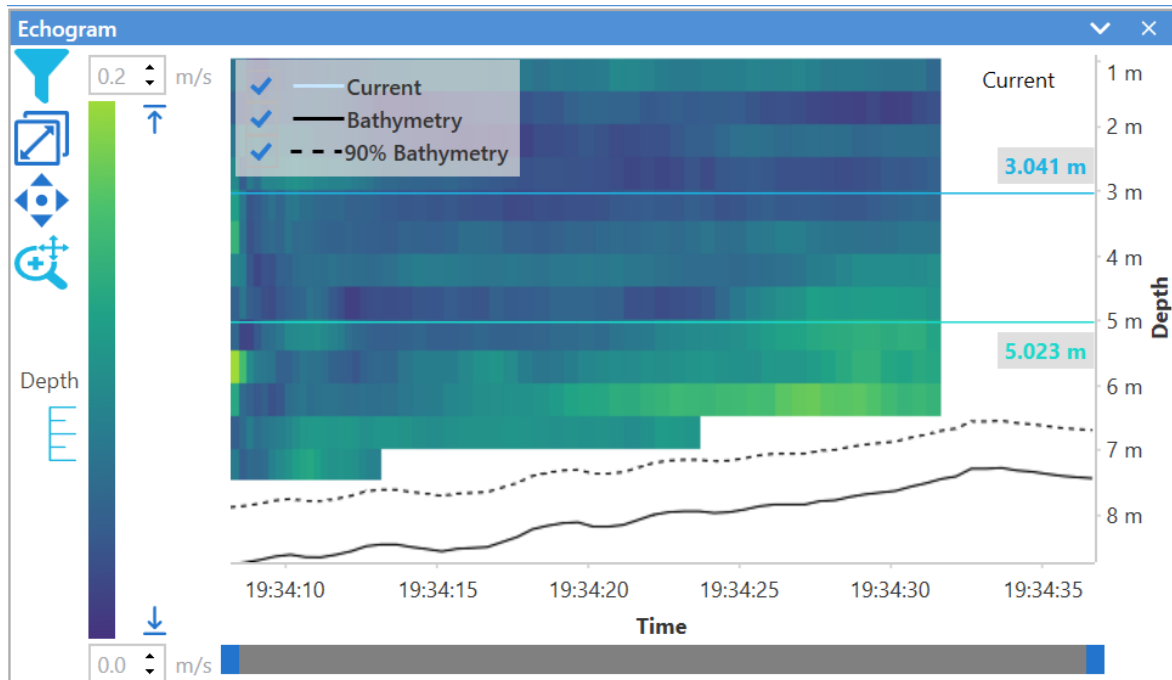
Figure 42: Layer sliders in current echogram

When enabling a layer, the following current related data is affected:

- Current vectors on the map

- Current field in the status panel

- STW field in the status panel

- NMEA messages

  o [$VDVDR](#) 66

  o [$VDVHW](#) 67

  o [$VDVBW](#) 66

6.5   Keyboard Shortcuts

F1	Open this manual
<Tab> and Arrow Keys	Move between settings. Use Spacebar to toggle checkboxes
<Ctrl>-R	Reset bottom track. Re-Align the bottom track with the vessel position on the Map
+	Zoom in on the Map
-	Zoom out on the Map
<Ctrl> Arrow Keys	Pan the Map

6.6   Adding Notes
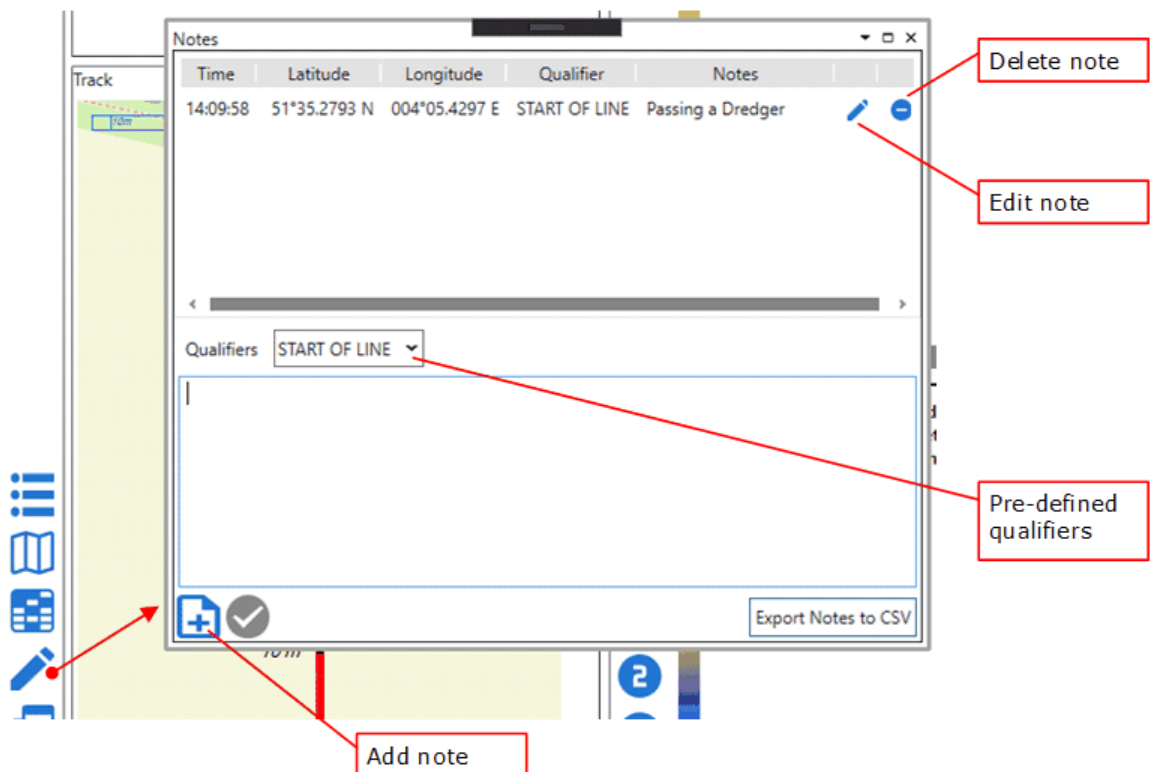
Figure 43: Adding notes

When measuring, it is possible to add notes. Notes will be tagged automatically with the time and position and are stored in the data file. To add a note, click the 'Pencil' icon. This will open the notes window where you can enter text in the lower part. This text will be saved, with the time and position data, when you click the '+' note button (or press CTRL+enter). The saved notes will be visible in the top section and can be edited or deleted by clicking the pencil or delete icon next to the message.

Also included in every note is an (optional) 'Qualifier'. This is a pre-defined text that can be selected from the 'qualifiers' drop-down box. The qualifier texts are defined in the 'General Settings' window. There is an entry named 'Note Qualifiers' followed by a textbox '(Collection)'. Click the text box to open an edit field where you can add or modify the list of qualifiers. Make sure to click 'Save Settings' afterwards.

Figure 44: Adding the Notes-Qualifiers

Notes are stored in the .SigVM data file (for details see the 'Export formats' section in the Signature Review manual). The notes in the current recording directory (excluding the current,

"live" recording) can be exported to a text file by clicking 'Export Notes to CSV'. After data collection all notes can be exported to a single file using the Notes processing option in Signature VM Review.
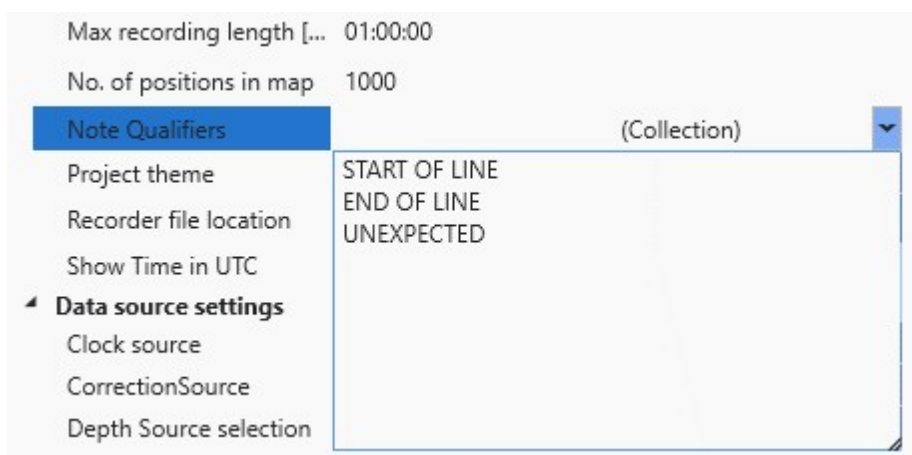
6.7 Error Messages

Occasionally the system may show error messages after starting the Signature Sensor. These messages are displayed as sent by the instrument and in general have the following structure:

```
NUM=n, STR="<Error Message>", LIM="<Limits as exceeded>"
```

The 'NUM' is the numeric value of this error, 'STR' is the human readable description and 'LIM' are the limits that were exceeded leading to the error. Usually the text will give the user a hint as to where or why the error occurred. The most common error is the following:

```
'NUM=9,STR="PTP clock not synchronized",LIM=""
```

This indicates that there is no PTP (Precision Time Protocol) signal present. This signal should come from the GNSS, so this either may not be connected yet, or the GNSS has not locked into any satellites and therefore has not found the correct time.

6.8 Echosounder details

Echosounder operation is an optional feature, available for some types of Signature VM systems. We refer to echosounder data as the vertical echogram, showing high resolution reflection intensities which may be used to detect biomass, sediment or fish.
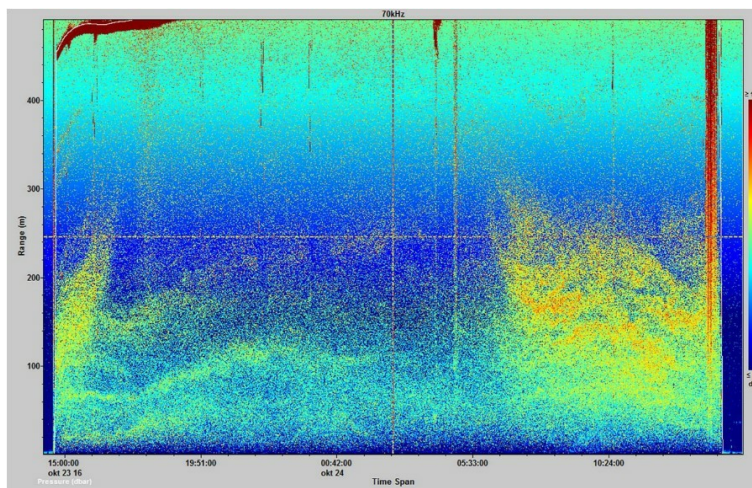
Figure 45: Typical Echosounder image, showing areas that might contain biomass

The Signature1000 and 500 use their centre transducer for echosounder measurements, so the echosounder frequency is also fixed to 1000 or 500 kHz. The Signature100 has a dedicated echosounder transducer that has a wider bandwidth and therefore more frequency options to choose from.

6.8.1 Pulse Compression

When transmitting a pulse, it is of interest to have it as short as possible, as the length of the pulse affects the range resolution. However, we also want the pulse to be long enough so that the measurement quality is improved. Therefore, there are two ways of processing the signal, either with or without pulse compression.

With pulse compression: With pulse compression enabled, the centre transducer transmits a sound wave (pulse) with a bandwidth of 25% (compared to the normal 6.25%). Each part of the pulse has a unique frequency, and the return pulse can be separated and integrated into a shorter single output pulse. Practically, that means that the return echo is compressed in its pulse duration in special filters, which results in very high-resolution data. Pulse compression thus provides a method to further resolve targets compared to "normal".

Benefits: The best resolution is achieved with pulse compression; minimum resolution is 3mm for Signature1000 and 6mm for Signature500. The Signal to Noise Ratio (SNR) increases because the length of the transmit pulse can be increased without affecting the resolution. Pulse compression works best with small scatterers.

Disadvantage: May introduce sidelobes in shallow water or when measuring close to boundaries.

Without pulse compression: Bandwidth of a transmit pulse without pulse compression is approximately 1/T, when T is the transmit pulse length in seconds. The length of the return echo will be a convolution of the rectangular transmit pulse and receive window. If the transmit pulse length is set to BinSize/(c/2) (where c is the speed of sound in water) or nominally BinSize/750, the bins will consist of triangularly weighted echoes, like the classical doppler profiler cells. In this case the resolution depends on both the length of the transmit pulse and the cell size.

The best resolution is achieved with the shortest allowable transmit pulse but still limited by the bandwidth which corresponds to a resolution of 12 mm for the Signature1000 and 24 mm for the Signature500.

Benefits: Reduced chance of sidelobe interference with a narrowband pulse when measuring in bottom boundary conditions (where SNR is generally high enough)

Disadvantage: The effective resolution will be limited by the receive filter, so you will see 1.2 cm resolution in the data even though the bin size is 3 mm.

In Signature VM it is possible to enable two Echograms, but only one of them may be using Pulse compression.

6.8.2 Noise level

Echosounder data as shown on the charts is the 'volume backscatter' strength. The raw measured reflection values are corrected for range, transmission losses and absorption. Since part of the returned signal is caused by the inherent noise of the echosounder itself and possibly by surrounding noise-sources, there is an option to enter a value for the noise level so the software can correct for it. If there is a need to see the raw echosounder data this is possible if you check "Unprocessed echosounder"(see figure 46[52]).

If known, the noise level can be used to correct the absolute reflection values. If left blank the default value will be used.

The average noise level can be measured using the diagnostics mode (see Figure 20: Taskbar explained[25] and section Spectrum[87]). Choose to obtain a spectrum from the echosounder beam, select the bandwidth used for recording and turn on the peak holding feature. After 15 seconds or so you should have a good estimate of the maximum noise level. The maximum signal strength at the center of the central peak can be entered into Processing settings -> Echosounder calibration -> Noise level dB (or in the text box "Noise level", see figure 46[52]).

In most circumstances the default range for the color bar does not fit the data. To auto fit the color bar range to the data range, use the buttons next to the top and bottom of the color bar. To manually adjust the maximum and minimum, use the text boxes located above and below the color bar. For heatmaps with different views, the limits can by synced across the views using "Sync heatmap limits"(see figure 46[52]).
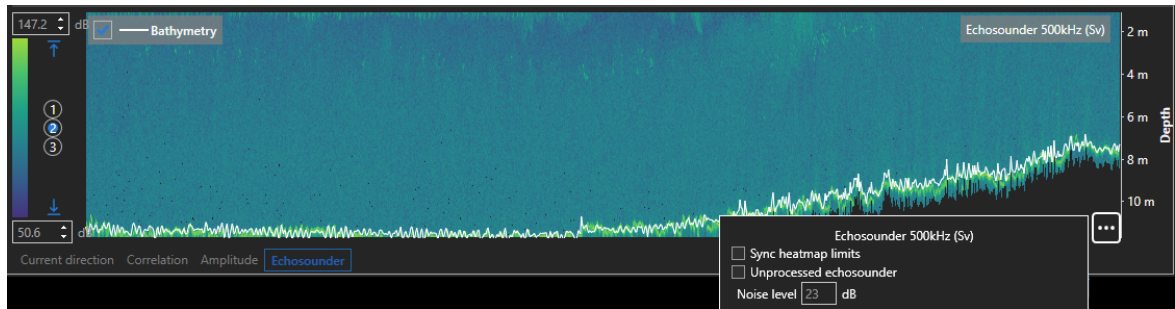
Figure 46: Echosounder image

7   Offsets

Before starting the actual measurement, it is important to align all sensors. The configuration contains two sub-sections for entering the offsets between the sensor and the GNSS relative to the vessel. All calibration factors can still be changed in post processing without further consequences.

Figure 47: Signature and GNSS mounting offsets

7.1   Vessel Coordinate system

As shown in the illustration (figure 48[ ]53) there are three different coordinate systems that apply.
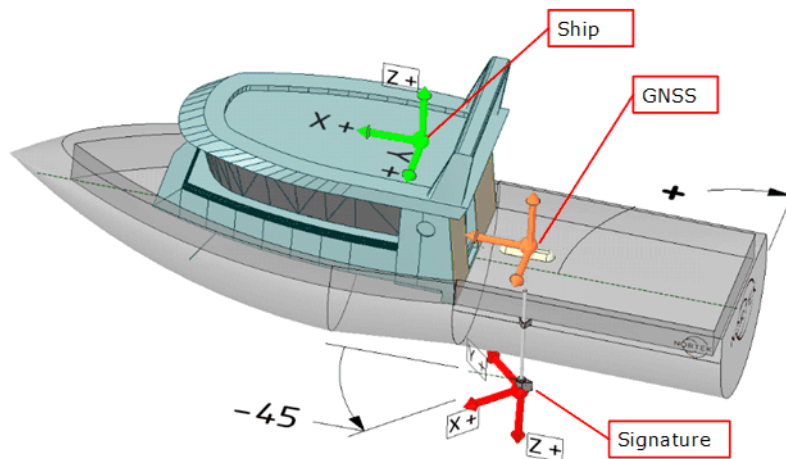
Figure 48: Vessel coordinate system

First there is the ship itself, to which everything should be aligned. The centre axis is the X-Axis, and forward is positive. The angles are right-hand, so positive angles are clockwise.

Second is the GNSS which should be aligned with the vessel centreline, but could be a few degrees off.

And finally, there is the Signature sensor which by default has 45 degrees offset if installed according to the instructions in the 'Installation' chapter. It is worth noting that the Signature sensor is essentially mounted 'upside-down'. The offset as entered in the software is the rotation as related to the vessel, so it is minus 45 degrees in this case.
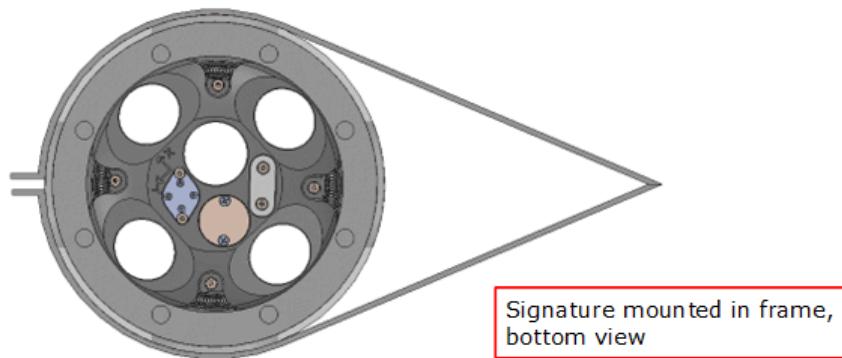
Figure 49: Signature mounted in frame (bottom view; Signature 1000 shown)
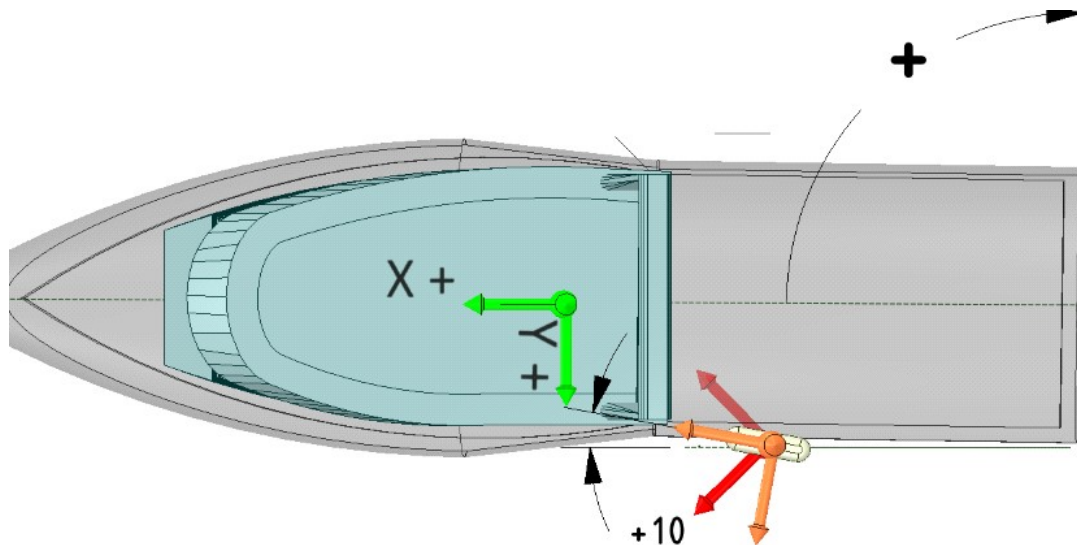
Figure 50: Signature and GNSS mounting coordinates

To illustrate the GNSS orientation offset it is shown here (figure 50[54]) at 10 degrees as an example. This offset should be as small as possible, and only if it is not possible to get it exactly to 0 correct it in the software.

7.2   Horizontal and vertical offsets

The easiest way to have everything aligned is to mount the Signature and GNSS on a single pole so they are on the same vertical axis, as shown in figures 48[53] and 50[54] . This way there is no need to enter X and Y offsets. If, however this is not possible, X Y and Z offsets may have to be entered like in the example below (figure 51[55]) where the GNSS is mounted on the roof of the vessel. When entering X, Y and Z offsets it is important to start from deciding what is the actual reference point.

On professional work vessels the Center Of Gravity (COG) is known and can be used as a reference point (0,0,0), in this case both the Signature instrument and GNSS offsets need to be entered.

In other situations you could take the Signature sensor as a reference. This simplifies things as you only have to enter offsets for the GNSS.
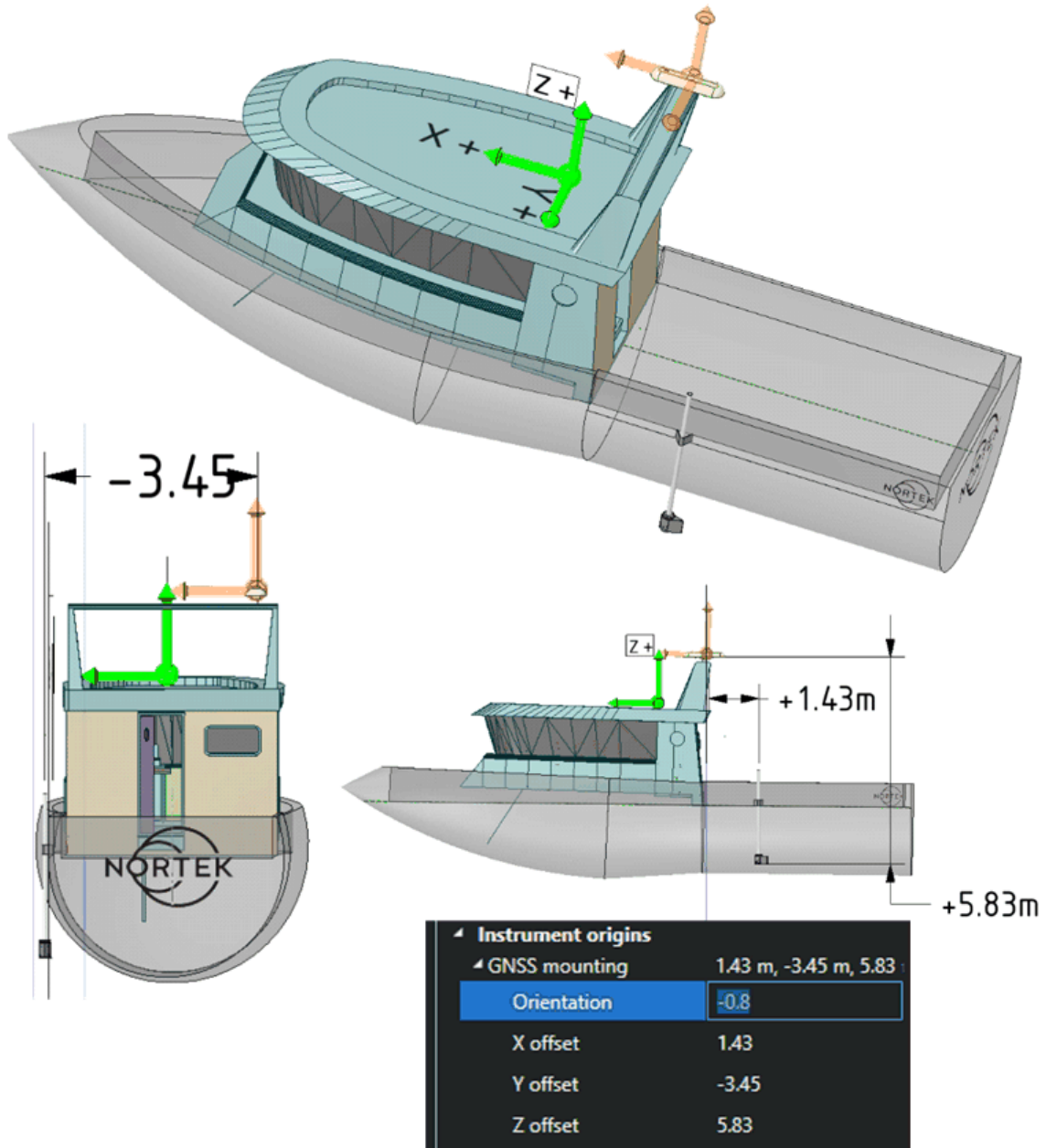
Figure 51: Offsets from the GNSS to the Signature

In the example the Y offset from the Signature to the GNSS is -3.45 m and the X Offset is +1.43 m (since the Signature is the reference (point 0,0,0) and we are entering the offsets FROM the Signature TO the GNSS).

7.3   Offsets diagram

The software includes a diagram showing the offsets and orientation to scale. Refer to the diagram to make sure you entered the offsets and orientations correctly. An example of the diagram with the offsets from the previous example is shown in figure 52.
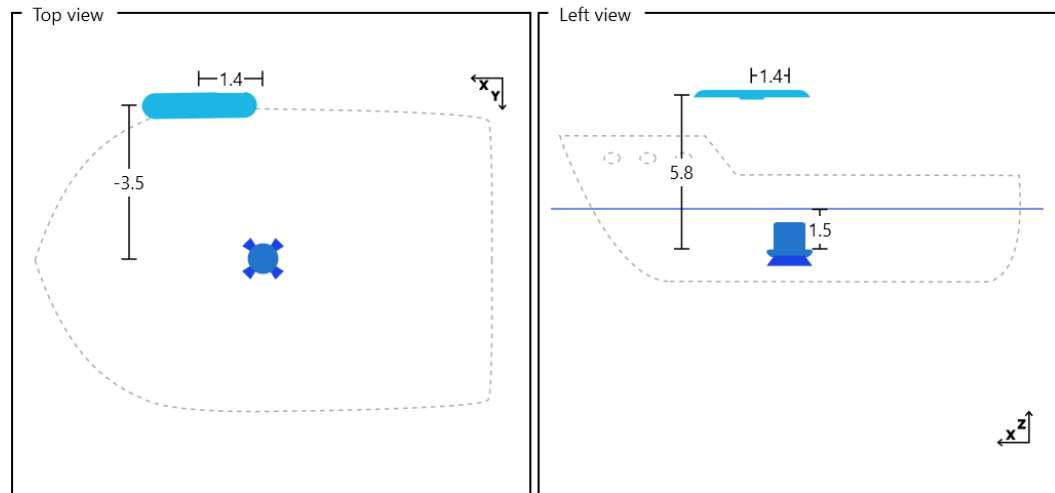
Figure 52: Offsets diagram

In figure 52 a water line of 1.5 meter was used. This is the distance between the reference point and the current water line of the vessel. Since the Signature is the reference point, the value of the water line equals the Signature mounting depth or transducer draft.

7.4   Orientation of the GNSS and Signature

7.4.1   Automatic alignment

For a quick alignment of the Signature instrument and the GNSS you can use the automatic alignment tool in the 'Configuration' menu under 'Instrument origins', see figure 53[57]. This tool uses the difference between the bottomtrack direction and GNSS direction to compute the valid orientation of the Signature instrument. For instructions on how to manually set the orientation of the Signature and GNSS, please refer to section Manual alignment procedure[58].
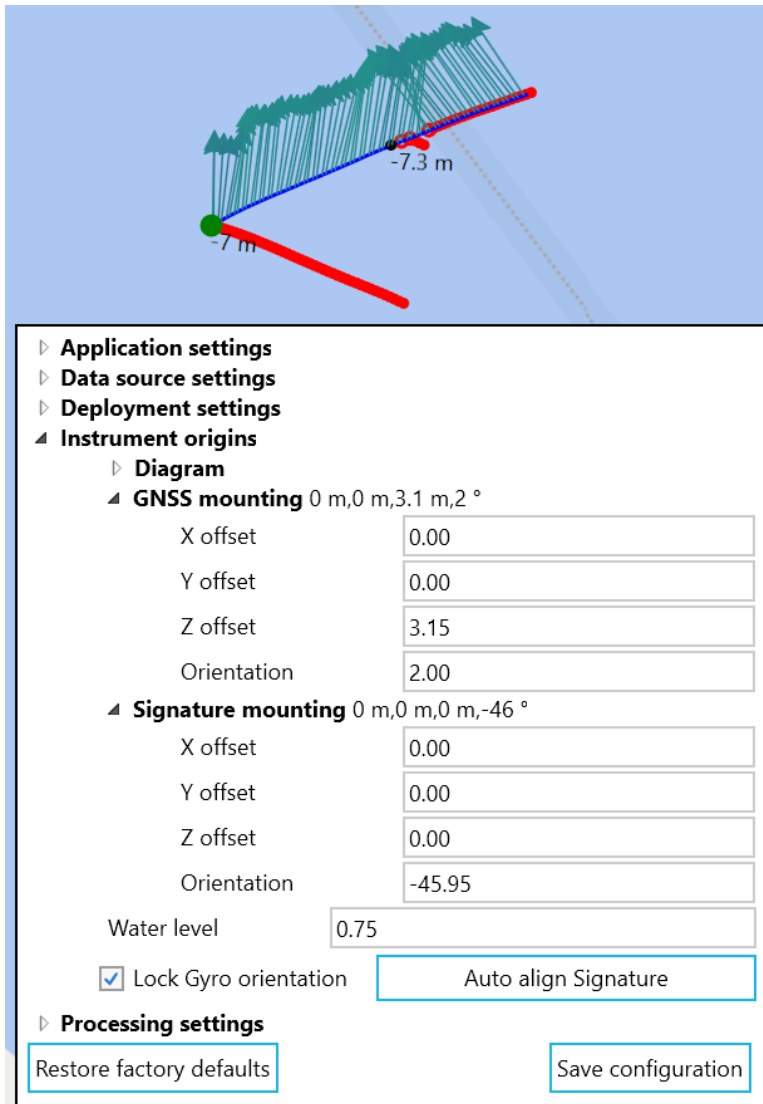
Figure 53: Automatic alignment

To be able to automatically align the instruments you need to be measuring and both bottomtrack and GNSS data should be available. Ideally you sail a straight line for a few hundred meters and then press the 'Auto align Signature' button. The Signature orientation will automatically be set to the correct value and the bottomtrack will reset. You should see the bottomtrack points overlap with the GPS data on the track. Make sure to save the configuration if you are happy with the alignment, otherwise changes will not be saved to the recording.

The list of data points used by the automatic alignment tool is cleared when pressing the auto align button. The button is disabled until there are enough data points for a new alignment calculation. This means that if you wish to use a certain track section for the alignment, you can press the auto align button at the start of the section to reset the tool and at the end of the section to apply the calculated orientation from the track section.

Unchecking 'Lock gyro orientation' makes the software calculate a GNSS orientation as well. This is not recommended in most cases since it can result in wrong orientations when there is a cross-wind or cross-current.

Note that this tool is meant to quickly get a reasonably good alignment. Using the Alignment tool in Signature VM Review together with the procedure described in the Signature VM Review manual might yield better results.

7.4.2 Manual alignment procedure

The 'Heading' and the GNSS direction need to be aligned. The heading, measured by the GNSS, is the actual direction that the antenna is pointing at, referenced to true North. The direction as indicated under the 'Global Navigation Satellite System' label is the direction in which the ship moves, relative to earth. When adjusting this it is important that the vessel is moving in a straight line, preferably straight into or with the local current. If the current (or strong wind) is coming in from the side, the vessel will drift sideways which will give an incorrect direction of movement. To adjust the offset, open 'Configuration' and adjust 'Orientation' (under 'GNSS mounting'). The correction will be applied immediately after pressing 'Enter' or 'Tab'.

Figure 54: Adjusting GNSS orientation and settings

<mark>*Don't forget to click 'Save Configuration'!*</mark>
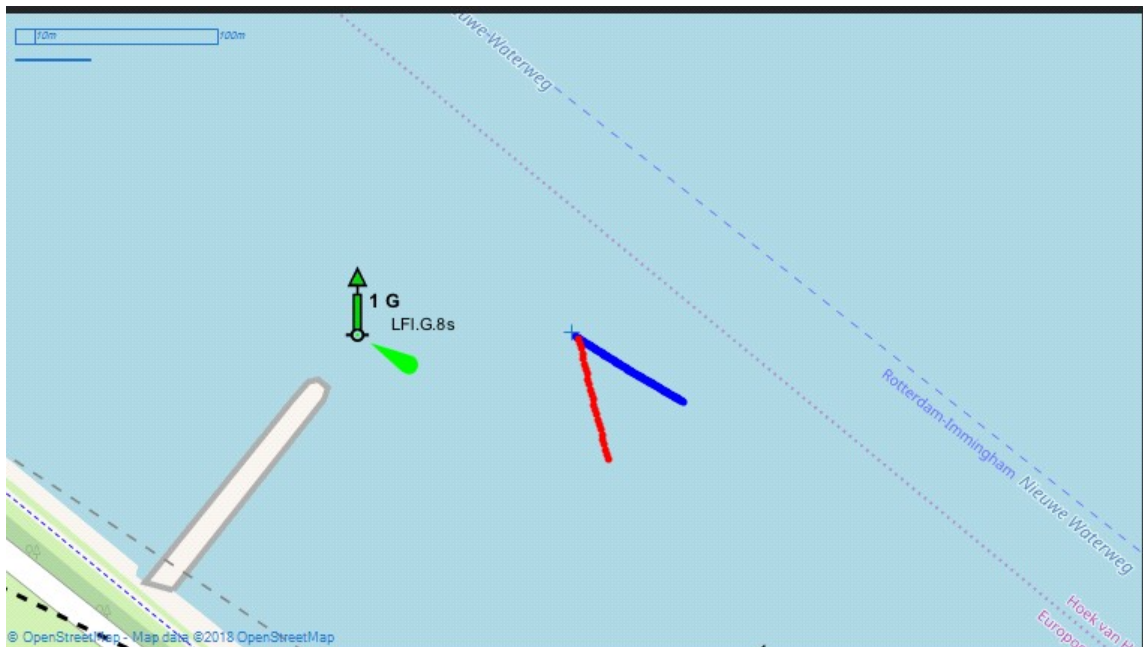
Figure 55: Bottom track and GNSS track deviation

The Bottom track velocity and direction are measured relative to earth by the Signature. The GNSS velocity and direction should match. In the example shown in the status screen (figure <u>56</u> [59]) this is not the case. This also shows up very clearly in the track plot (figure <u>55</u> [58]). The blue line shows the track according to the GNSS, the red line according to the bottom tracking.

It's clear that the bottom track direction is about 45 degrees off, which is due to the 45 degrees offset of the Signature sensor.

To correct for this, open 'Configuration' and adjust 'Orientation' for the Signature mounting, in this case to -45 degrees. The correction will be applied immediately after pressing 'Enter' or 'Tab'.

Figure 56: Aligning for bottom track

Don't forget to click 'Save Configuration'!

8   Data output

The Signature VM system can output data in different forms: NMEA, or (binary) AD2CP data with embedded NMEA (if available).

To enable data output, first select 'Use output channel' in the Configuration window. If this is enabled, the 'Output' options will be visible when clicking the 'Show Details' button (see figure 57 60). The details available in the 'Output' section will change in accordance with selections you make.
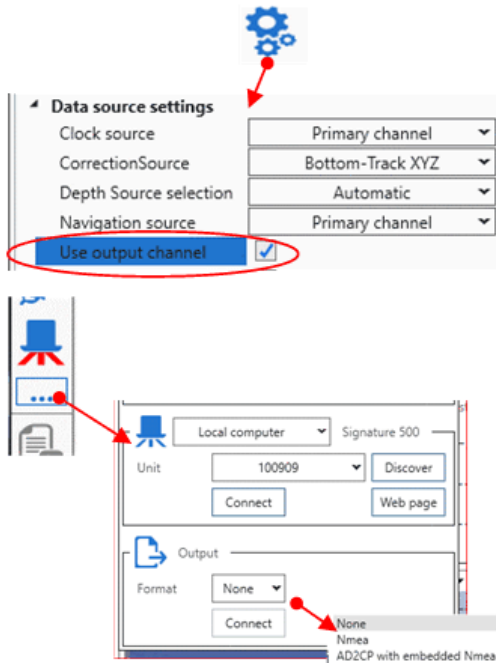
Figure 57: Enabling data output

8.1   NMEA format

NMEA compatible output may be sent to a user specified destination.

All messages conform to the NMEA-0183 version 3.01 format, with an optional IEC61162-450-timetag. Without the time tag an NMEA message starts with a $ and ends with a carriage return and line feed. Data fields follow comma (,) delimiters and are variable in length. Null fields still follow comma (,) delimiters, but contain no information.

An asterisk (*) delimiter and checksum value follow the last field of data contained in an NMEA-0183 message. For details on calculation of the checksum, see, e.g., https://en.wikipedia.org/wiki/NMEA_0183. (Note that the official NMEA 0183 Interface Standard document is a copyrighted document; see https://www.nmea.org/nmea-0183.html.)
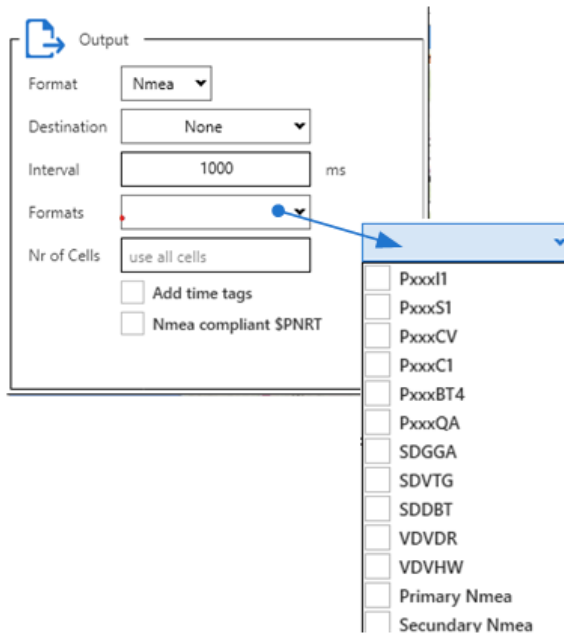
Figure 58: NMEA message options

In the NMEA options window (see figure 58[61]) you can select the required messages in the dropdown menu "Formats". Sections "$SDDBT –Echosounder- Depth Below Transducer[64]" through to "$P---S1 – Sensor Data[71]" provide details of the data fields and formats of the different messages. Note that if specific data is not available, no message will be sent.

The options 'PrimaryNMEA' and 'SecondaryNMEA' allow for replication of the primary and/or secondary NMEA input stream to the destination selected. Invalid NMEA will not be forwarded, but other than that, the forwarded NMEA data will not be altered.

If you select the option to add time tags, IEC61162-450 time tags will be added to the NMEA messages. In this case, NMEA messages are prefixed by a \c followed by a time tag (in Unix epoch notation) followed by a checksum (surrounded by an asterisk (*) and a backslash (\)). The remainder of the NMEA message is unaffected.

An example of a NMEA message with an IEC61162- 450-timetag:

\c:1582266519*58\$SNDBT,471.3,f,143.6,M,78.5,F*37

When you select the NMEA output format, fields are available to supply an interval for the output messages, and a cell limit.
The interval determines how often the data is sent. The cell limit determines the number of data cells reported in the $PNORCV and $PNORC1 messages.

When "NMEA compliant $PNRT" is checked the proprietary messages are sent with a $PNRT prefix; when it is unchecked the messages are sent with a $PNOR prefix. Note that the $PNOR prefix is not compliant with the NMEA standard (as it is not our officially registered manufacturer's mnemonic code) and can cause attached instruments to misinterpret the message as being originated from a non-Nortek instrument.

8.2 AD2CP format

The AD2CP data format is a binary format developed by Nortek. Details of the format can be found in the "Integrator's Guide – Signature"

https://support.nortekgroup.com/hc/en-us/articles/360029513952-Integrators-Guide-Signature

The AD2CP format is enhanced with optional IEC61162-450-timetagged NMEA navigation information. This is only available if a classic NMEA navigation source is connected to the system. At this moment there is no support for the Advanced Navigation GPS binary format.

8.3 Output destinations

The output of the Signature VM can be sent to different types of destinations. Selection of a destination option will result in additional configuration fields to become visible, specific to that option. Destination options for NMEA output and AD2CP output are identical, so they will be described only once. (Do note that the dialog windows for NMEA and AD2CP output will look different overall, due to the extra configuration options for NMEA output; see figure 59[62] and 60[62].)
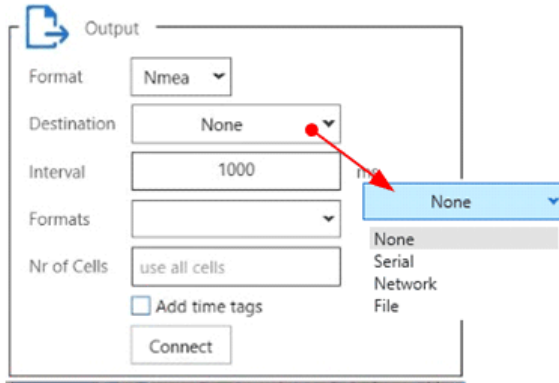
Figure 59: Output destination options
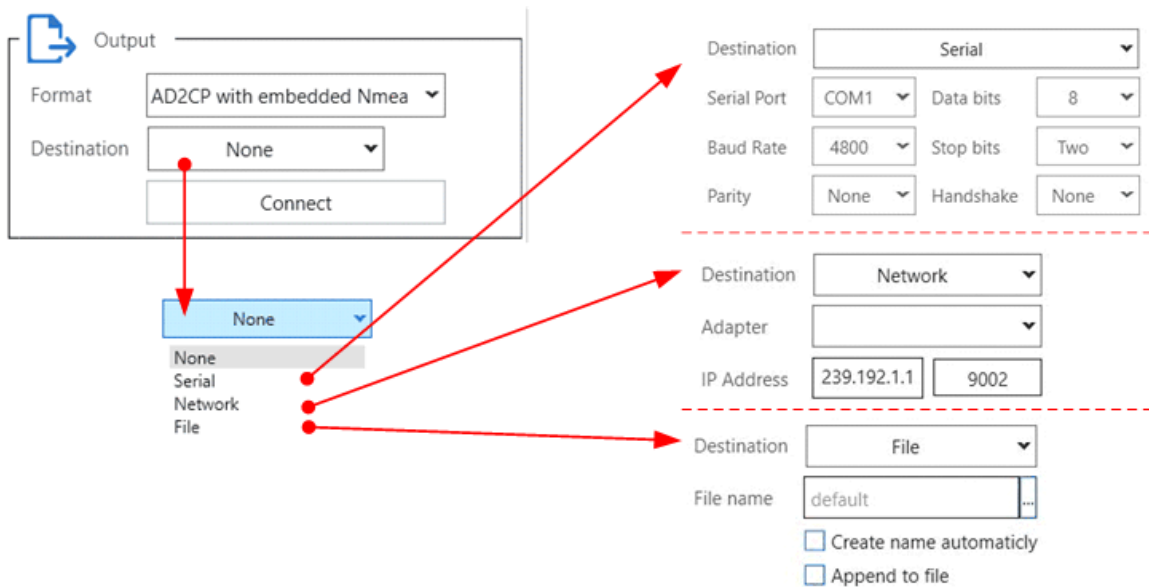
Figure 60: Configuration options for different output destinations

8.3.1 Serial output

The serial output format is considered a stream: there is no begin or end synchronization.

The configuration options for serial output are assumed to be well known. The relevant part of figure 60[62] shows the configurable parameters; each parameter has a drop-down list. (The only thing to be aware of is the possible absence of a serial port.)

8.3.2 Network output

The data is sent to the selected network address and port as UDP messages. The UDP protocol is a connectionless network protocol; this means that the destination does not need to be active or even present. UDP sends its messages whether they are received or not (and does not attempt resending).

There are two distinct ways to use the UDP output:

UDP Broadcast – in this case the UDP packets are delivered to any pc on the network. This can cause an unwanted and unnecessary amount of network traffic as the data packets are also delivered to computers on the network that are not interested in it.

UDP Multicast – this uses an IP destination address in the range 224.0.0.0 to 239.255.255.255 and is sent only to computers that have subscribed to the multicast group. This is more efficient than the UDP broadcast.

The default is to use UDP Multicast on address 239.192.1.1, using port 9002.

The destination IP address can be a specific destination like '192.168.1.123', a broadcast address like '10.0.0.255' or it can be a multicast address as show in the example. In general addresses in the 239.x.x.x range are known as multicast addresses and can be received by multiple computers on the network. Broadcast addresses can be received by computers on the same network with the same network-mask.

For the NMEA output the UDP network destination is considered a stream. There is no special handling of a begin or end condition.

For ADCP output the internal deployment record of the connected instrument is sent every 30 seconds. This allows clients to do a late join and still have access to all necessary information to process the data.

8.3.3   Data rates

Please be aware of the data rate for serial output. Even relatively simple NMEA sentences quickly outpace the standard setting of 9600 baud. Sending out multiple NMEA sentences over a single serial connection will very likely result in dropped details if attempted at 9600 baud (due to buffer overflows).

A hard and fast rule for an acceptable baudrate setting cannot be given here. Please look up the NMEA message details in terms of number of characters sent (see section NMEA message details[64]), combined over the messages you want to send. From this you can determine the required baudrate.

8.3.4   File output

For file output there are four different modes of operation, resulting from independent selection or de-selection of the options "create name automatically" and "append to file". In the following descriptions, "multiple file operation" results from selection of "create name automatically".

- Single file operation with append
  All data is written into a single file as selected by the user. The current and later recordings are all added to this file. For this mode of operation, uncheck "create file automatically" and check "append to file".

- Single file operation without append
  Data is written to a single file, but later stop and start operations result in overwriting the existing data. For this mode, uncheck "create file automatically" and uncheck "append to file".

- Multiple file operation with append
  All data is written to a file, where the filename is generated by the system based on the date and time. The location of the file is specified by the user. Later recordings are written into separate files. To select this mode, check "create file automatically" and check the "append to file" box.

- Multiple file operation without append
  Data is written to a file, where the filename is generated by the system based on the date and time. The location is specified by the user. Every "interval" a new file is created - this is the interval specified for NMEA output. To select this mode, check

"create file automatically" and uncheck the "append to file" box. (This mode can be used with other software that detects and reacts to creation of a file in a specified directory.)

Please note that for single file operation you need to supply a file name, whereas for multiple file operation you need to supply a file path. The label "File name" / "Directory" will change corresponding to the state of the "create name automatically" checkbox. The edit field following the "File name" / "Directory" label allows specification of the file name or location by the user; the ellipses-button ("...") allows selection by means of a standard file/directory selection dialog window. Note that the default location is the one specified in the Configuration window as "Recorder file location" (see section "Configuration[32] " of this manual).

8.4   NMEA message details

8.4.1   Approved NMEA sentences

8.4.1.1 $SDDBT –Echosounder- Depth Below Transducer

Field	Description	Data Format
Depth, feet	Depth below transducer in Feet	dd.dd
f	The letter 'f 'for feet	
Depth, meters	Depth below transducer in Meters	dd.dd
M	The letter 'M 'for Meter	
Depth, fathom	Depth below transducer in Fathom	dd.dd
F	The letter 'F' for Fathom	

Example:

$SDDBT,32.81,f,10.00,M,5.47,F*39

8.4.1.2 $SDGGA - Global Positioning System Fix Data

Field	Description	Data Format
Time	Time in UTC, 0-24H, 0.01 second resolution	HHmmss.ss
Latitude	Geographical Latitude	dddd.dd
N or S	The letter 'N' or 'S' for North or South	
Longitude	Geographical Longitude	ddddd.dd
E or W	The letter 'E' or 'W' for East or West	
Quality	GPS Quality Indicator	N
Nr Of Satellites	Number of satellites in view, 00 - 12	NN
HDOP	Horizontal Dilution of precision (meters)	dd.d

Field	Description	Data Format
Altitude	Antenna Altitude above/below mean-sea-level (geoid) (in meters)	dd.dd
M	Units of antenna altitude, Meters	
Separation	Geoidal separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid	dd.dd
M	Units of separation, Meters	ddd.ddd
Differential Age	Age of differential GPS data, time in seconds since last SC104 type 1 or 9 update, null field when DGPS is not used	N
Reference Station	Differential reference station ID, 0000-1023	NNNN

Example:

$SDGGA,121816.244,5134.6213945,N,00405.4297275,E,0,00,0.0,-10.0,M,0.0,M,,*7A

8.4.1.3 $SDVTG - Track made good and Ground speed

Field	Description	Data format
Track Degrees	Heading in degrees North	ddd.dd
T	The letter 'T' for True North	
Track Degrees	Heading, magnetic north	ddd.dd
M	The letter 'M' for Magnetic North	
Speed Knots	Speed over ground in Knots	dd.dd
N	The letter 'N' for knots	
Speed km/h	Speed over ground in km/h	dd.dd
K	The letter 'K' for kilometres per hour	
mode	Single letter mode indicator, can be one of the following: A: Autonomous mode D: Differential mode E: Estimated (dead reckoning) mode M: Manual Input mode S: Simulator mode N: Data not valid	

Example: $SDVTG,75.0,T,,M,1.94,N,3.6,K,A*06

8.4.1.4 $VDVBW - Dual ground / water speed

The VBW sentence contains the longitudinal and transverse ground and water speed.

By default the water speed is averaged over the full water column, when a <u>layer</u>[]47 is enabled, the water speed is the speed through water in the selected layer.

Field	Description	Data format
Longitudinal water speed	Negative means astern, in knots	d.d
Transverse water speed	Negative means port, in knots	d.d
Status	A is valid	A
Longitudinal ground speed	Negative means astern, in knots	d.d
Transverse ground speed	Negative means port, in knots	d.d
Status	A is valid	A
Stern transverse water speed	Not filled	
Status	Not filled	
Stern transverse ground speed	Not filled	
Status	Not filled	

8.4.1.5 $VDVDR – Current Speed and Direction

The VDR sentence contains the corrected current speed and direction. These are the same values as shown as current sticks in the Track plot, i.e. averaged over time and profile. When a <u>layer</u>[]47 is used however, the current is averaged in the selected layer.

Field	Description	Data format
Direction	[degrees true North]	ddd.d
"T"	Marker for True North	T
Direction Magnetic	<empty>	
"M"	Marker for Magnetic heading	M
Speed	Current Speed in knots	dd.dd
"N"	Marker for Knots	N

8.4.1.6 $VDVHW – Vessel through water Speed and Direction

The VHW sentence contains the speed and direction of the vessel relative to the water. By default this is the vessel speed relative to the water speed averaged over the full water column. When a layer[47] is enabled, the STW is the speed through water in the selected layer.

Field	Description	Data format
Direction	Heading degrees true North]	ddd.d
"T"	Marker for True North	T
Direction Magnetic	Heading degrees Magnetic	ddd.d
"M"	Marker for Magnetic heading	M
Speed	Vessel speed, relative to water knots	dd.dd
"N"	Marker for Knots	N
Speed	Vessel speed, relative to water km/h	dd.dd
"K"	Kilometers	

8.4.2 Proprietary NMEA sentences

The following messages are a subset of the messages as used by the Nortek DVL (Doppler Velocity Log), but the 'Tagged NMEA' versions are not supported
(e.g. $PNRTS2,DATE=083013,TIME=132455,EC=0, SC-34000034…).

By default the NMEA messages are sent with the $PNRT prefix, these messages are compliant with the NMEA IEC61162-1 standard. For compatibility with existing equipment that uses the nonstandard $PNOR messages the output format can be changed (see figure 58[61] in section "NMEA format[60]" for details). The difference is only in the prefix, otherwise the message details are the same. (However, the checksum will be different, due to the difference between NRT and NOR.)

Note that "NOR" is not our officially registered manufacturer's mnemonic code, but has been used historically.

In the next sections, "$P---" can be either "$PNRT" or "$PNOR", dependent on the compliance selection. (The examples show the $PNOR variant; see the remark about the checksum, earlier.)

8.4.2.1 $P---BT4 – Speed over ground and depth

Field	Description	Data format
DT1	Time from trigger to bottom echo (NOT USED)	d.ddd
DT2	NOT USED	d.ddd
Speed Over Ground	[m/s]	d.ddd
Direction	[degrees true North]]	d.d

Field	Description	Data format
Figure Of Merit	#	dd.ddddd
Distance to Bottom	[m]	dd.d

Example:

$PNORBT4,0,0,1.234,23.4,12.34567,12.3*09

8.4.2.2 $P---C1 – Velocity data per Cell

Field	Description	Data format
Date	Date	MMDDYY
Time	Time in UTC, 0-24H, 0.01 second resolution	Hhmmss
Cell Number	#	Dd
Cell Position	Distance from sensor to centre of the cell[m]	dd.dd
Velocity East	[m/s]	dd.ddd
Velocity North	[m/s]	dd.ddd
Velocity Up	[m/s]	dd.ddd
Amplitude Beam 1	[dB]	ddd.d
Amplitude Beam 2	[dB]	ddd.d
Amplitude Beam 3	[dB]	ddd.d
Amplitude Beam 4	[dB]	ddd.d
Correlation Beam 1	[%]	dd
Correlation Beam 2	[%]	dd
Correlation Beam 3	[%]	dd
Correlation Beam 4	[%]	dd

Example (DF101, 4 beams)

$PNORC1,072623,075212.85,1,1.25,0.499,-0.001,-0,35.5,35.5,35.5,35.5,95,95,95,95*63

8.4.2.3 $P---CV – Velocity data per Cell

Field	Description	Data format
Date	Date	MMDDYY

Field	Description	Data format
Time	Time in UTC, 0-24H, 0.01 second resolution	Hhmmss.ss
Cell Number	#	Dd
Cell Position	Distance from sensor to centre of the cell[m]	dd.dd
Velocity East	[m/s]	dd.ddd
Velocity North	[m/s]	dd.ddd
Velocity Up	[m/s]	dd.ddd
Velocity Up2	[m/s]	dd.ddd
Speed	[m/s]	dd.ddd
Direction	[degrees]	ddd.dd
Amplitude Units	D=dB	D
Amplitude Beam 1	[dB]	ddd.d
Amplitude Beam 2	[dB]	ddd.d
Amplitude Beam 3	[dB]	ddd.d
Amplitude Beam 4	[dB]	ddd.d
Correlation Beam 1	[%]	dd
Correlation Beam 2	[%]	dd
Correlation Beam 3	[%]	dd
Correlation Beam 4	[%]	dd

Example:

$PNORCV,201419,112049.21,59,29.7,-2.464,-
3.178,0.55,0.396,4.022,217.788,D,33,33.5,33,32.5,12,32,34,21*78

8.4.2.4 $P---I1 – General Information

Field	Description	Data format
Instrument Type		N
Head Id	Serial number of instrument	N
Number of Beams		N

Field	Description	Data format
Number of Cells	Number of valid cells	N
Blanking Distance	[m]	dd.dd
Cell Size	[m]	dd.dd
Coordinate System	Always E(ast) N(orth) U(p) for Signature VM	ENU

Example: $PNORI1,4,123456,3,30,1.00,5.00,ENU*5B

8.4.2.5 $P---QA – Quality and performance figures

The QA sentence contains data that may be used for monitoring the quality of the recorded measurements.

Amplitude and Correlation figures are averaged over the approved cells only, so they do not include bottom reflections.

Field	Description	Data format
Date	Date	MMDDYY
Time	Time in UTC, 0-24H, 0.01 second resolution	hhmmss.ss
Valid cells	Valid cells as used to calculate the averages	dd
Error Code	Signature Error code (16 bits)	Hex
Status Code	Signature Status code (16 bits)	Hex
Quality Status	Quality status string (8 characters; see table below for details).	"xxxxxxxx"
Amp1	Average Amplitude Beam1 [dB]	ddd.d
Amp2	Average Amplitude Beam2 [dB]	ddd.d
Amp3	Average Amplitude Beam3 [dB]	ddd.d
Amp4	Average Amplitude Beam4 [dB]	ddd.d
Corr1	Average Correlation Beam1 [%]	dd
Corr2	Average Correlation Beam2 [%]	dd
Corr3	Average Correlation Beam3 [%]	dd
Corr4	Average Correlation Beam4 [%]	dd
FOM1	Figure Of Merit Beam1	ddddd

Field	Description	Data format
FOM2	Figure Of Merit Beam2	ddddd
FOM3	Figure Of Merit Beam3	ddddd
FOM4	Figure Of Merit Beam4	ddddd

Quality Status: String with status letters: G, M or D or -:

(G)ood, (D)egraded, (M)issing or '-' for not enabled. Example: GGDGGM-G

Character nr	Measurement	Source
1	Position	GNSS
2	Heading	GNSS
3	Speed over Ground	GNSS
4	Time	GNSS
5	Heading Pitch Roll	GNSS
6	Bottom track	Signature (G or M)
7	Velocity	Signature velocity Burst
8	Echo	Echosounder (G or M)

8.4.2.6 $P---S1 – Sensor Data

Field	Description	Data format
Date	Date	MMDDYY
Time	Time in UTC, 0-24H, 0.01 second resolution	Hhmmss.ss
Error Code	See Signature manual for details	N
Status Code	See Signature manual for details	N
Battery Voltage	[V]	dd.d
Sound Speed	[m/s]	dddd.d
Heading	True Heading [deg]	ddd.d
Heading Std Dev.	[deg] (Not Used, always 0)	dd.dd
Pitch	[deg]	dd.d

Field	Description	Data format
Pitch Std Dev.	Standard Deviation [deg]	dd.dd
Roll	[deg]	dd.d
Roll Std Dev.	Standard Deviation [deg]	dd.dd
Pressure	[dBar]	ddd.ddd
Pressure Std. Dev.	Standard Deviation [dBar]	dd.dd
Temperature	[deg C]	dd.dd

Example (DF101):

$PNORS1,083013,132455,0,34000034,23.9,1500.0,123.4,0.02,45.6,0.02,23.4,0.02,123.456,0.02,24.56*39

8.5   Compliant NMEA

Option	Default	Description
NMEA Compliant	Yes	Use our officially registered manufacturer's mnemonic code for proprietary NMEA sentences ($PNRT); deselect this tickbox ("no") to use the historical mnemonic code ($PNOR), for compatibility (but note that this code is not registered to Nortek, hence using this code is not compliant; see also section "Proprietary NMEA sentences[67]" for details, and figure 58[61] in section "NMEA format[60]" for the location of this tickbox).

9 Installation

9.1 Instrument orientation

When mounting the Signature sensor to the vessel it is important to note the orientation. As shown in figure 61 [73] , the 'X' is not pointing straight forward, but 45 degrees off the centre line. If mounted like this, the heading offset as used by the software should be set to -45 degrees (See section "Offsets [53] " for details on how to enter the orientation.)
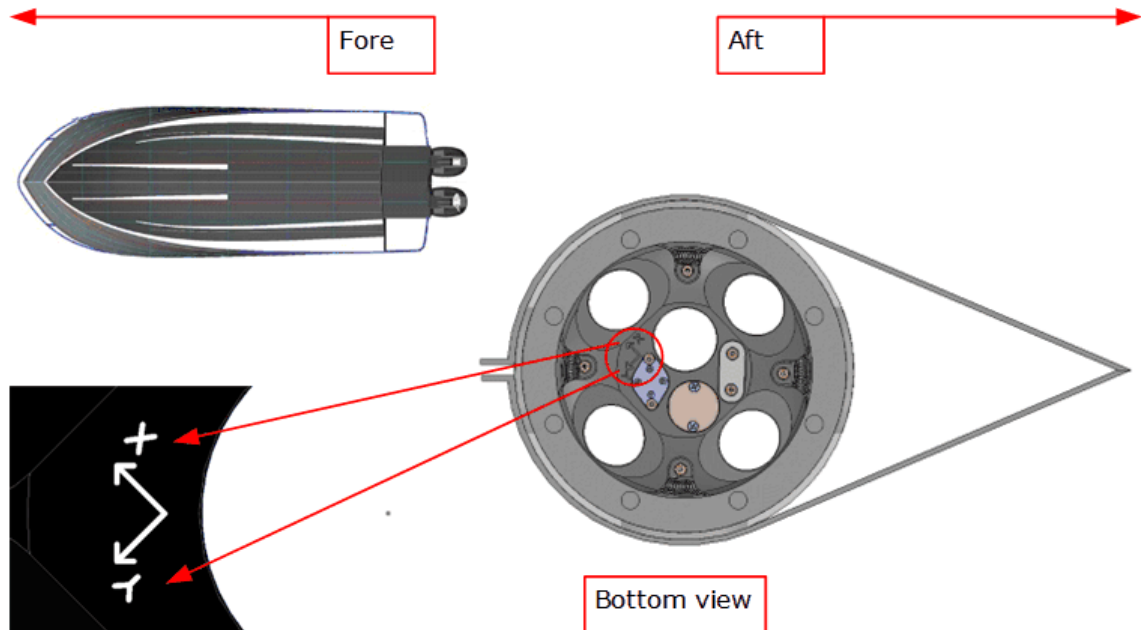

Figure 61: Signature orientation relative to the vessel

9.2 Mounting Considerations

9.2.1 Bubbles

Try to avoid mounting the Signature sensor in areas where bubbles from the propeller or thrusters will pass over the Signature sensor head. The system can tolerate some bubbles in front of the acoustic transducers but when the bubble-cloud gets too dense, the acoustic energy will be blocked, and the profiling range will be greatly reduced. Also, bubbles on the sensor head will change the speed of sound and potentially lead to erroneous results in the velocity measurements.

In order to avoid interference from bubbles, the best solution is to find an area under the hull where there are fewer bubbles. It this is difficult it can be a good idea to mount a V-shaped structure in front of the Signature sensor that will deflect the bubbles. Another possibility, often used with commercial echo sounders, is to mount the Signature sensor on a piston rod that can be moved as much as 0.5-1m below the hull, so the sensor head is located below the bubble layer.

9.2.2 Grounding

When mounting the sensor in a ship's hull or on another platform, make sure the grounding point always touches the water.
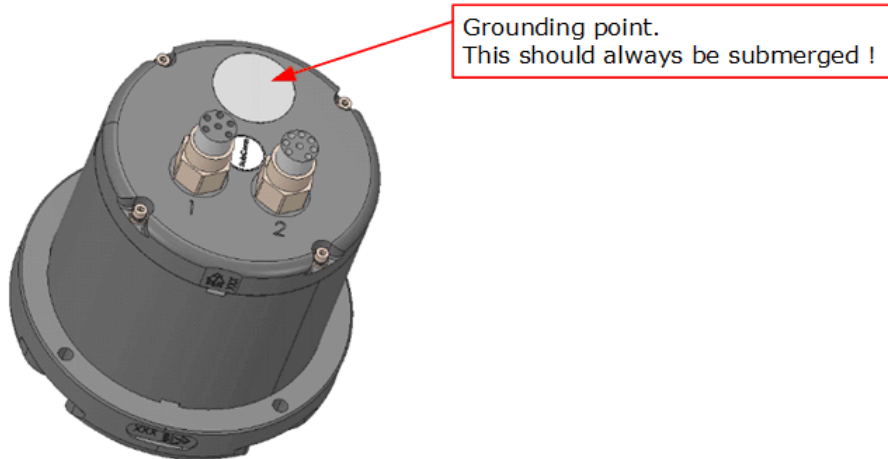

Grounding point.
This should always be submerged !

Figure 62: Signature grounding point (Signature 500 shown)

9.2.3 Ship movements

Try to avoid mounting the Signature sensor too close to the bow or to the stern. Instead, the best areas are toward the middle of the ship. There are two reasons to pick an area toward the middle. First, the vertical motion due to pitch and roll is minimal toward the middle. Second, the ship-induced flow field has stronger asymmetries toward the bow and stern. These asymmetries will reduce the accuracy of the velocity data close to the hull and are best kept to a minimum. Ship-induced motion is usually a bigger problem when the relative water depth is smaller, and the ship is larger or bulkier (less "classic" hull structure). It is usually not a significant problem on small vessels or for Signature sensors mounted over the side.

The tilt angle of the installation should be as small as possible because a level sensor head makes it easier to interpret and analyse the velocity data. However, a few degrees of tilt do not make a great difference in the accuracy of the horizontal velocity data.

9.2.4 Ship generated flow fields

All ships generate their own flow field. The magnitude of this field is a function of the ship size, shape, ship speed, and the water depth. It is weaker away from the hull than it is close to the hull and it will be weaker on the side of the ship than it is directly below the hull. The magnitude of the flow field can be analysed by looking for persistent vertical gradients in the velocity data.

a) The flow field is strongest close to the hull and will usually "pull the water along with the ship". As a result, the sign of the velocity gradient will remain constant and it will not change direction as the ship moves in the opposite direction. If the gradient remains constant, regardless of the direction of the ship motion, it is not a part of true current regime, but an artefact of the ship induced flow field.

b) When the Signature sensor is mounted close to the bow or to the stern, it will show a net vertical velocity close to the hull. If the vertical velocity has a strong gradient (i.e. it is not constant with the water depth), it is usually a result of the motion.

9.2.5 Over the Side Mounting

Movable mounts are used for short term surveys or when the Signature sensor will be moved from ship to ship. Most of these mounting arrangements are designed so the Signature sensor will be mounted over the side. It is important that the mount is rigid so that the orientation of the Signature sensor does not change over the course of the survey.

Note that the relative orientation of the Signature sensor as referenced to the GNSS coordinate system should remain unchanged over the survey. Mounting systems that use a separate, towed catamaran or other towed body are not suitable unless the GNSS antenna is also mounted on the towed body.
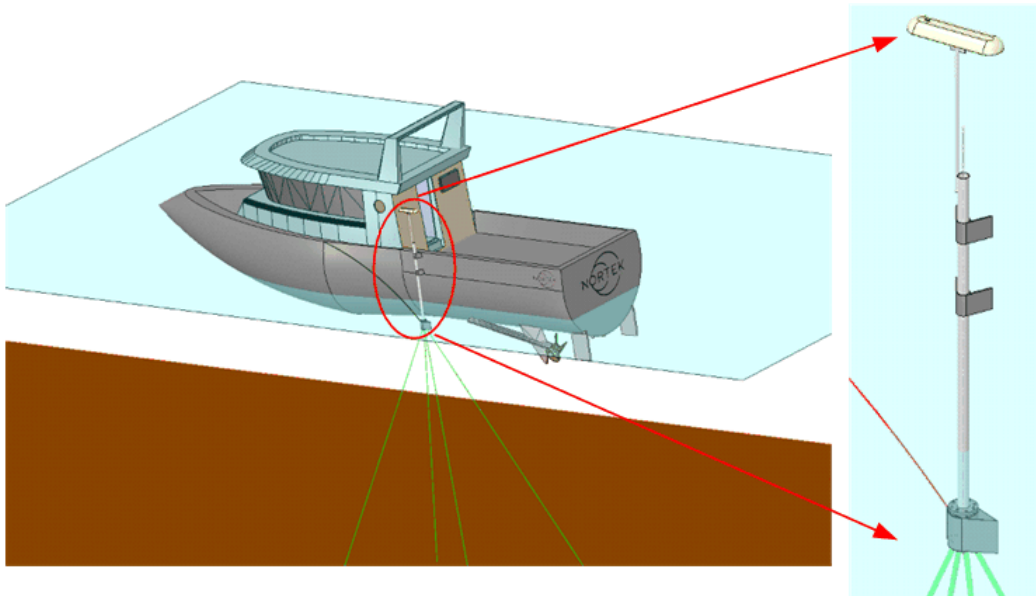

Figure 63: Over-the-side mounting pole

The instrument may be supplied with an over the side mounting frame. This stainless-steel frame is basically a container for the Signature instrument that protects it against damage from impact and to ease the water-flow around it. Using the drop-shaped cover will also significantly reduce the drag on the instrument when it moves through the water.

For maximum flexibility, the top of the container has 8 slots that fit M12 bolts. It is up to the user to provide a mounting structure with a mating flange. The example (figure 64^{□ 75}) shows a standard flange, model EN 1092-1.
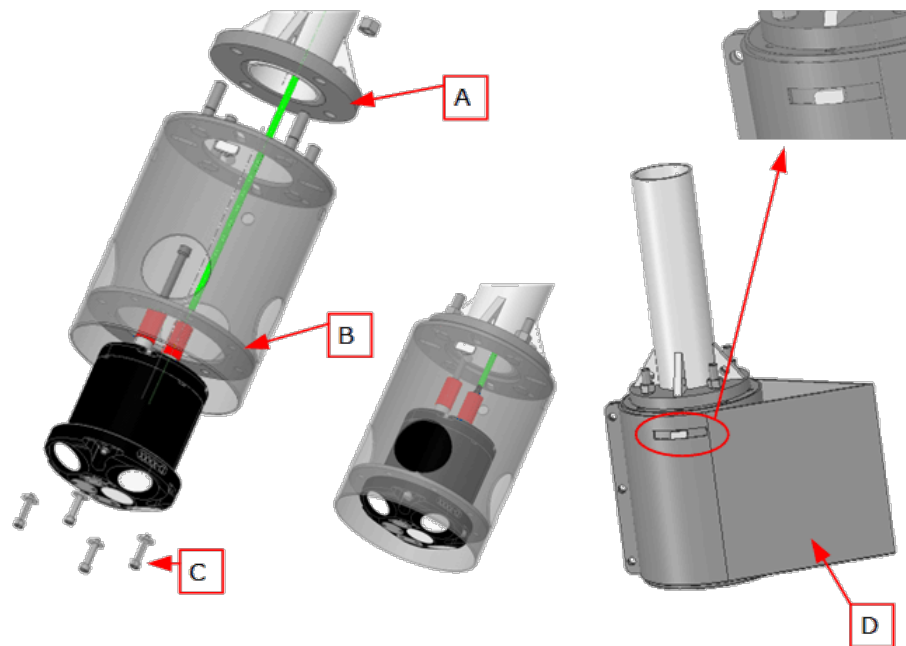
Figure 64: Mounting frame (for Signature 500 / 1000)

1. Mount the bolts on top of the cylinder and align them with the holes in the flange (A)

2. Route the cable and connect it to the instrument.

3. Mount the instrument to the internal flange (B) using the four bolts (C).

4. Attach to the flange

5. Finally mount the drop-shaped cover(D), line-up the rectangular (hammerhead-) bolts with the slots in the cover.

9.2.6 GNSS Mounting
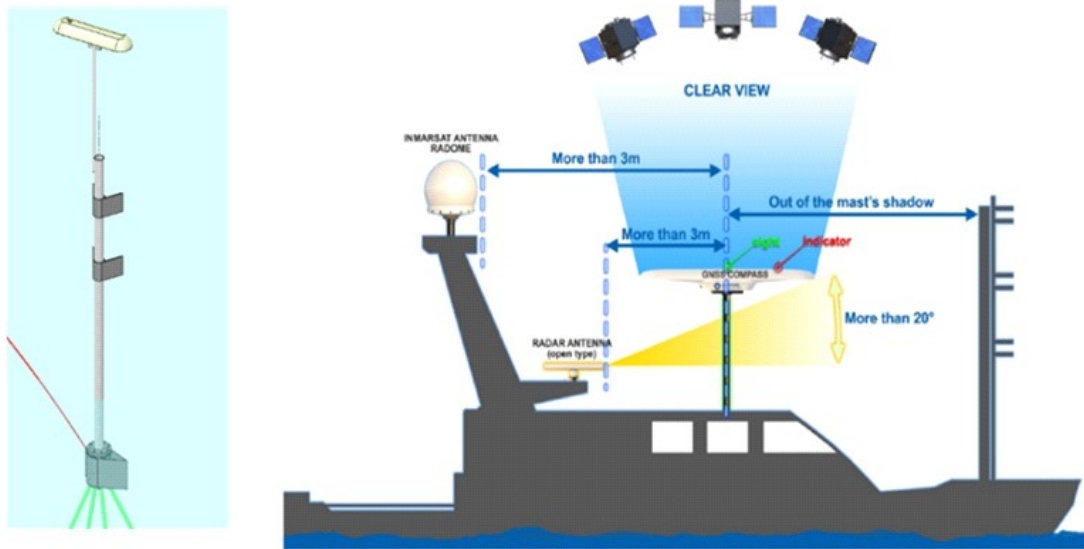
Figure 65: Suggested GNSS locations

Ideally the GNSS antenna should be mounted as close to the Signature as possible, or at least in the same vertical plane. This is not always possible and there may be several other mounting considerations like the clear view of the sky or nearby radar. It is not a huge problem if it isn't completely aligned but the closer the better.

The GNSS antenna comes with a stainless-steel Mast/Rail bracket that can be clamped to a horizontal or vertical pole as shown in figure 66 [77].

To attach the antenna to the mounting pole, first put the nut and the plastic ring on the thread, then screw on the antenna. Point the antenna so it is in line with the ship's main axis and fix it in position using the nut.

Figure 66: GNSS mounting bracket
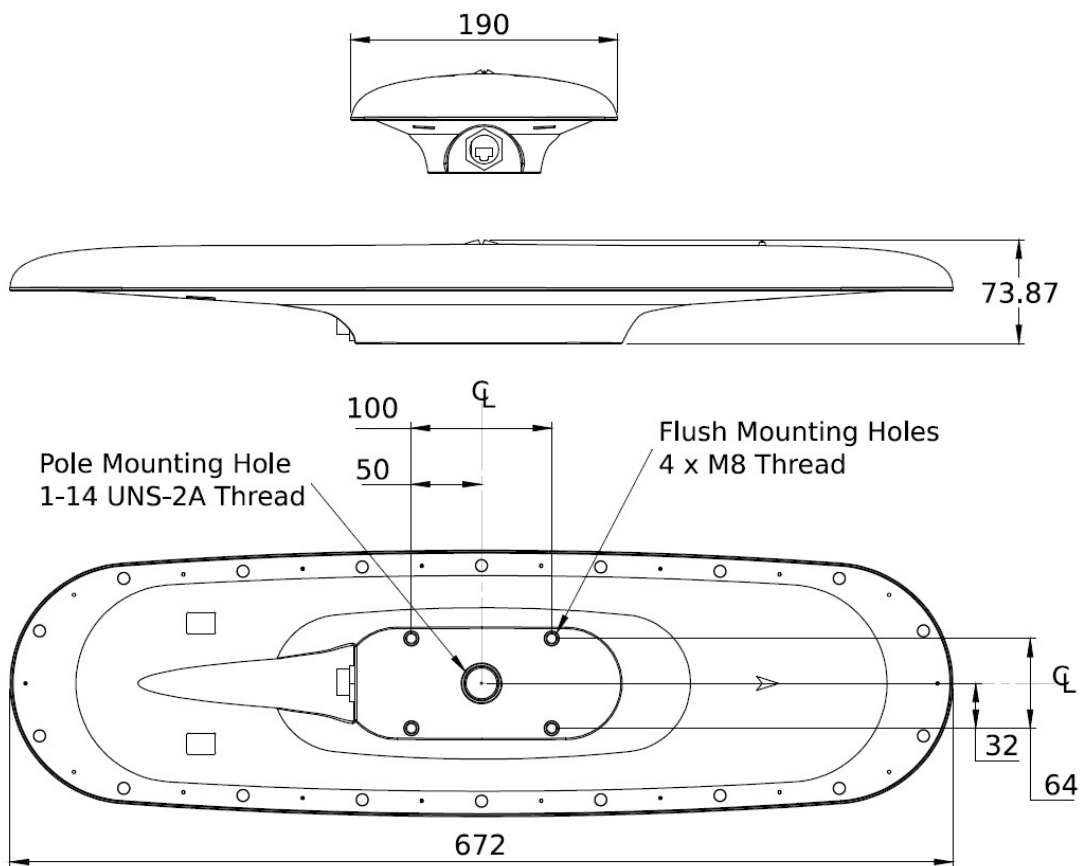
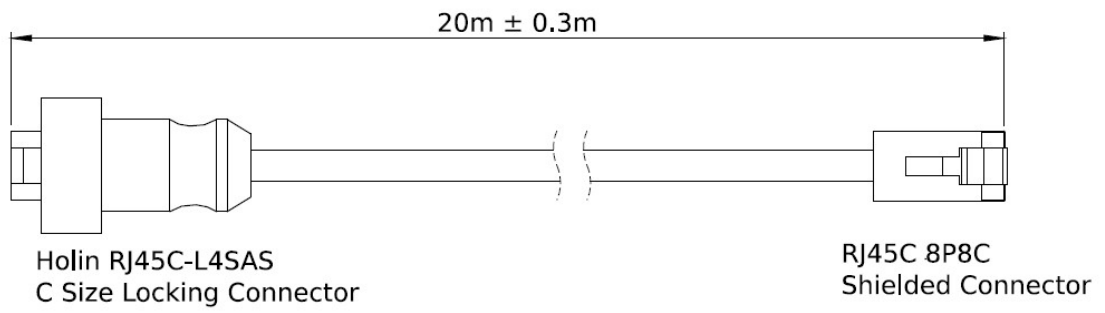*Figure 67: Mechanical drawing of GNSS Compass*

20m ± 0.3m

Holin RJ45C-L4SAS
C Size Locking Connector

RJ45C 8P8C
Shielded Connector

Figure 68: GNSS Ethernet Cable

10   Maintenance

10.1   Signature Sensor

We recommend a regularly scheduled procedure which will act as a preventative measure to ensure your instrument continues functioning as intended. The following sections can be used as a maintenance guideline for the components that may be exposed to wear and tear.

- When cleaning the external surfaces use a mild detergent and be extra careful with the transducers.

- Check the pressure sensor and remove any dirt from the holes in the lid. Be careful when opening the pressure sensor cap as it is easy to dent and damage the sensor.

- Be careful when cleaning and lubricating the connectors.

- When opening the instrument, great care should be taken to keep the sealing surfaces clean and protected from mechanical damage. Always keep water out of the open housing. The grounding point should always be free from biofouling.

10.2   Biofouling

Current profilers used in long term monitoring projects will become covered with biological material. Eventually, the growth can become strong enough that the transducers are blocked, and the profiling range is reduced. To know when to maintain the instrument it is best to monitor the long-term variation in the amplitude data. This parameter varies with short time scales (depending on suspended sediment concentration, zoo plankton, bubbles, etc.), but biological growth (especially barnacles) adds a long-term downward trend that can be monitored. The profiling range gradually goes down as the growth on the sensor increases. At some point, the signal strength will be too low to get the desired profiling range. Through experience you will gain knowledge about how long it takes before the transducers are covered and this information can later be used to set regular maintenance intervals where the transducers are cleaned.

When the instrument leaves the factory, the surfaces are quite smooth, and it will take some time before any growth starts. After the first cleaning, the surface is rougher, and it becomes easier for new material to grow. Typical maintenance intervals are 6-12 month, but the growth rates vary a lot with the geographical location, water temperature, season, and deployment depth. In general, heavy growth is seen in hot and shallow areas. Cold- and deep-water areas see very little growth so maintenance can be less frequent.

To clean the transducer, we recommend not to use strong organic solvents such as acetone. Barnacles must be removed mechanically, but we strongly advise against using sharp objects capable of harming the surface.

10.2.1 Antifouling Paint and patches

The important thing regarding painting transducers is that the paint is not too thick, otherwise the signal strength will decrease. You can probably use most anti-fouling paints if it is not too (chemically) aggressive and contains no solids (metal flakes, etc) that could interfere with acoustic beams. Anodes and pressure ports should not be painted. For permanent hull mountings on vessels with a low maintenance interval, Nortek advices to use antifouling patches. These consumables can be purchased via the Nortekgroup web shop. The patches double the standard cleaning interval and a diver can quickly clean the patches from marine growth.

10.3   Instrument Care

All Nortek instruments are intended for use in water. Other fluids may have an adverse effect on the plastic materials used. For prolonged storage at elevated temperatures close to the specified limit, or when temperature variation is uncertain, it is recommended that the screws securing

the end cap be loosened in order to minimize the risk of any deformation due to temperature/stress over time.

If the instrument has been subjected to environmental conditions outside the specified design limits (refer to the instrument brochure for specifications) mechanical tolerances may be affected.

10.4   Connector Care

It is extremely important to keep connectors clean and well lubricated. Before plugging in connectors, we recommend to always blast the pins with compressed air, inspect them for cleanliness and then protect the cable connector by applying a thin layer of silicone grease.

Before deployment:

- Disconnect.

- Flush the connector set with fresh water or compressed air, remove dirt. Remember to also check the female connector.

- Check that both connectors are dry. If not, let them air-dry.

- Inspect for damage, corrosion and cuts.

- Apply a thin film of Silicone grease.

- Mate the connector halves and check if they are properly mated.

After deployment and before storage:

- Flush the connector set with fresh water or compressed air, remove dirt.

- Check that both connectors are dry. If not, let them air-dry.

- Inspect for damage, corrosion and cuts.

- Mate with dummy plug if available.

10.5   Cable Care

- Do not pull on the cable to disconnect connectors.

- Avoid sharp bends at the cable entry to the connector.

- Ensure that the cable is fixed to the mounting fixture to avoid mechanical stress to the connection.

- Elastomers can be seriously degraded if exposed to direct sunlight or high ozone levels for extended periods.

11   Triggering and time-synchronization

When using the Signature sensor in an environment with other acoustic instruments that operate in the same frequency band, instrument activity needs to be staggered, usually by means of triggering, to prevent interference.

The Signature sensor itself, and the Signature VM software, offer several options for triggering. Figure 69 shows the different options from the software perspective; the drop-down box behind "Triggering" in the Signature Connect dialog shows the options. Triggering also has hardware aspects. Section Triggering[81] and its subsections provide further details on the various options for triggering, including the hardware aspects where relevant.

There are several options for time-synchronization; see the drop-down box behind "Clock source" in figure 69. Section Time synchronization[85] provides further details on these options. To use the PTP or NTP option, an appropriate time-source needs to be available on the network. The Advanced Navigation GNSS that is part of the Nortek VM Coastal system functions as a PTP clock-source.

Note that for both Triggering and for Clock source, the contents of the Connect Dialog will change depending on the selections you make. The figures in the relevant sub-sections illustrate this.

Also note that these screen-shots show the DF21 and DF22 output options. These are licensed options, and only show if the license is present. (See section Additional Options[28] .)
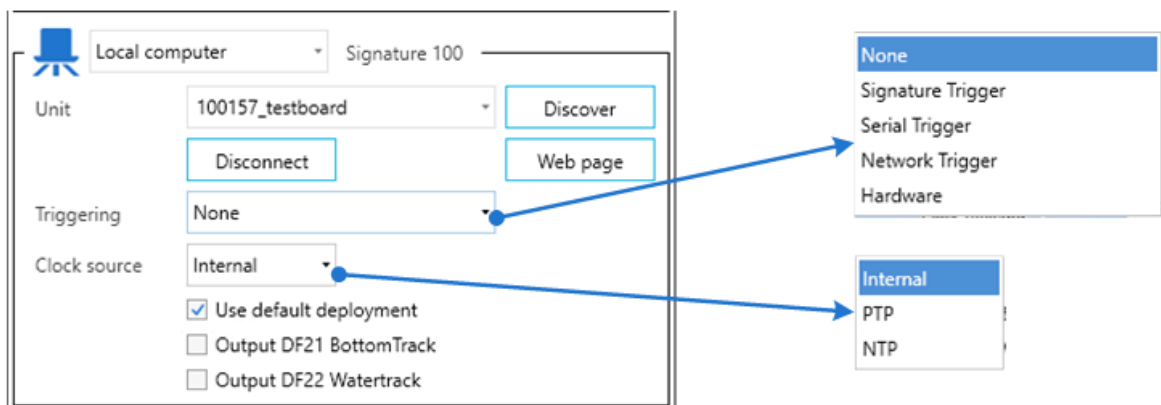
Figure 69: Trigger and clock source optoins in the Signature connection dialog window

11.1   Triggering

There are two distinct triggering mechanisms: via direct communication with the Signature instrument itself, or through communication with the VM software via the Processing Unit the software runs on.

Triggering through direct communication with the Signature instrument itself we call "ping-based" triggering. In this case, the trigger signal is either an RS485 signal or a network signal, directly to the Signature instrument.

In "ping based" triggering, every single ping that is part of a measurement cycle (ensemble) needs a separate trigger. "Ping based" triggering corresponds to the option "Signature Trigger" in the drop-down menu of figure 69. Section Ping-based triggering (Signature triggering)[82] explains this in more detail.

Triggering through communication with the VM software we call "ensemble-based" triggering. For this, the trigger signal can be serial, a network message, or a dedicated hardware connection, to the Processing Unit that runs the Signature VM software and controls the Signature instrument.

In "ensemble-based" triggering, a single trigger will initiate all of the pings that are needed for a measurement cycle (ensemble). All of the options "Serial Trigger", "Network Trigger", and "Hardware" fall in this category. Section <u>Ensemble-based triggering</u>[83] provides further details.

11.1.1 Ping-based triggering (Signature triggering)

Ping-based triggering or "Signature triggering" is the Signature sensor's built-in triggering mechanism, using direct communication with the Signature instrument itself. (Note: This is not available on the Signature 333.)

Upon receiving a trigger, the instrument will do one transmit and receive cycle (one ping). This means that if the instrument is configured for multiple bursts per measurement, multiple triggers will be required for a full measurement cycle. For the Signature VM, which requires at least one velocity and one bottom track ping per measurement, this means it needs two triggers for every full cycle. If you add altimeter or echosounder bursts it will need more triggers to complete the measurement.

When this method is used there is a risk that the individual triggers are too much separated in time and thus do not produce an optimal result when the data of the individual pings is combined. On the Signature it can take 8-16 triggers to complete a measurement cycle.

To put the Signature sensor into this triggering mode, use the VM software and select "Signature Trigger". After this, the Connect dialog will show extra drop-down boxes for "Mode" and "Options" (see figure 70). See the next sub-sections for details on the different menu selections.
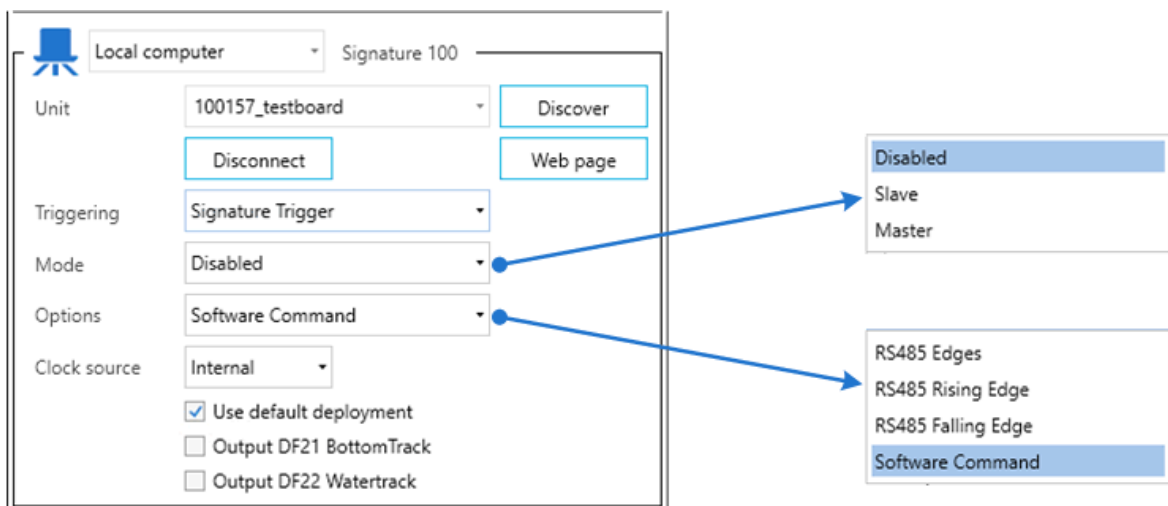
Figure 70: Mode and option menus for "Signature Trigger" style triggering.

11.1.1.1 Signature Triggering: Slave mode

To send an external trigger coming from an external source, the instrument must be set to 'Slave'. After receiving a trigger signal, the instrument will perform one transmit and receive cycle (a.k.a. a single ping).

11.1.1.2 Signature Triggering: Master mode

"Trigger mode: Master" enables master trigger output. After performing a transmit and receive cycle itself, the instrument sends out a trigger signal, to allow other instruments to perform a measurement.

Note that this mechanism only works in specific circumstances. The Integrator's Guide mentions:

"RS485EDGE trigger must be used with this option. This enables several instruments to be synchronized together through RS485 with one of the instruments acting as master. Only continuous measurement configurations are supported in this mode, and all synchronized AD2CP instruments must be of the same frequency and have the same deployment configuration."

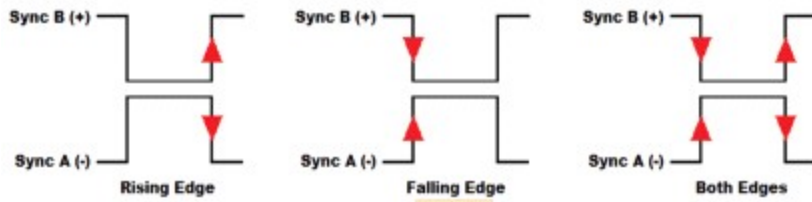### 11.1.1.3   Signature Triggering: RS-485 options

Figure 71: RS-485 trigger signal details

An RS-485 signal can be used to trigger the Signature, either Rising Edge, Falling Edge or Both Edges of a RS-485 Signal. Figure 71[83] shows the polarities of the differential RS-485 signal pair for the trigger types. When triggered the instrument will perform a complete ping (transmit and receive) before it goes back to monitoring the trigger. Any triggers asserted during an ongoing ping will be ignored. The pulse length should be at least 1 ms.

The signal should be applied to Pin 7 and 8 of the 8-Pin Subconn connector.
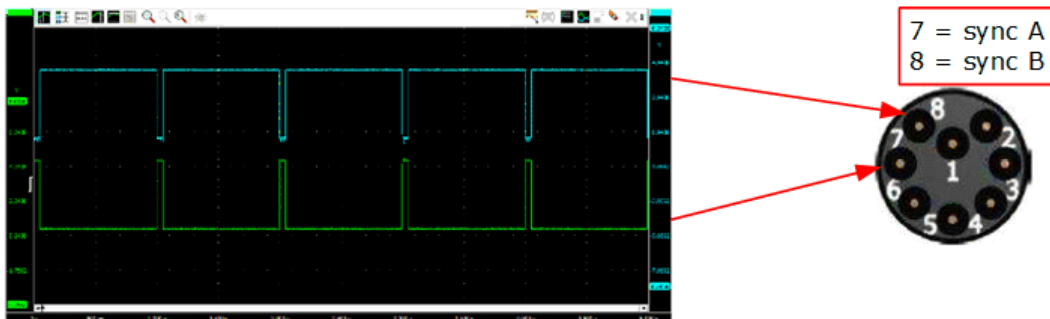
Figure 72: RS-485 triggering oscilloscope trace and connection pins

11.1.1.4   Signature Triggering: Software command

"Trigger mode: Command" allows the Signature to be triggered by a command. Sending the TRIG<CR><LF> command to ethernet port 9000 or 9001 on the IP address of the instrument will trigger it. The actual moment of triggering is right after it receives the <LF> (LineFeed) character.

By default, the Signature VM software connects to the instrument on port 9000, so it is possible to make a second connection on port 9001 and send the TRIG command to that. After the instrument receives the trigger it will do one transmit / receive and return the data for that specific transmission on both data ports.

11.1.2 Ensemble-based triggering

The ensemble based triggering mechanism is built into the Signature VM software. After receiving an external trigger, the software will take care of the amount of triggers the Signature sensor needs to complete a measurement cycle.

Ensemble triggering supports three different types of interfaces: hardware based, and two software-based protocols (UDP or serial).

Additionally, the ensemble-based triggering supports handshaking. For both hardware and software triggering, after receiving a trigger, the VM software will acknowledge the start of its active state by sending a busy signal. For software triggering, it will also send a ready state signal when done.

When the system is offline it will not respond to a trigger command, in general the busy indicator will be sent within 100 ms.

When using Triggering the Sensor timeout can be adjusted to prevent false "missing data" detection (red indicator in the status panel) .

11.1.2.1 Hardware trigger

Hardware trigger is primarily intended for use with the Ocean/Operations Processing Unit model 4420. DIN-rail mounted connectors provide access to signal lines "trigger" and "busy" (as well as signal ground and chassis ground). These signal lines are connected to the CTS (trigger in) and RTS (busy) lines of COM1. Figure 73 shows the connectors, including the labels.
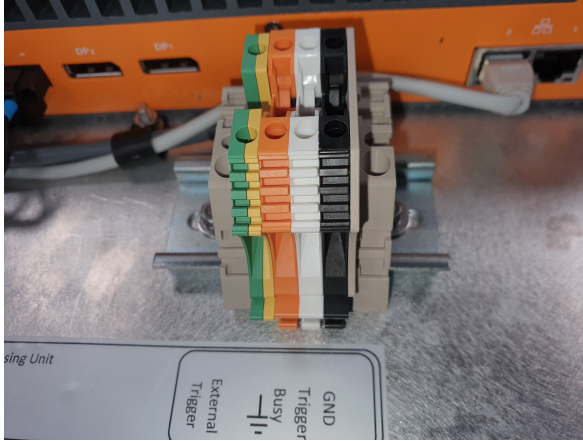

Figure 73: Hardware trigger connectors at the back of the Processing Unit model 4420.

Figure 74 shows the extra drop-down menus in the Connect dialog upon selecting "Hardware" as the Triggering option.

For the hardware handshake the trigger signal happens by activating the "trigger" (CTS) line of the serial port. The busy state is indicated by the "busy" (RTS) line.

The default settings for hardware trigger are a rising edge for the trigger moment, and a high level (in terms of voltage) to indicate the busy state. Table 7 gives on overview of the options for the trigger and busy signals.
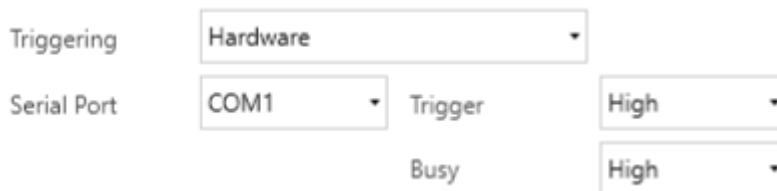
Figure 74: Hardware trigger options

Table 7: Possible settings for the hardware trigger

Signal	Signal level selection from drop-down box	
	High	Low
Trigger	Trigger on the rising edge	Trigger on the falling edge
Busy	High voltage indicates the system is busy	Low voltage indicates the system is busy

Notes

- The voltage levels are RS-232 levels: high voltages between +3 and +15 V, low voltages between -3 and -15 V.

- The software and this manual do *not* refer to the RS-232 logic 0 and logic 1 levels. (Where we mention "a high level in terms of voltage", we do mean +3 .. +15 V)

- The busy signal level is only valid while the measurement is running (i.e., the "Start" button in the "Start measurement" dialog window has been pressed; see section <u>Start measuring</u>[37]). Before start of the measurement, and after stopping a measurement, the voltage level will go back to a default low voltage, irrespective of the "High" or "Low" selection for "Busy".

11.1.2.2 Software trigger

For software trigger there are two options: a network UDP based trigger or a serial connection. For both networking and serial triggering, the trigger is initiated by sending a "TRIG\n" command to the VM Coastal or Ocean/Operations Processing Unit, where the system will respond with "BUSY\n". When the measurement cycle is complete the software will send back a "READY\n" command. ("\n" is the newline character, hexadecimal 0x13h.)

Figure 75 shows the options for the Network Trigger choice: primarily the network adapter on which it should listen for the trigger messages, and the UDP port number. The default IP Address as shown is a reserved, special purpose IP Multicast address.

Triggering	Network Trigger
Adapter	Ethernet
IP Address	239.192.1.1	9002

Figure 75: Network trigger options

Figure <u>76</u>[85] shows the various extra drop-down menus that show when selecting the Serial Trigger options. These are all typical serial communication parameters, that should be selected to match those of the serial trigger provider.

Triggering	Serial Trigger		
Serial Port	COM1	Data bits	8
Baud Rate	4800	Stop bits	Two
Parity	None	Handshake	None

Figure 76: Serial triggering options

It is worth noting that neither the Coastal Processing Unit, nor the Ocean/Operations Processing Unit, have accessible serial ports. To use the Serial Trigger option, you would have to provide a USB-to-Serial converter. In that case, you also need to be careful about selecting the correct COM-port: both the Coastal Processing Unit and the Ocean/Operations Processing Unit will list several other COM-ports.

The Coastal Processing Unit has several COM-port connections on the motherboard. None of them is physically accessible, but they will be listed.

The Ocean/Operations Processing Unit has two COM-ports on the outside of the PC; the first one is in use for the Hardware Trigger option. The other one is not accessible due to space constraints in the hardware.

11.2 Time synchronization

The VM System has different possibilities to synchronize the clock of the Signature: Internal, PTP (Precision Time Protocol), or NTP (Network Time Protocol). For information arriving from other sources i.e. Heading, Position etc., the VM system timestamps the moment the data is received. For this purpose it maintains an internal clock reference that is synchronized with the Time message (ZDA for NMEA) from the GNSS.

11.2.1 Internal clock

When internal is used, the Signature VM system synchronizes the clock of the Signature with the PC clock at the start of the deployment. Due to limitations of the Signature (in setting the clock), the accuracy in the timing is +/- 0.5 sec.

11.2.2 PTP

When using PTP, the Signature updates its internal clock continuously from the external PTP source to adjust for small clock drifts; the accuracy in timing is down to the sub microsecond level.

11.2.3 NTP

When using NTP, the Signature updates its internal clock continuously from the external NTP source to adjust for small clock drifts; the accuracy in timing is down to the millisecond level. The PC running the VM software can be configured as NTP server. For more information see: [Use Windows 10 as NTP Server – Nortek Support Center (nortekgroup.com)](#).

For an external NTP server the IP address of the Server needs to be supplied (see figure [77](#)[86]).
 The NTP server used by the PC can be found by typing "`w32tm /query /status`" in a command console.

The synchronization with NTP can take a relative long time when the system is synchronized for the first time after powerup.
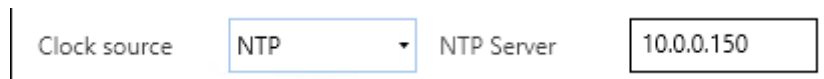
Figure 77: NTP server IP address

12 Spectrum

For noise interference troubleshooting the software allows you to record a frequency spectrum. This can be used when you notice issues with the data received from the Signature instrument to further narrow down the issue.

12.1 Instructions

In order to be able to record a spectrum, a Signature instrument should be connected.

Steps:

1. Open the Signature VM software

2. Turn on the Diagnostics mode by clicking on the stethoscope icon

3. Connect[27] your Signature instrument

4. Start collecting a spectrum by clicking the play button in the Diagnostics window (please note it may take up to 15 seconds for the sampling to start)
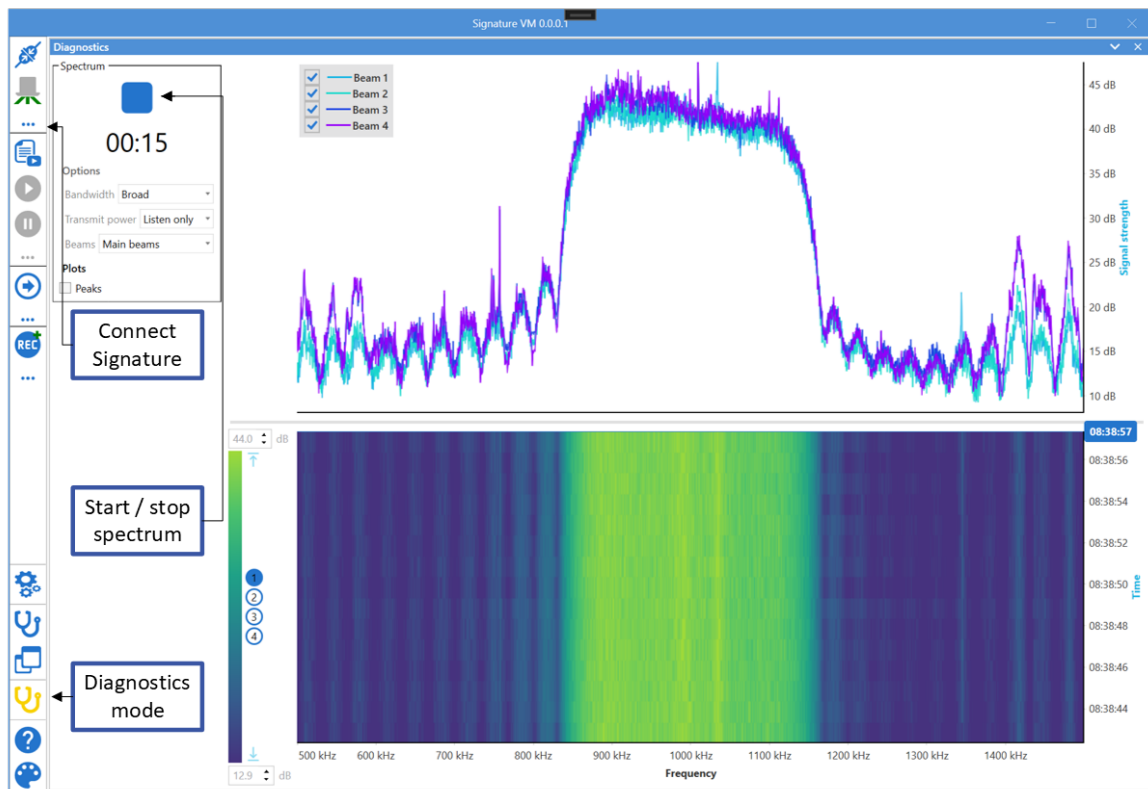
Figure 78: Recording a spectrum

The recording will get a .VMDiag extension which you can open in Signature VM Review.

12.2 Options

A spectrum can be recorded in different bandwidth modes. Generally, it is recommended to use the bandwidth that is also used when surveying, usually broadband. In some cases it might be useful to study a wider spectrum, in this case full bandwidth can be selected.

The transmit power should be set to "Listen only" when identifying noise issues. Since when the instrument transmits a pulse the noise floor is disturbed significantly, reducing the chance of seeing externally introduced noise.

If your instrument has an echosounder, the spectrum of the echosounder beam can be collected instead of the spectra of the main beams. This can be useful for calculating the noise level of the echosounder.

12.3 Interaction

The spectrum is shown in two different plots. The bottom heatmap shows the spectrum over a period of time, the top line plot shows a instant spectrum for the time selected using the horizontal line in the bottom heatmap. The horizontal line can be moved (by means of the time-label on the right-hand side) to show the detailed line spectrum at a different point of time.

Use the "Peak hold" check-box to show the maximum values in the top line plot.

12.4 Example spectra

Table 8 88 shows examples of clean and noisy spectra from a Signature 1000 instrument. The noisy spectra are polluted with a 50 kHz square wave from about halfway through the recording, the clean spectra show little pollution.

Table 8: Example spectra

Bandwidth	Clean	Noisy
Narrow		
Broad		

Bandwidth	Clean	Noisy
Ultra		
Full		
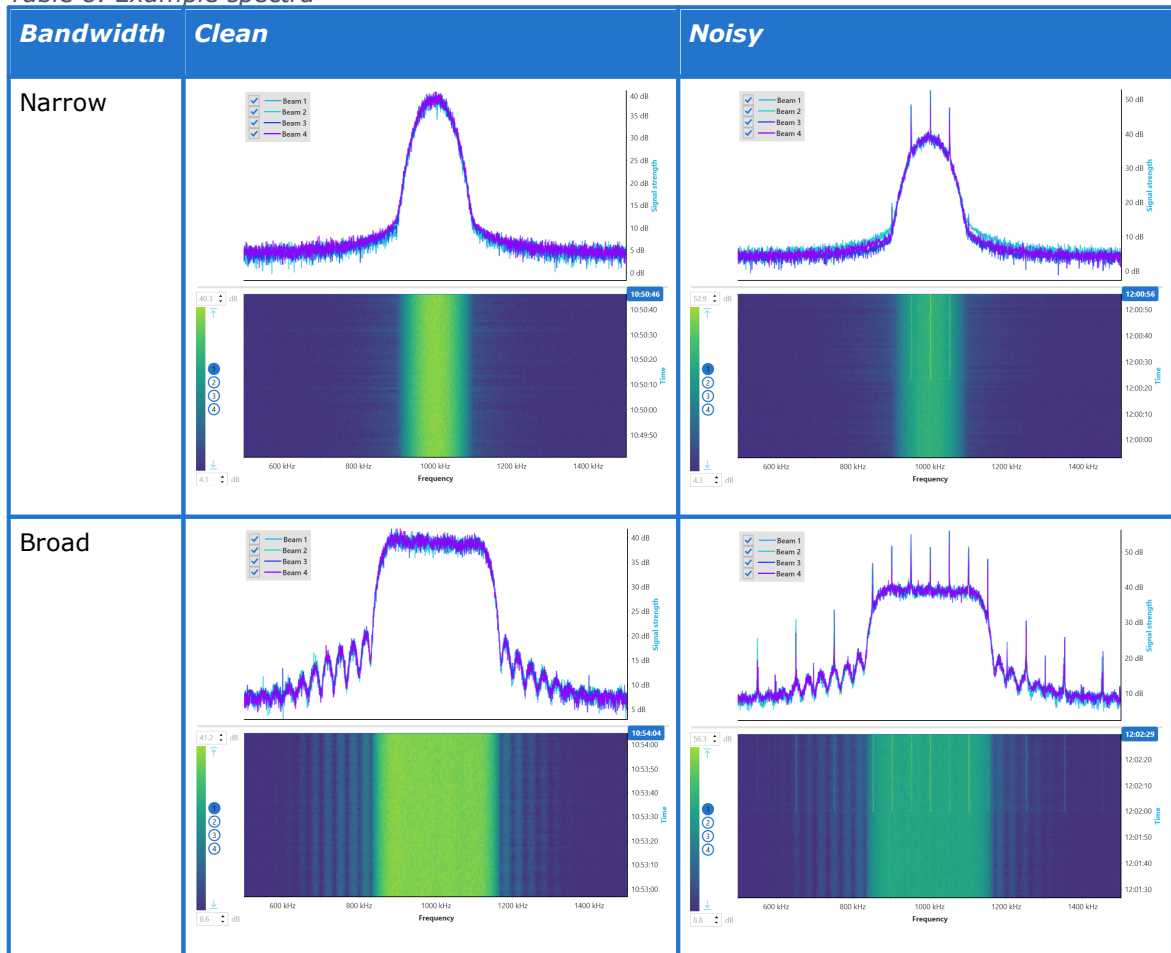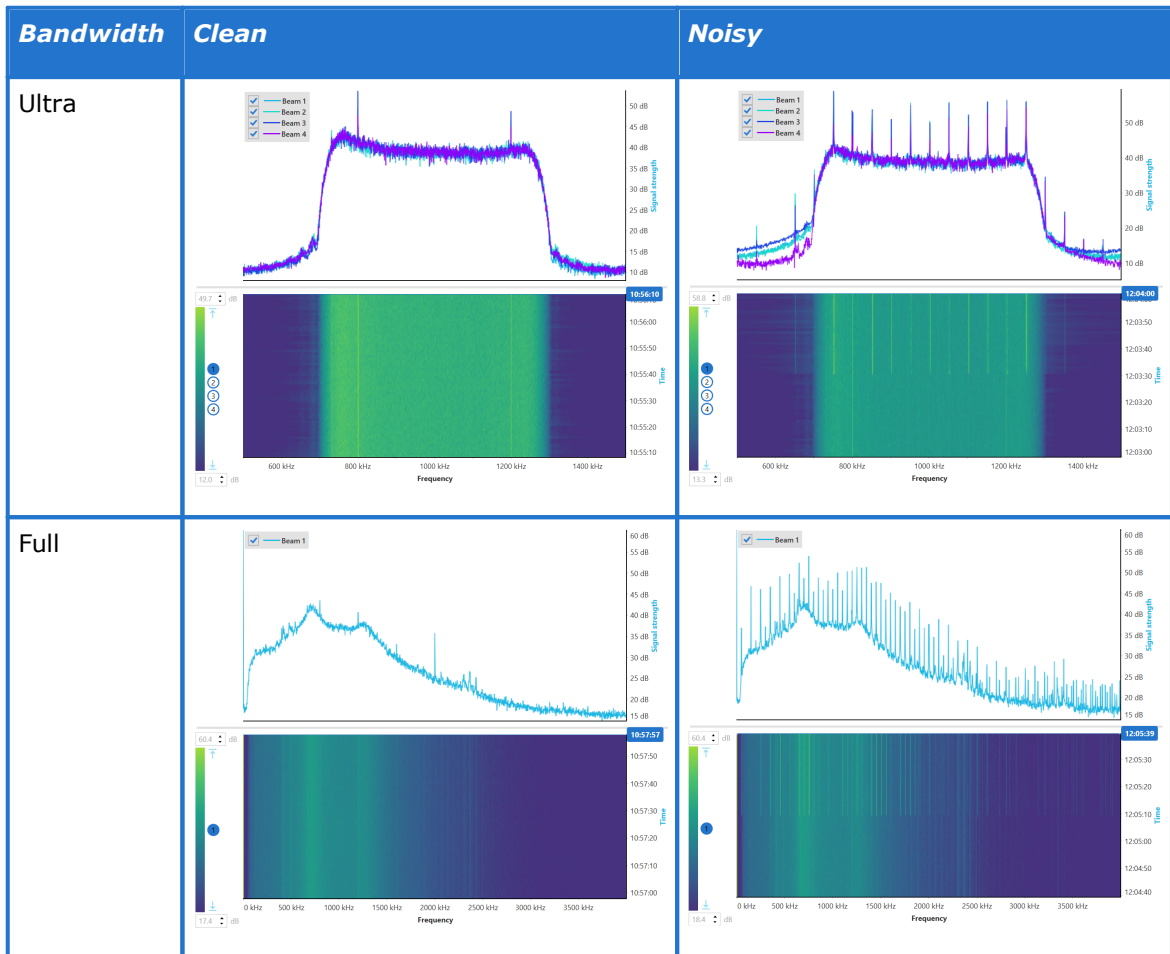
A clean spectrum should have a well defined peak around the instrument frequency with a low noise floor and show no changes over time. The noisy spectra in table 8 [88] show narrow peaks at multiples of the introduced frequency of 50 kHz. A square wave, produced in for example switching power supplies, produces these many peaks. Clean sine waves show up as one single frequency. Single, or multiple narrow peaks are a sign of noise pollution.

12.5 Replaying a recorded spectrum

A spectrum is recorded in a file with the .VMdiag extension. The Signature VM software can replay this file just like .SigVM files.

Signature VM Review can also display .VMDiag files for easy reviewing.

13   Troubleshooting

This section contains information on where to start looking if an instrument does not behave as intended. If you encounter a problem, you should:

1. Get a good overview of the problem; make notes during the troubleshooting process

2. Work in a systematic way and do not neglect the obvious. Start by looking at simple causes, such as power not connected, bad connections, etc.

3. If the setup uses custom cables, power supply, etc. first assemble and test the instrument using the cable and battery (if applicable) that originally came with the instrument. You can always return to the standard setup, which is the easiest way to get the system to work, to confirm that the problems are not caused by a faulty instrument.

4. If your instrument behaves strangely try updating both your software and firmware to the latest versions. There may be incompatibilities between an older version of firmware and newer version of software, and vice versa. The latest versions of firmware and software can be downloaded from our support page (https://www.nortekgroup.com/software).

To help us give good support if you need to get in touch (via support@nortekgroup.com), please:

1. Be specific about the error - a screenshot is often helpful

2. Include a raw sample file or a collected data set showing the error

3. Include information about firmware and software version used

4. Include serial number or order number

5. Include a support file (through the button in the taskbar)

13.1   Remote Support through TeamViewer
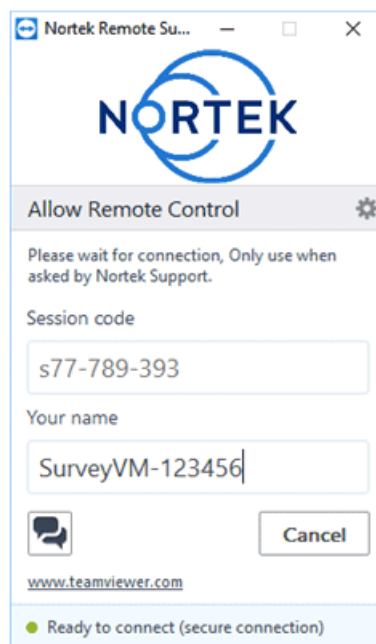
Figure 79: Starting the TeamViewer session

In general, every Signature VM computer comes with the TeamViewer software. This allows the user to give a Nortek support engineer access to the computer so he or she can check what might be wrong with your software or configuration. Make sure you have a working internet connection, and when requested by the Nortek engineer, click the TeamViewer icon to start a session.

Note that every time a TeamViewer session is started, a notification will be sent to Nortek.

When the program has started successfully, and the 'Ready to connect' message is visible no further action is necessary. The Nortek engineer can now connect to your computer and try to solve your problem.

13.2 Communication

The blue LED indicator light on the instrument is not lit

- Is the instrument in Command mode?

- Does the LED blink (short) when applying power?

Cables are often exposed to heavy use and the power connector might break. Using a multimeter to ping through each pin may reveal a breakage.

14   Computer configuration

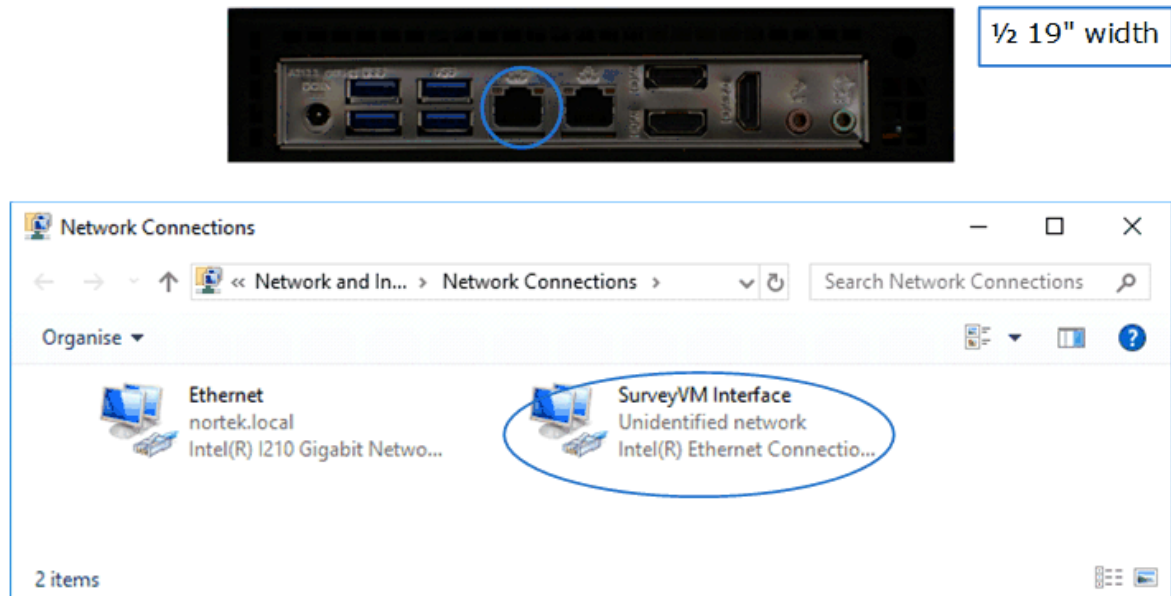The data acquisition computer is configured to work as a standalone unit. No connection to an external network or the internet is required.

Figure 80: Network interface "SurveyVM"

Two Ethernet ports are available. One is named 'Ethernet' and is a general-purpose port that may be used to connect to internet.

The port named 'SurveyVM Interface' is set to a fixed IP address: 192.168.100.1. This port is connected to an Ethernet switch inside the interface box, and the sensors are connected to this switch.

An OpenDHCP server is running on the computer as a service. This is configured to use only the 'SurveyVM Interface' port so DHCP will only work on this port, and addresses used will always be in the range 192-168.100.1 to 192.168.100.254

OpenDHCP was added to the Windows firewall as an allowed application.

Both the Signature Sensor and the GNSS are set to 'DHCP' so they will get an address from the computer when connected to the 'SurveyVM Interface'.

Remote Desktop is enabled, and this is explicitly bound to the 192.168.100.1 address, so it will only work if a computer is connected directly (or through a switch) to the 'SurveyVM Interface' port. Remote desktop is not possible over the 'Ethernet' port.

14.1   Enable Remote Desktop from the other network

As mentioned above, the remote desktop connection is limited to be used from a computer connected to the interface, because it is explicitly limited to use only the network adapter with IP address 192.168.100.1.
If a remote desktop connection is required from the rest of the network, you should disable this rule.
Click the Windows key and type 'Firewall'. In Firewall, select 'Inbound Rules', and find the settings for 'Remote Desktop – User mode (TCP-in)' and 'Remote Desktop – User mode (UDP-in)'
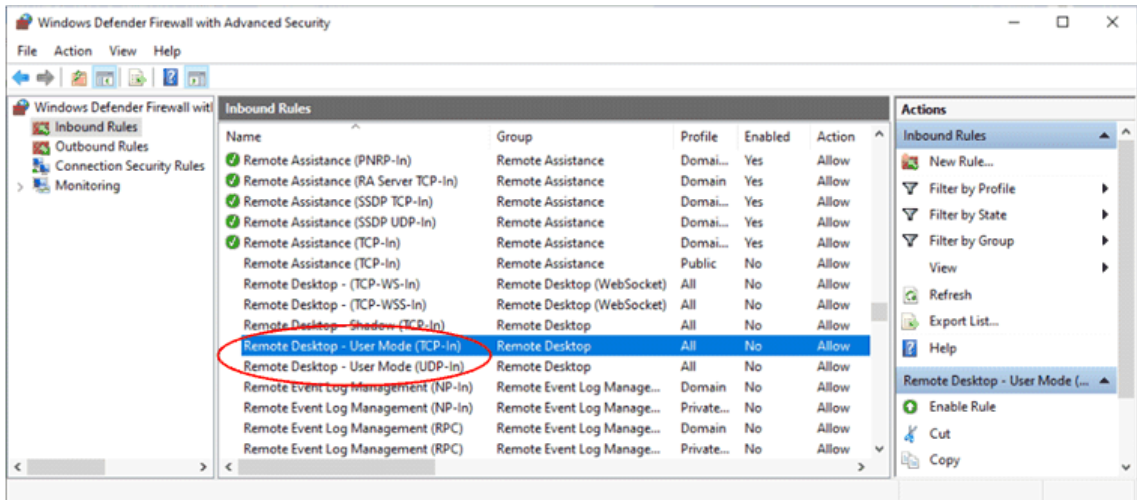
Figure 81: Firewall configuration for Remote Desktop

To change the settings, double-click on the settings, and, on the tab 'Scope', change the Local IP address to 'Any Address'. Click OK to confirm, and repeat for the other setting as well.
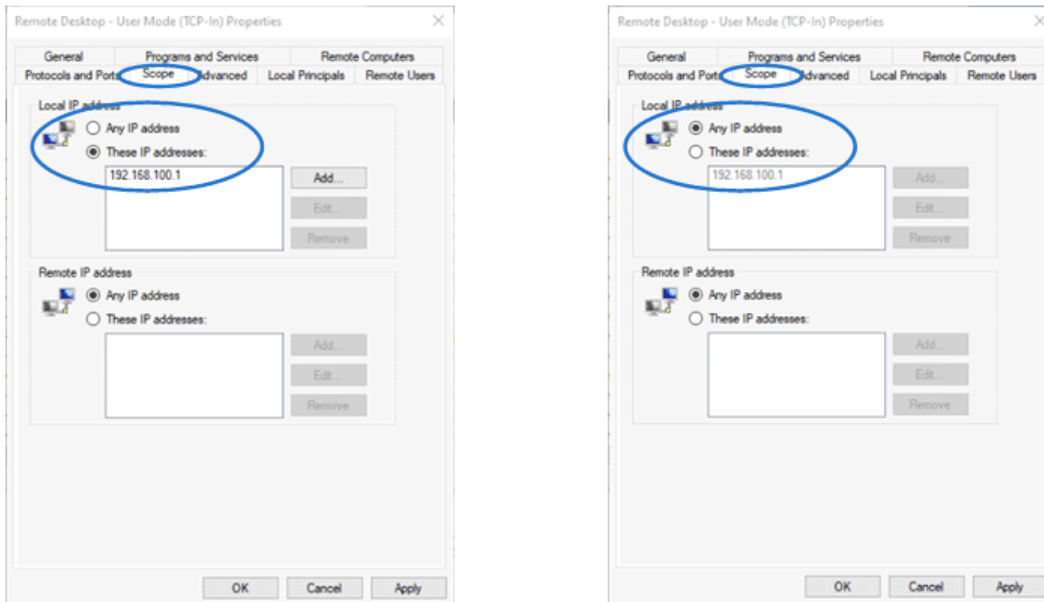
Figure 82: Firewall rule for Remote Desktop

From now on, anybody on the main network can also access the remote desktop.

15 GNSS

The Advanced Navigation GNSS Compass can be monitored and configured through its internal web-interface. Some settings require the user to enter a username and password. The default settings are:

Username   : admin
Password   : password

The older version 1 hardware of the GNSS instrument came in two variants: a standard (LC) and a High Accuracy (HA) version. Both offer the same accuracy in heading, roll and pitch, but the HA version has a more accurate horizontal and vertical position.

As of end 2021, a new hardware version 2 of the GNSS combines both options in a single package.

15.1 Filter setting

Standard filter setting on the GNSS is 'Small Boat', which is shown to work fine with most survey vessels. Should the system be used on larger vessels it could be set to 'Ship'. Note that changing the filter settings will not alter the response or lag of the measurements, it just helps the instrument to find a fix by giving it some information on the expected movements.

15.2 Increasing the position accuracy using RTCM (NTRIP) and RTK

The Advanced Navigation GNSS can receive external correction signals over the Ethernet link using a protocol named 'NTRIP' (Networked Transport of RTCM via Internet Protocol). The GNSS has a built-in NTRIP client that can be configured through the menu (see figure 83 94).

Figure 83: NTRIP configuration

NTRIP data is supplied by several different providers. Usually it is a local, commercial service of a company that maintains the local network of reference stations.

The GNSS will only accept RTCM V2 or V3.0 packets. So if your provider offers multiple options, make sure you select one of these. If the right messages are received and processed, the 'Bytes Processed' counter will change, and the status should change to 'RTK Float Fix'

 The use of the NTRIP client requires that the system is connected to the internet. To test if it is working, use the server at 'www.rtk2go.com', port 2101 as shown in the example in figure 83 94 . This is a cloud service that provides free transfer of data from any base station. Most of

them are just private stations which will often be offline, but the 'Get Mountpoints' function will work and fill the drop-down list with available stations.

The standard version of the GNSS will only use the DGPS information for increased accuracy, but the HA (High Accuracy) version requires NTRIP data to get to a RTK fix.

15.2.1 Network settings for using NTRIP - RTK

By definition NTRIP data is received over an internet connection. The standard VM system has its own local network for the GNSS, Signature and computer, which is separated from the optional internet connection on the second ethernet adapter. (See chapter "Computer configuration[] 92 " for details).

The NTRIP data on the secondary adapter must be able to reach the GNSS which means the two adapters have to be linked, but this requires some care. You need to disable DHCP, and link the adapters. The next subsections describe these steps in order.

15.2.1.1 Disable DHCP

Before linking the adapters, disable the internal DHCP server! If this is still active it will try to assign IP addresses to all devices linked to the secondary adapter, which may well be all of the external network. (Do note that if you disable DHCP, you will need to assign fixed IP addresses to the Signature sensor and to the GNSS Receiver.)

The OpenDHCP server runs as a Windows Service in the background. To disable it, open the Task Manager, select the Services tab, and find the OpenDHCP service. If the status is 'Running', right click on it and choose 'Stop'. To make sure the service is not started automatically when the system restarts, right click again, and open Services. This will open a new 'Services' window, this time with more details, like the 'startup type'. Again, scroll to the OpenDHCP entry, right click and select Properties. Change the Startup Type to Manual or Disabled.

15.2.1.2 Link the adapters

Open the Network Configuration, and select the adapter with internet access, usually named 'Ethernet'
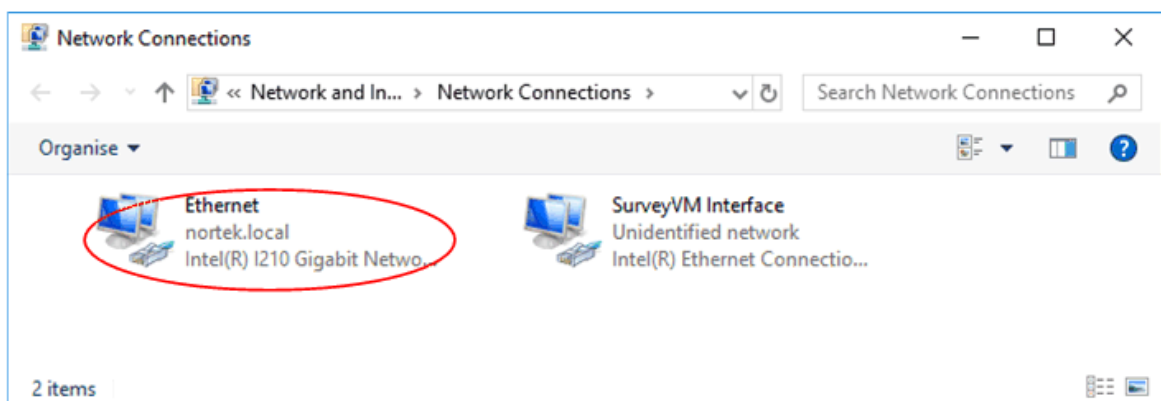
Figure 84: "Ethernet" interface

Right click on this, select properties, and open the 'Sharing' tab. Check 'Allow other users…', and from the dropdown box select the SurveyVM Adapter.
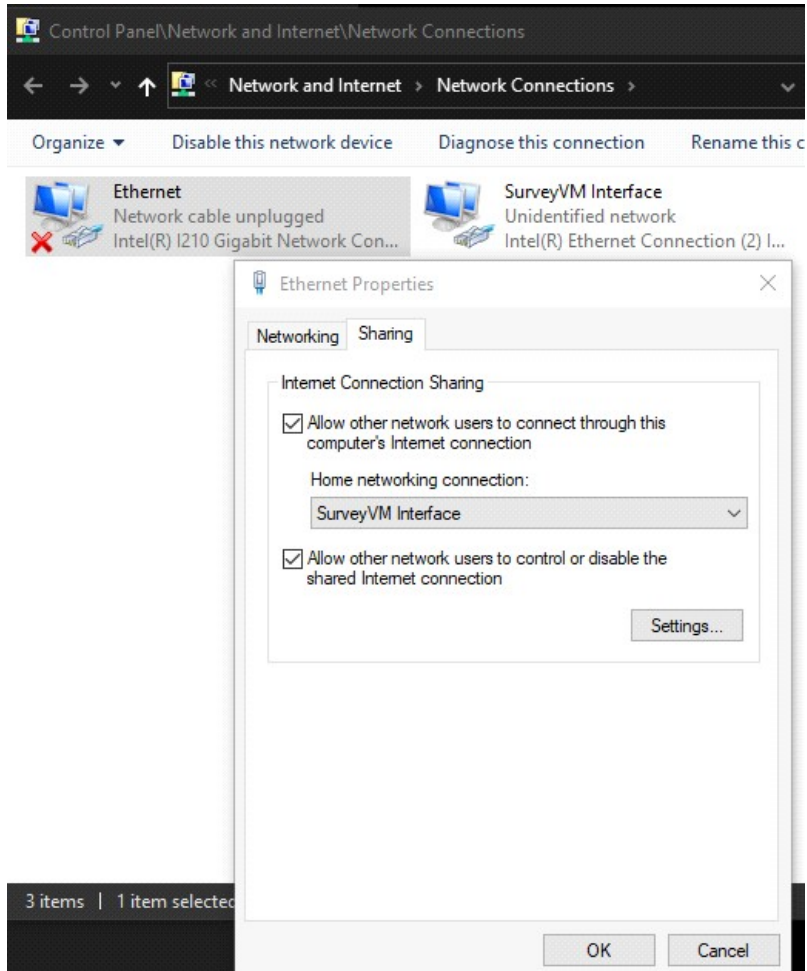
Figure 85: Configuration for network sharing

16   Glossary

Accuracy	A value giving the degree of closeness of a velocity measurement to the actual velocity. Refer to the data sheet for specific minimum accuracy.
AD2CP	Nortek's broadband signal processing platform.
AHRS	Attitude and Heading Reference System. Provides attitude information and replaces the traditional tilt and magnetometer. AHRS is especially useful in dynamic environments. Note that this feature also requires additional hardware.
Altimeter	Measures the distance to the surface (or, in the case of a vessel-mounted system, the distance from the instrument to the bottom)
Amplitude	See [signal strength](#) [99]
ASCII output	Data is displayed in ASCII format (plain text).
Bandwidth	Wider signal bandwidth is used to get more information and improve the velocity precision. Reduced bandwidth is used in long range mode (only relevant when current profiling) to increase range. This bandwidth reduction makes the measurements less precise.
Beam Coordinates	In Beam coordinates, a positive velocity is directed in the same direction as the beam points. Beam 1 is marked with an "X" on the head.
Blanking	Specifies the distance from instrument head to the start of the measurement cell, where no measurements take place, to give the transducers time to settle before the echo returns to the receiver. The size of the blanking area is user selectable in the software using the "Start of profile" parameter (a.k.a. the "Blanking Distance").
Break	A break command is used to change between the various operational modes of the instrument and to interrupt the instrument regardless of which mode it is in. When break is received in command mode, you can see that the LED is switched off for a short time.
Broadband	In this context it means using a more complex transmit pulse to improve the measurement accuracy in each ping.
Cell	One measurement cell represents the average of the return signal for a given period. The cell size corresponds to the distance travelled during the transmit pulse. The cell is shaped like a triangle due to convolution; this is indicative of the weighting of the measurement.
Coarse Profile	Instrument setup that prioritizes achieving the maximum range at the expense of reduced resolution.
Command mode	An instrument in command mode is powered up and ready to accept your instructions. If no commands are received for about five minutes, it automatically goes into Power Down Mode, unless Ethernet power is connected. LED is lit constantly when in command mode.

Compass calibration	Each compass system has been calibrated at the factory to quantify the characteristic response of the individual components and of the system as a whole. When it leaves the factory, each system can measure its tilt and the direction of its magnetic field vector accurately. However, users may disturb the magnetic field near the instrument when they deploy. Adding a battery pack and mounting the instrument with deployment hardware adds magnetic materials that change the earth's field at the instrument. The compass calibration procedure quantifies this magnetic hard iron disturbance, and the instrument's compass algorithm then corrects for it to obtain accurate heading.
Correlation (nominal)	Nominal correlation is a function of cell size and velocity range. Nortek recommends using 50% of the max correlation as a cut-off value, beyond this point the validity of your data is questionable.
ENU Coordinates	Polar magnetic coordinates; East, North and Up. A positive east velocity goes toward east. This is a right-handed orthogonal system.
Fine Profile	Instrument setup that prioritize the highest possible resolution at the expense of the maximum range achievable.
Firmware	Internal software of the instrument, as opposed to the instrument software running on a PC. New firmware is posted on the Nortek site. You will need to register to get access, but access is otherwise free of charge.
Frequency spectrum	See spectrum ⁹⁹
Internal sampling rate	Rate of sampling for internal sensors. Refer to the specific instrument brochure for details.
LED	Light Emitting Diode, visible from the outside of the instrument. The LED can be set to blink for every sample (On), blink for the first 24 hours of deployment (On for 24h), or never (Off).
License	Different capabilities of the instrument are protected under licenses which can be purchased. Contact your sales representative for more information. Licenses that are ordered with the instrument are already registered. You will not need a new license when updating the firmware version.
NMEA	Standard data format defined by the (USA's) National Marine Electronics Association
Noise floor	The amplitude of the internal noise of the instrument. This will limit the minimum detectable signal that can be received.
Ping	Same as a single transmit pulse.
Precision	The value given is a theoretical estimate of the precision of the velocity measurements based on how the instrument is set up. The nominal value is given for the horizontal components in a default instrument acoustic beam configuration. In order to improve the precision, the user may consider one of the following options: (1) larger cell sizes, (2) longer average interval (3) reduced velocity range, or (4) increased measurement load

Sampling rate   Specifies the rate at which data is output

SDU Coordinates   Speed - Direction - Up.

Sidelobe   The acoustic beams focus most of the energy in the centre of the beams, but a small amount leaks out in other directions. Transducer sidelobes are rays of acoustic energy that go in directions other than the main lobe. Because sound reflects stronger from the water surface (and "hard" bottoms) than it does from the water, the small signals that travel straight to the surface (or bottom) can produce sufficient echo to contaminate the signal from the water.

Signal strength   Strength of return signal, presented in dB.

Sleep mode   The instrument is not actively collecting data

SNR   SNR is the Signal-to-Noise ratio and is a data quality indicator

Spectrum   Graphical view of signal strengths at different frequencies

XYZ Coordinates   Cartesian coordinate system. A positive velocity in the X-direction goes in the direction of the X-axis arrow (as indicated on the instrument). The X-axis points in the same direction as beam 1. Use the right-hand-rule to remember the notation conventions for vectors. Use the first (index) finger to point in the direction of positive X-axis and the second (middle) finger to point in the direction of positive Y. The positive Z-axis will then be in the direction that the thumb points.

17   Connector Pin Configurations

Note that the connectors present on an instrument depend on the instrument model.

Table 9: 6-pin connector, Stand alone, Ethernet (N2550-003, N2550-008)
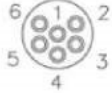
Connector on the instrument side	Pin nr	Function	Wire color	Joint	Wire color	Pin nr	Connector on the computer side
MCIL6M with MCDLS-F (red) Male face view:	1	Gnd	Black		Black	Jacket	2-pin jack plug
	2	Pwr+	Red		White	Center	
	3	Rx-	White		Green	6	RJ 45 insulation connector
	4	Rx+	Blue		Green/White	3	
	5	Tx-	White		Orange	2	
	6	Tx+	Orange		Orange/White	1	

Table 10: 8-pin connector, Serial communication, RS232 and RS422 (N2550-001)

Connector on the instrument side	Pin nr	Function	Wire color	Joint	Wire color	Pin nr	Connector on the computer side
MCIL8M with MCDLS-F (red) Male face view	1	Gnd	Black		Black	Jacket	2-pin jack plug
	2	Pwr+	Red		White	Center	
	3	RS232 Tx / RS422 Tx-	White		Red	2	9-pin DSUB Female face view
	4	RS422 Tx+	Blue		White	8	
	5	RS232 Rx / RS422 Rx+	White		Orange	3	
	6	RS422 Rx-	Orange		Purple	7	
	7	Sync A	White		Blue	1	2-Pin Terminal block
	8	Sync B	Green		Black	2	

*) GND on pin 1 on instrument side, pin 5 on DSUB and on Jack Plug (jacket)

Figures

Figures

Tables