

NORTEK MANUALS

VM Operations version - Manual



N3015-026500-O | V2.9

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1 Introduction

1.1 Introduction

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

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

Nortek online

At our website, <http://www.nortekgroup.com>, you will find technical support, user manuals, and within reasonable time also the latest software and firmware for this product, until that time you will be notified by Nortek whenever there is a new software version available. General information, technical notes and user experience can also be found on the website.

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)






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Table 1: Revision history - Manual N3015-026500-0

Version	Date	Supports Software version	Notes
Version 2.9	jul-2024	2.9	Minimal changes
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	Spectrum
Version 2.5	dec-2022	2.5	New Processing unit and Junction Box
Version 2.4	jul-2022	2.4	First release of Operations version

1.2 Health and Safety

	<p>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</p>
 	<p>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 the equipment as unsorted municipal waste but use the return to collection systems according to local law or return to the Nortek facilities.</p>
	<p>Relevant plastic parts on the Signature sensor are marked for end-of-life recycling (Directive 2008/98/EC on waste)</p>
	<p>Use the following safety guidelines to help ensure your own personal safety and to help protect your equipment and working environment from potential damage</p> <p>Data usage limitations</p> <p>The VM Operations system is not to be used for navigation or for any purpose relating to safety at sea.</p> <p>General Power Safety for the Junction Box, and Processing Unit model 4420</p> <p>Observe the following guidelines when connecting your equipment to a power source:</p> <ul style="list-style-type: none"> • 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. <p>System Safety</p> <ul style="list-style-type: none"> • 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

This manual describes the VM Operations product, and in particular the VM Operations software.

Please be aware that the VM Operations version is part of a product family. Different products in this family use or can use different versions of the Signature VM sensor. The VM Operations software is the latest addition to this family, and is intended for use with the Signature333 sensor.

This manual shares large sections with the manuals for other versions of the software.

Some figures in this manual depict a Signature sensor that may be different from the sensor you purchased. 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].

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.

3 System Overview

The VM Operations system is an integrated system with the 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 Signature333 sensor. The Signature sensors are advanced four-beam current profiling systems. Built on the advanced AD2CP platform, they are designed for unprecedented performance in demanding environments. The Signature333 also measures its own speed and direction across the seabed using a technique known as ‘bottom tracking’. With the Signature333 it is also possible (optional) to output Nortek’s proprietary DF21 DVL bottom track format over a serial line.

Position and movement of the moving platform (usually a vessel) is recorded using the ship’s existing Global Navigation Satellite System (GNSS) receiver. By combining the measured movements from both a heading sensor (possibly the GNSS) and bottom track it is possible to correct the measured water velocities for the movement of the platform itself.

A dedicated processing unit with VM Operations software collects the data and continuously monitors the quality of the data.

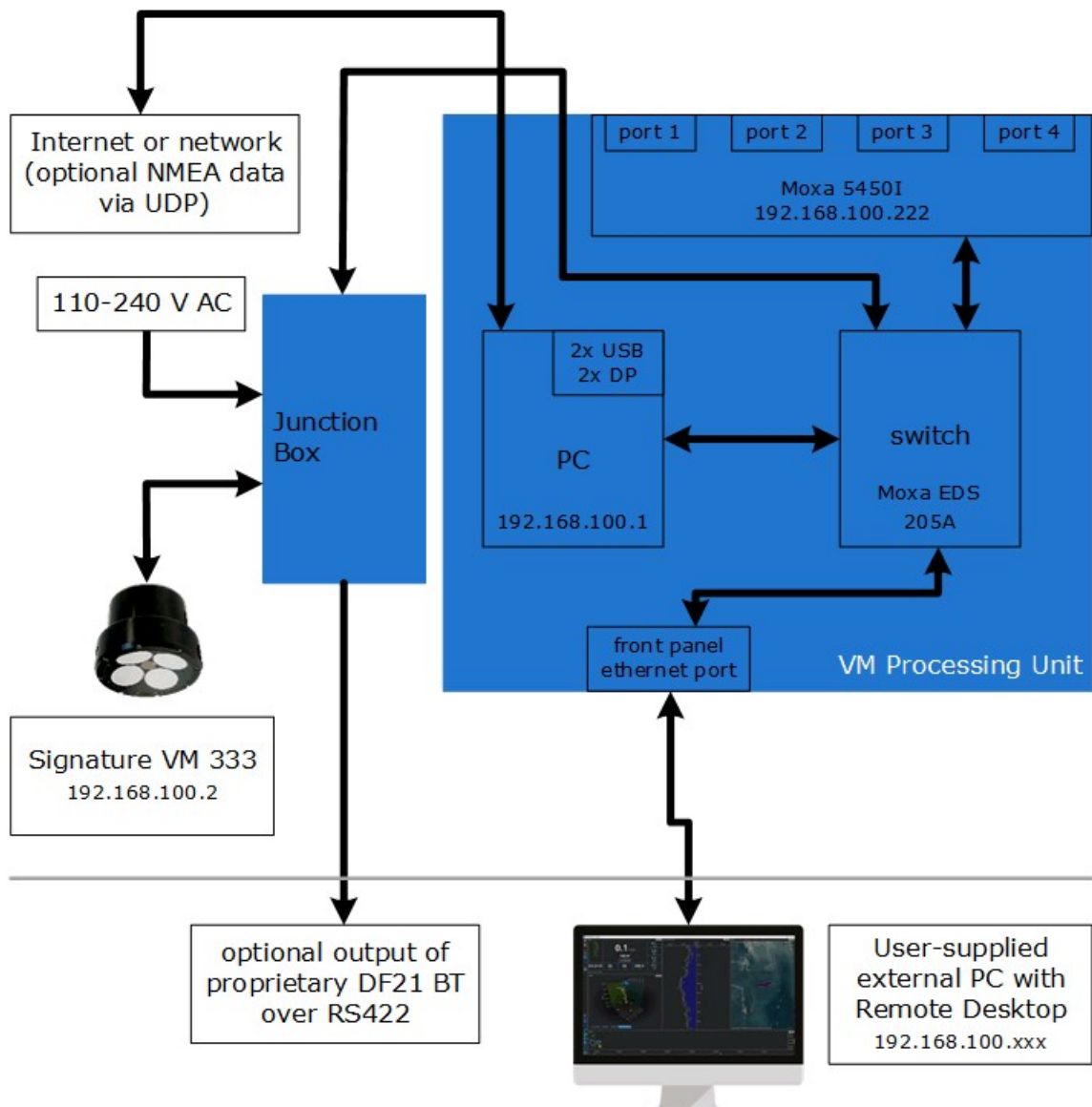


Figure 1: Nortek VM Operations schematic system diagram of processing unit, with IP addresses

3.1 Signature AD2CP Sensor

Figure 2 below shows the Signature333 but can be translated easily to any of the Signature sensors like the Signature100 and 55. The Signature333 and 100 sensor heads have four acoustic transducers, slanted at 20 degrees from vertical. The Signature55 has three acoustic transducers. The Signature333 unit has a concave projected transducer configuration. For dimensions, please refer to the specific instrument data sheet, available for download from our website.

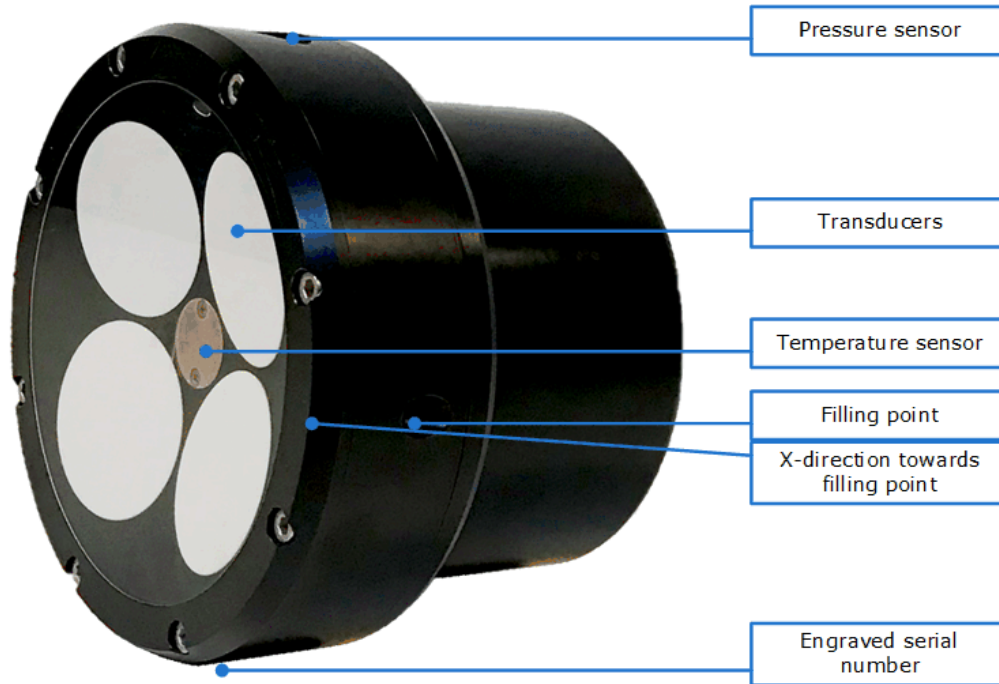


Figure 2: Signature333 Transducers and sensors

The pressure sensor and temperature sensor are both visible from the outside. Also note the beam configuration: the x-direction is towards the filling point. (Some early production models had an engraved marker, sometimes wrongly positioned.)

For more general information on the Signature ADCP sensor series 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 Data acquisition system



Figure 3: VM Operations Processing Unit, version 4420

Data is collected using a processing unit running the 'VM Operations' software. The VM Operations processing unit provides all necessary connections. The complete system is 19" 2HE rack mountable. It can be controlled using a local keyboard, mouse and monitor (not provided), or from a remote location over Ethernet using the front connector. It is also possible to connect the unit to a KVM switch. Please note that this unit requires input from a professional grade heading and dGNSS device over a serial or ethernet port.

Table 2: Processing unit specifications (version 4420)

Aspect	Description
Processor/memory	Intel i5/8 GB
Hard disk	SSD, 256 GB
Operating system	Windows® 10
Housing	19" rack-mountable 2HE
Dimensions	482x87x400 mm
Input	110-240 V AC, 100 W Max.
Total weight	5 kg
Connections	Power, Signature ADCP LAN, 2x DisplayPort, 1x LAN, 1x LAN for remote desktop, 2x USB, 4x RS232 RS422 RS485 configurable port.

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 VM Operations Software

The VM Operations 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 itself will check periodically for newer versions, if it detects an internet connection.)

4.3 Processing unit

The VM Operations processing unit version 4420 provides an ethernet connection to the Signature sensor (via the Junction Box) and has interconnections between the different parts. This model uses AC power and has four serial ports. Each port can be configured for use with RS-232, RS422 or RS485 signals at different baud-rates.

The serial interface is based on a 4-port MOXA 5450I. It is connected to the VM processing unit over Ethernet. It is on the internal sub-network with IP addresses 192.168.100.x. The serial interface is fixed on IP address 192.168.100.222. Data on all serial ports is transmitted to the processing unit using the UDP protocol, where each physical COM port is assigned a different ethernet IP port number.

4.4 Connecting and configuring the parts

A VM Operations system delivery consists of a Signature sensor, a Processing Unit and a Junction Box. The processing unit provides all necessary interconnections for other components.

Note that only one ethernet port on the processing unit is configured to connect to the VM Operations Interface (front). The system will not work if this is connected to the wrong port!

The second ethernet port at the back of the PC may be connected to the local network and is only used to access the internet. Please note that for compliance with IEC 61162-450 this port must not be connected with the vessel's bridge network.

4.4.1 Connecting the Signature Sensor

The Signature sensor is connected through its Ethernet interface. Connector details depend on the exact sensor type. (For the Signature333 as part of the Operations product, the connection is via the Junction box.)

When mating the SubConn connectors pay attention to the following guidelines:

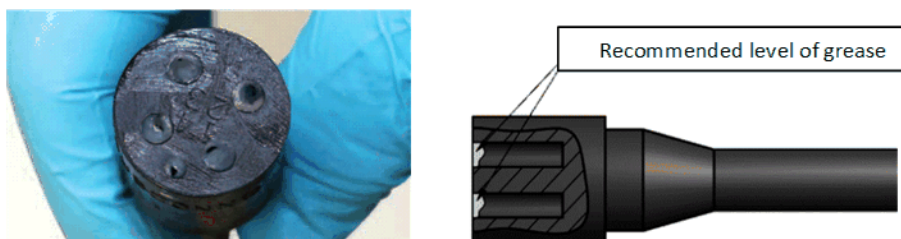


Figure 4: Greasing the connector

- 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 connects to the Junction Box.

4.4.2 Junction Box

The Junction Box is typically wall mounted close to the VM ADCP sensor head. The junction box may also be mounted on top of the bell housing of the optional bottom penetration unit. Please consult the installation manual of the single or double bottom penetration unit for more information. The Junction Box provides the connection to the Signature VM Sensor on the one hand, and an ethernet connection to the processing unit and a mains connection on the other hand. The junction box also supports serial output for the licensed Nortek proprietary bottom track format DF21 over serial (RS422). This optional serial output is intended to forward data to INS systems and is based on one way communication. Serial cables should be kept as short as possible and baud rate settings as high as possible to avoid any data delays.

Depending on the ADCP type and assembly the junction box has a slightly different layout. There are 3 different versions of the junction box:

1. VM Operations 333 kHz i.c.w. a Nortek sea valve assembly
2. VM Operations 333 kHz without sea valve assembly
3. VM Operations 100 kHz or 55 kHz without sea valve assembly

The main difference is in the connections between the ADCP and the junction box. The functionality is the same. Please see the diagrams of the different versions in figures [6](#)¹⁷, [7](#)¹⁸, and [8](#)¹⁹ on the next pages.

The delivery of the system does not include an ethernet cable to connect the junction box and the processing unit; this ethernet cable must be yard supplied. We recommend LAN CAT5e as a minimum, preferably LAN Cat5e with shielded twisted pairs, for example (marine approved) Prysmian/Draka ICS IE ToughCat 5e cable.

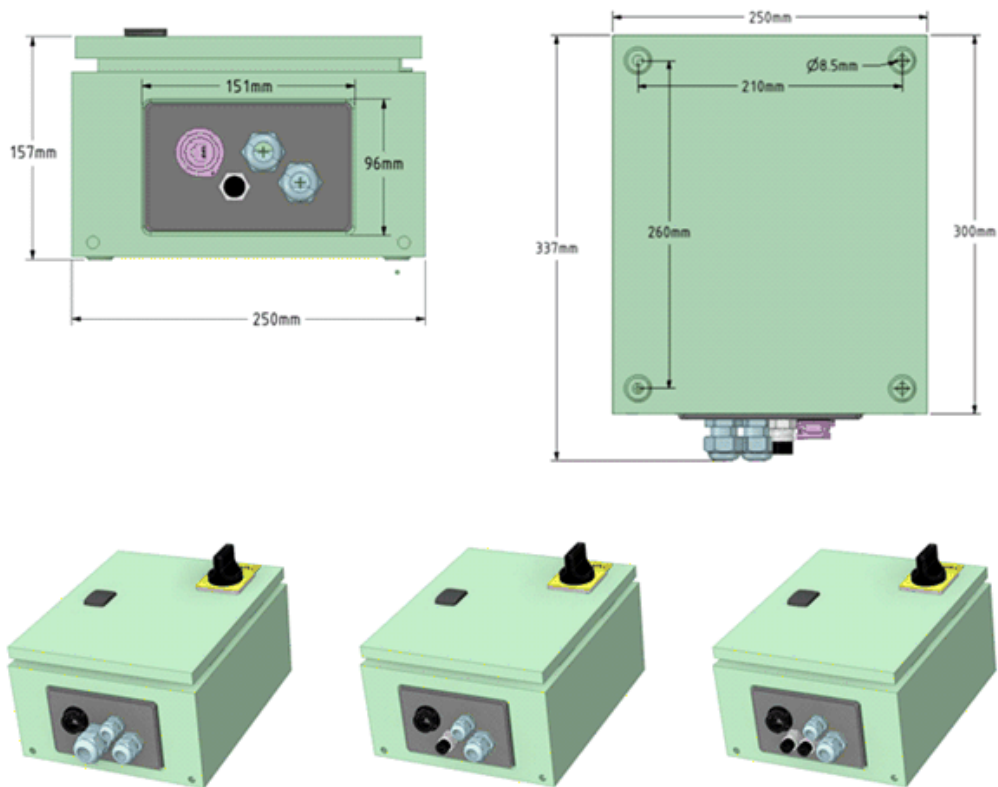


Figure 5: Junction box dimensions. The cable connection plate differs with the type of ADCP sensor or set-up. Bottom left 333 kHz sea valve version, bottom middle standard 333 kHz version (without sea valve), bottom right VM Ocean/Operation series version (100 & 55 kHz)

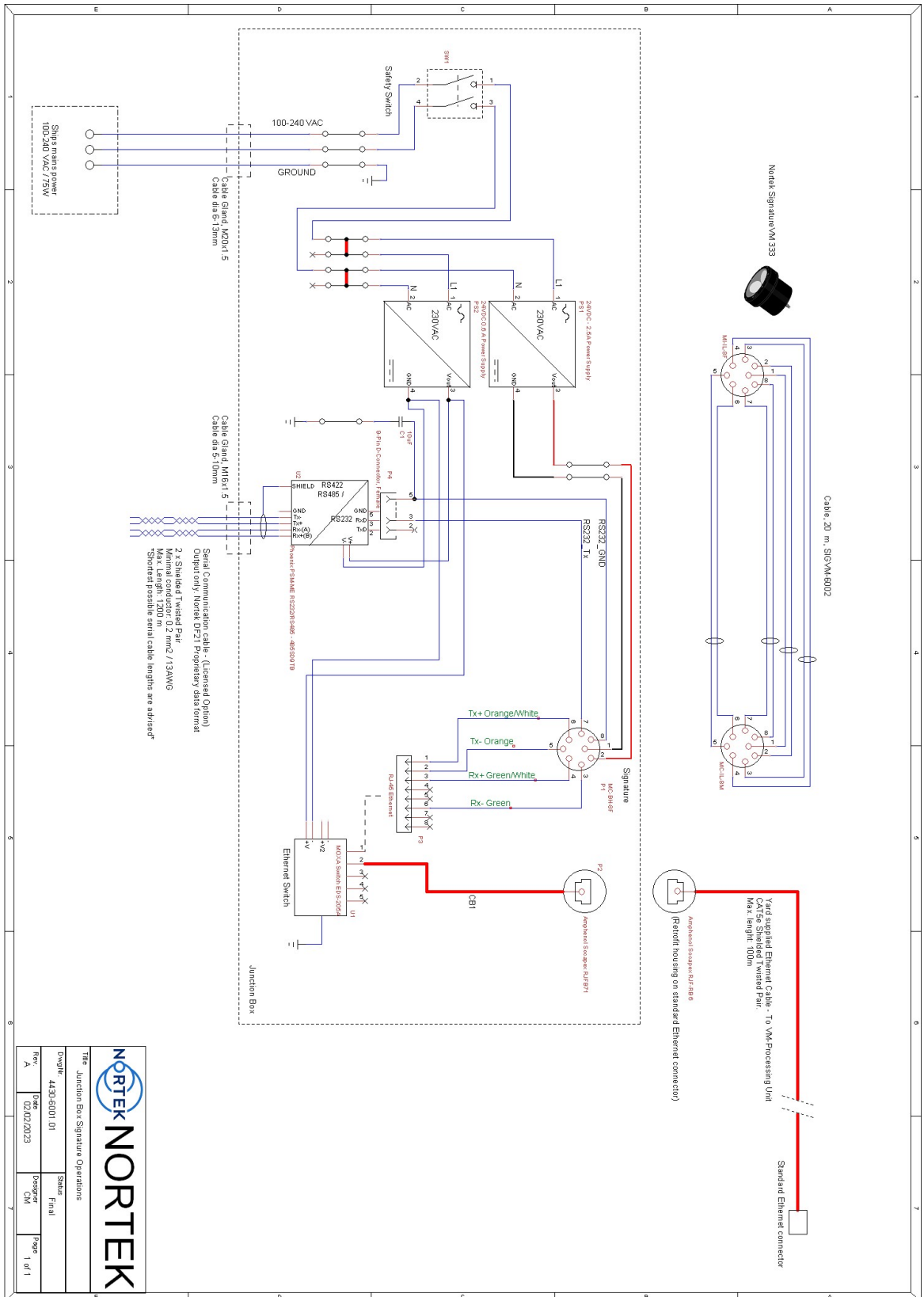


Figure 6: Junction box schematic drawing 4430-6001.01 Junction Box Signature Operations without sea valve assembly

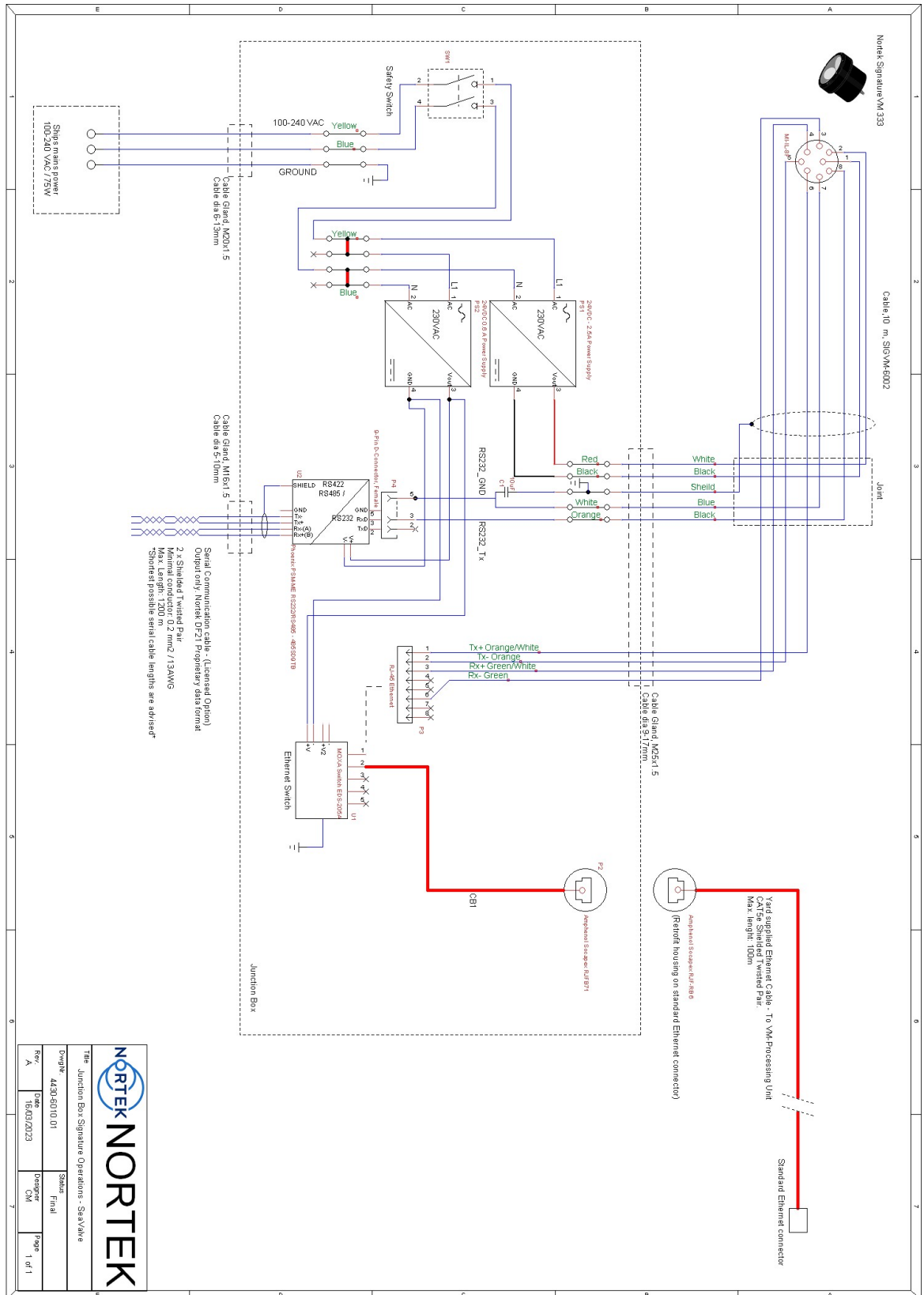


Figure 7: Junction box schematic drawing 4430-6010.01 Junction Box Signature Operations SeaValve 333 kHz unit with sea valve assembly

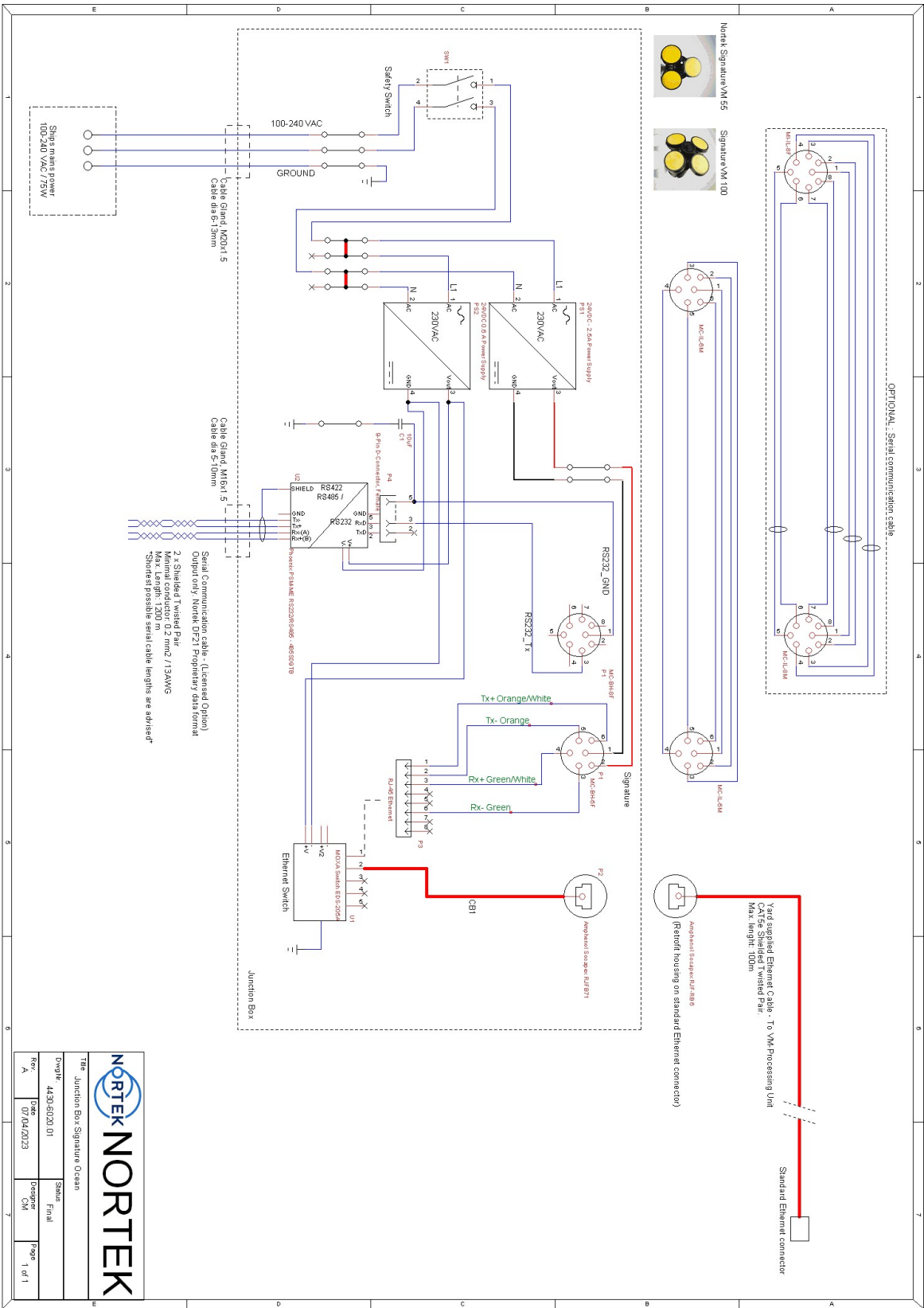


Figure 8: Junction box schematic drawing 4430-6020.01 Junction Box Signature Ocean (100 and 55 kHz) without sea valve assembly

4.4.3 Serial interface configuration

To configure the interface, open the browser and enter the IP address (as shipped from Nortek: 192.168.100.222). This will bring up a login screen (see figure 9).

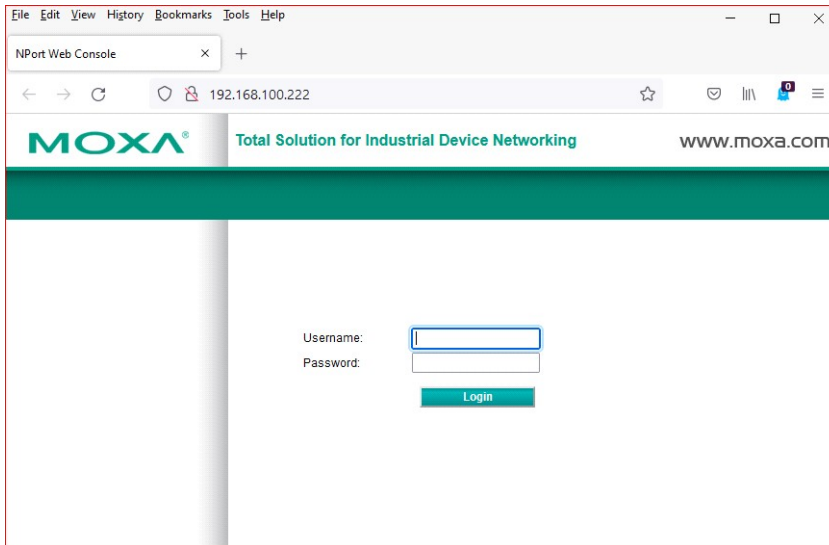


Figure 9: Login webpage of the MOXA serial interface subsystem

The username is admin, the password is moxa

Type the password in the password box, then *click the login button*. Sometimes you will have to click the button twice before it is accepted.

If successful, it starts with a screen showing previous login times. Click the button 'Continue'. It will now show a screen urging you to select a better password. Click the button 'Skip', and the home screen of the serial interface will be shown (see figure 10).

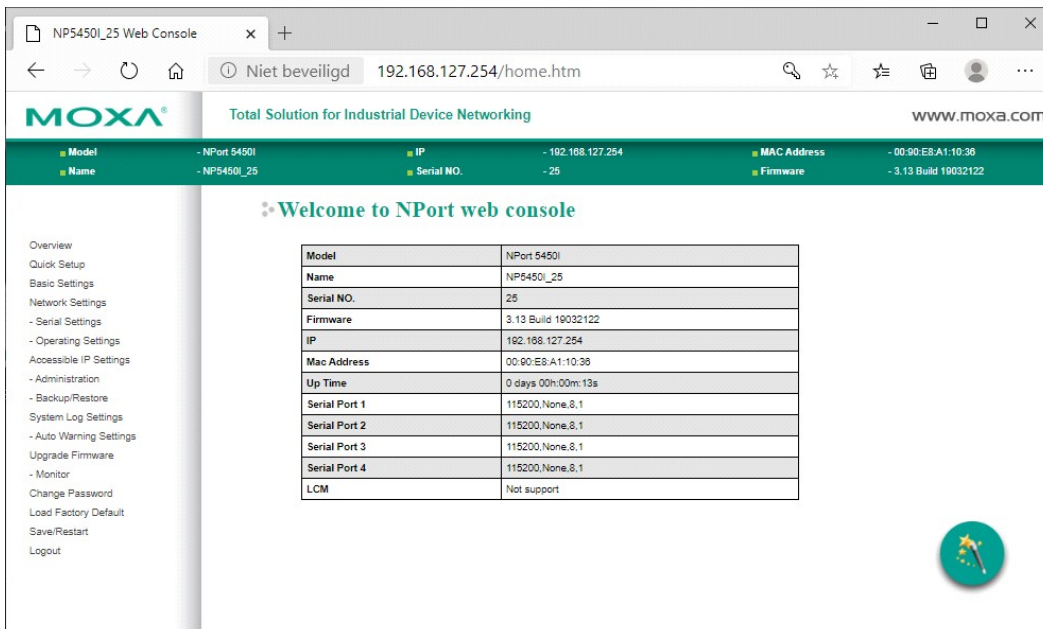


Figure 10: Home screen of the MOXA serial interface subsystem

After choosing 'Save/Restart', or after clicking the 'Submit' button, the unit will reset and there will be an audible 'beep'. This may be useful to check if the unit is actually connected and operational.

Note that 'Load Factory Defaults' will revert all settings to the original settings as chosen by Moxa, so you will have to re-configure the unit for use with the Signature VM system. (The

Moxa Factory Default IP address is 192.168.127.254; you will have to change that back to 192.168.100.222 for use in the VM Operations system.)

4.4.3.1 Network settings

There are only four important settings for the network, as shown in the image in figure 11 below.

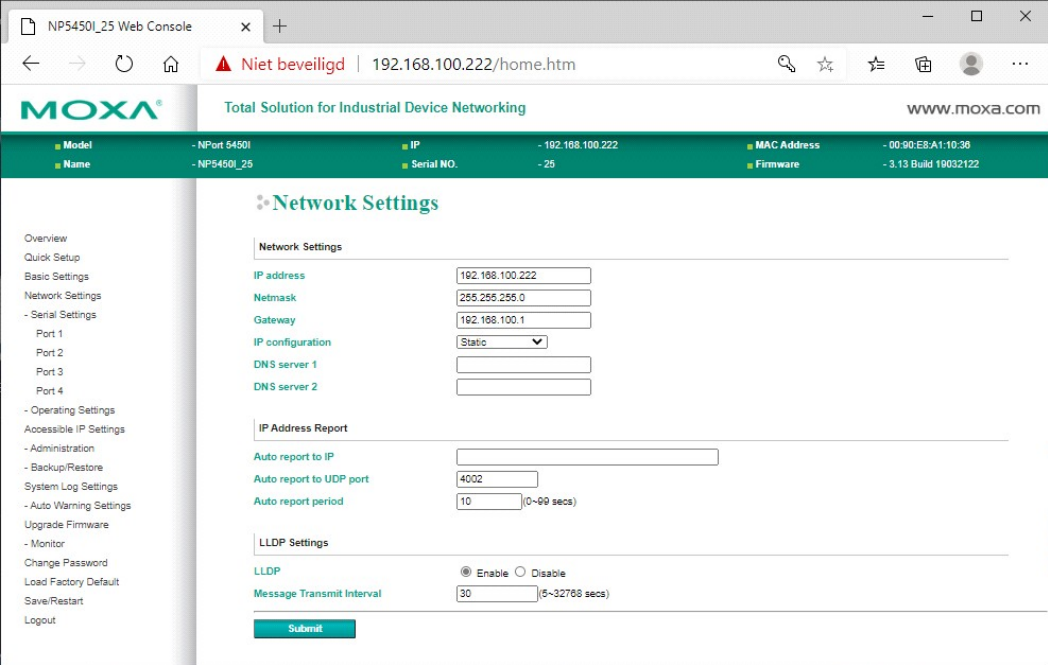


Figure 11: Network settings

The interface is set to a static IP address of 192.168.100.222, the Gateway is set to 192.168.100.1, which is the IP address of the VM Processing Unit. (The other two settings are setting the IP configuration to static, which is the first setting to make, and the subnetmask, 255.255.255.0) No other settings are relevant.

4.4.3.2 Operating Settings

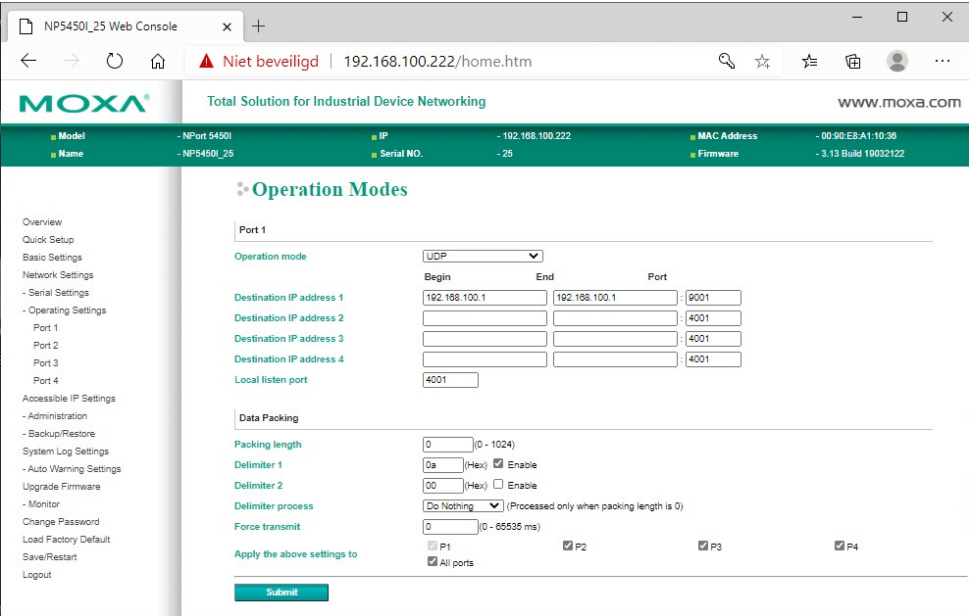


Figure 12: Operating settings – port 1

The Operation mode settings should be set for each port. Note that you can set the main operating parameters line 'Operation Mode' and 'Delimiter' for all ports at once by checking 'Apply.. to all..'. But if you change settings that are only applicable to this specific port, you will have to Submit them first before moving to the next port.

Operation mode: *UDP Mode*. All data will be sent to the processing unit using the UDP protocol.

Delimiter 1: *a (Hex)*. Data on the serial ports usually comes in the form of ASCII text (NMEA messages). The serial interface stores these messages and sends them to the Signature VM processing unit after it receives the 'Delimiter' character. All NMEA based messages end with a 'Carriage return' (or 'D' in Hexadecimal) and 'Linefeed' (or 'A' in Hexadecimal) character.

Destination IP address 1: *192.168.100.1 Port 9001*: Received data will be sent to this IP address, which is the address of the Signature VM processing unit. The port number is used by the Signature VM software to determine which Serial port the data is coming from. Each serial port can have its own port number: 9001, 9002, 9003 or 9004. But this is not required. If two serial ports send data to the same IP port the messages will simply arrive as if they were coming from one. This is not a problem if the messages have different identifiers.

Local listen port: *4001*. When sending data out from the Signature VM processing unit (using the 'Output' function in the Signature VM software), this sets the IP port where to send it to. Note that every physical serial port has its own IP port: 4001, 4002, 4003 and 4004.

4.4.3.3 Serial Settings

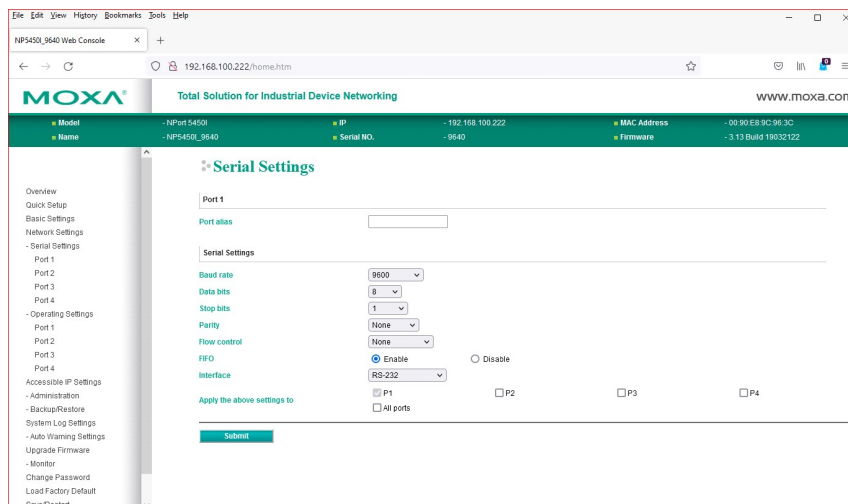


Figure 13: Serial settings. Example for Port 1.

Here each serial port can be configured for RS232 / 422 / 485, Baudrate, Parity and, Stopbits. Make sure 'flow control' is set to 'None', as there are no connections available to use hardware flow control (no RTS/CTS signals). 'Port Alias' can be left blank since that is not used.

Note that the default baudrate is set at 9600 baud. Generally speaking, you need to adjust this to the sending or receiving baudrate at the other end. Also consider the warning in section "[Data rates](#)"⁶⁶, about the sending baudrate in relation to NMEA message strings.

4.4.3.4 Configure VM Software

4.4.3.4.1 Receiving NMEA data

The serial interface sends data to the software over ethernet, using the UDP protocol. In the software this is referred to as 'Network NMEA'. Note that there is also a 'Serial NMEA' option available but this can only be used on computers that have an internal serial port.

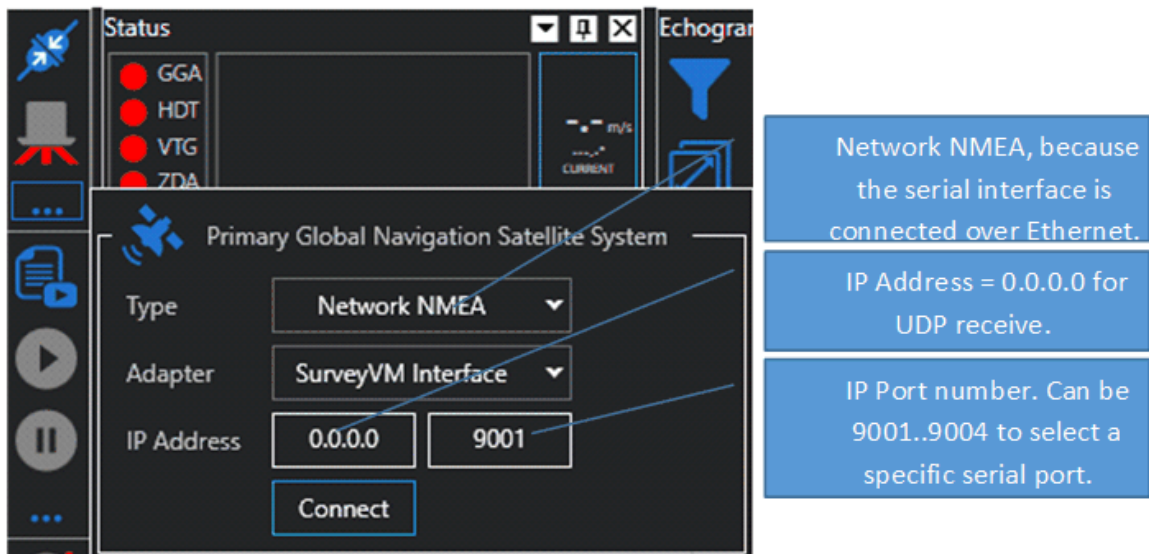


Figure 14: Settings in the Signature VM Operations software

The serial interface is connected to the ethernet port named 'SurveyVM Interface', and for the UDP protocol to work the address must be set to 0.0.0.0.

The software can read NMEA compatible data from two different sources or 'channels' at the same time. These channels are named 'primary' and 'secondary', and both channels can read NMEA messages. If you have just one navigation source (a GNSS with serial output), select 'Primary channel' in the settings window (figure 15).

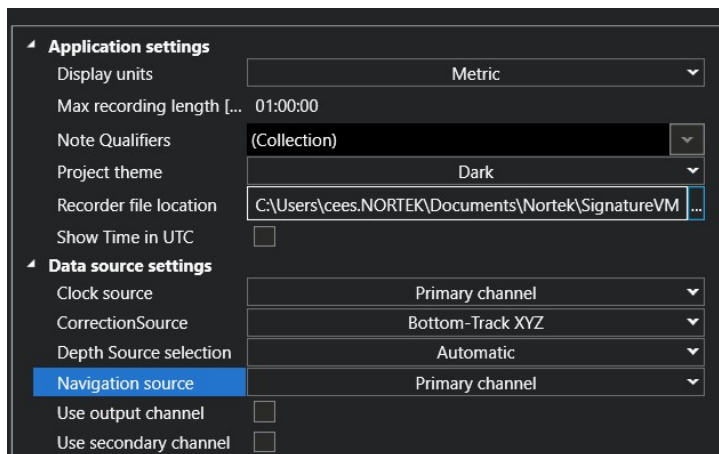


Figure 15: Configuration settings: Primary channel

If you have a second source, you can enable this in the settings by checking 'Use secondary channel'. If enabled, there will be an extra section in the setup for 'Secondary Global Navigation Satellite System' which can be configured to read data from a specific port (figure 16²⁴).

The image shows two configuration windows for satellite systems. The top window is for the 'Primary Global Navigation Satellite System'. It has a 'Type' dropdown set to 'Network NMEA', an 'Adapter' dropdown set to 'SurveyVM Interface', and an 'IP Address' field with '0.0.0.0' and a port field with '9001'. A 'Connect' button is at the bottom. The middle window is for the 'Local computer' section, with a 'Unit' dropdown set to '101747' and buttons for 'Discover', 'Connect', and 'Web page'. The bottom window is for the 'Secondary Global Navigation Satellite System', with 'Type' set to 'Network NMEA', 'Adapter' set to 'SurveyVM Interface', and 'IP Address' set to '0.0.0.0' and port '9002'. A 'Connect' button is at the bottom.

Figure 16: Options for Primary and Secondary channel

4.4.3.4.2 NMEA Output

To send data out over one of the serial ports, first make sure that 'Use output channel' is checked in the settings window (figure 17).

The image shows the 'Data source settings' window. It contains several dropdown menus: 'Clock source' (Primary channel), 'CorrectionSource' (Bottom-Track XYZ), 'Depth Source selection' (Automatic), and 'Navigation source' (Primary channel). The 'Use output channel' checkbox is checked, and the 'Use secondary channel' checkbox is unchecked.

Figure 17: Configuration: Use output channel

If so, there will be an 'Output' section in the setup (figure 18).

The image shows the 'Output' configuration window. It has a 'Format' dropdown set to 'Nmea', a 'Destination' dropdown set to 'Network', an 'Adapter' dropdown set to 'SurveyVM Interface', and an 'IP Address' field with '192.168.100.222' and a port field with '4003'. The 'Interval' is set to '1000 ms', the 'Formats' dropdown is set to 'PNORCV', and the 'Nr of Cells' is set to 'use all cells'. There is an unchecked 'Add time tags' checkbox and a 'Connect' button. Three blue callout boxes on the right provide explanations: the first points to the 'Destination' dropdown, stating 'Network, because the serial interface is connected over Ethernet'; the second points to the 'IP Address' field, stating 'IP Address = 192.168.100.222 for the serial interface.'; the third points to the port field, stating 'The IP Port number that refers to the physical Serial Port. Here 4003 refers to Port 3 on the interface.'

Figure 18: Configuration options for output

4.4.4 GNSS location and/or heading/gyro data via a network connection

The processing unit facilitates serial connections to obtain GNSS location and heading data. It is also possible to obtain this data via the network, using UDP, if that is how the data is available. For this purpose, use the extra network port that is available on the processing unit.

Configuration for this case is similar to that described in section "[Receiving NMEA data](#)"²². Now, however, the data does not originate from the MOXA converter, but from the GNSS and/or Gyro. This means you need to select not the "SurveyVM" network interface (which connects to the processing unit), but the "Ethernet" network interface (which is the extra network port on the back of the processing unit).

As the GNSS and/or Gyro source configuration will differ from one ship to another, it is not possible to prescribe the required settings in detail. You will have to provide the IP address(es) and UDP port number(s) as they are configured on the GNSS and/or Gyro itself. If you have a choice on the sending side between UDP Broadcast and UDP Multicast, consider that UDP Multicast is less taxing on network traffic.

Configuration settings to use GNSS location and/or heading via the network:

- In Primary GNS System, select "Network NMEA" as type (figure 19)
- Select the correct network adapter, titled "Ethernet"
- Fill in the source IP address and UDP port as appropriate, i.e., the IP address and port that the computer needs to be listening for
- Click the button "Connect" to start receiving
- The button "Diagnostics" opens a window showing the NMEA messages that the system receives with these settings
- Be aware that you may have to adjust the Windows firewall settings to allow the processing unit (and this application) to receive this network traffic

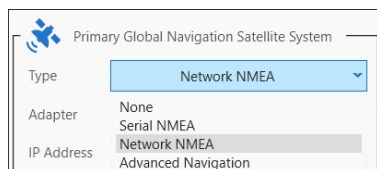


Figure 19: Select "Network NMEA" from the Type dropdown list

If both the location and heading data is available on the same IP address and UDP port, configuring just this one combination is sufficient. The software does not *need* the GNSS location and (Gyro) heading NMEA data to use different IP addresses and/or UDP ports. However, if the GNSS location and (Gyro) heading data sources use different IP addresses and/or UDP ports, you will need to configure a second navigation data source as follows:

- In the Configuration settings, in the section "Data source settings" (see figure [20](#)²⁶), enable the secondary channel ("Use secondary channel")
- Determine which source you will consider the Primary channel and which one the Secondary channel (if you have already configured the Primary GNS System settings, take this into consideration, lest you have to correct this configuration)
- For each of Clock source, Heading source, Navigation source, and Speed over ground source, select the appropriate source (channel) for that data
- For Heading source, you can also select which type of NMEA sentence will provide the heading information (HDT, THS, or NTHPR)

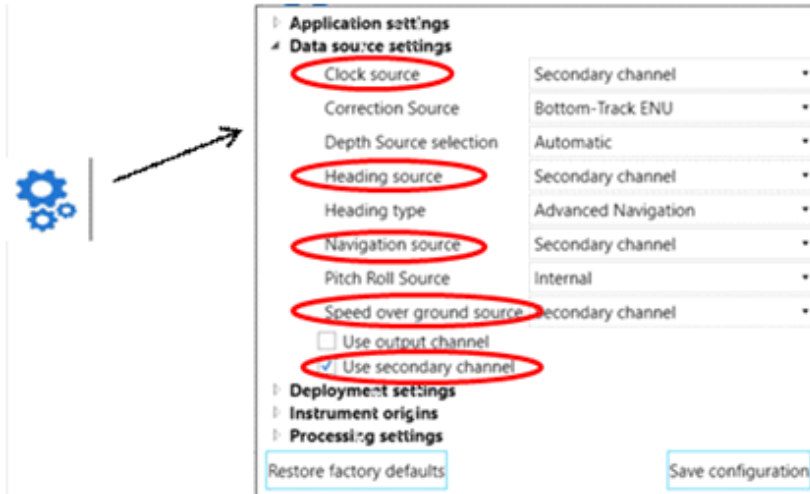


Figure 20: Configuration settings for a second source of navigation data

Next, in the Instrument Connection details pop-up, you will see an additional section "Secondary Global Navigation Satellite System". As for the Primary GNS System details, select "Network NMEA" and the "Ethernet" network adapter, and fill in the IP address and UDP port for the secondary source.

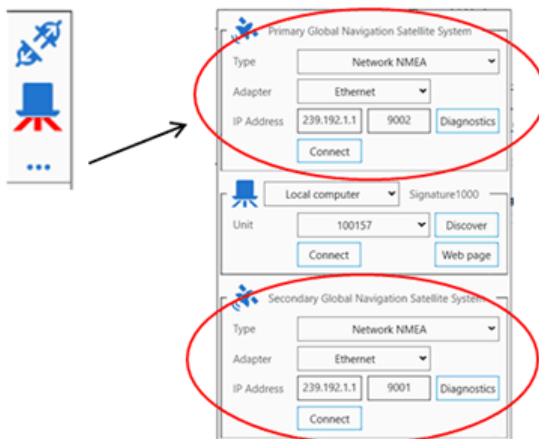


Figure 21: Two Network NMEA sources for navigation data

4.4.5 Connecting to the Processing Unit

Though it is possible to connect to the VM Operations Processing Unit using a keyboard, mouse and monitor, the general idea is to use a Remote Desktop connection from another computer (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. It needs a fixed IP address in the 192.168.100.xxx range.

With a Windows 10 computer, the configuration steps to set a fixed IP address follow. (Note: you will need an account with Administrator privilege for this.)

First select your Ethernet adapter (via Settings → Network & Internet → Change adapter options, under Advanced network settings). With your Ethernet adapter selected, you can then either click the ribbon-button "Change settings of this connection", or right-click and select Properties from the pop-up context menu, or double-click it and in the subsequent Status dialog

window click the Properties button. (This is the point where you may need to select a local Administrator account if your normal account does not have Administrator privileges.)

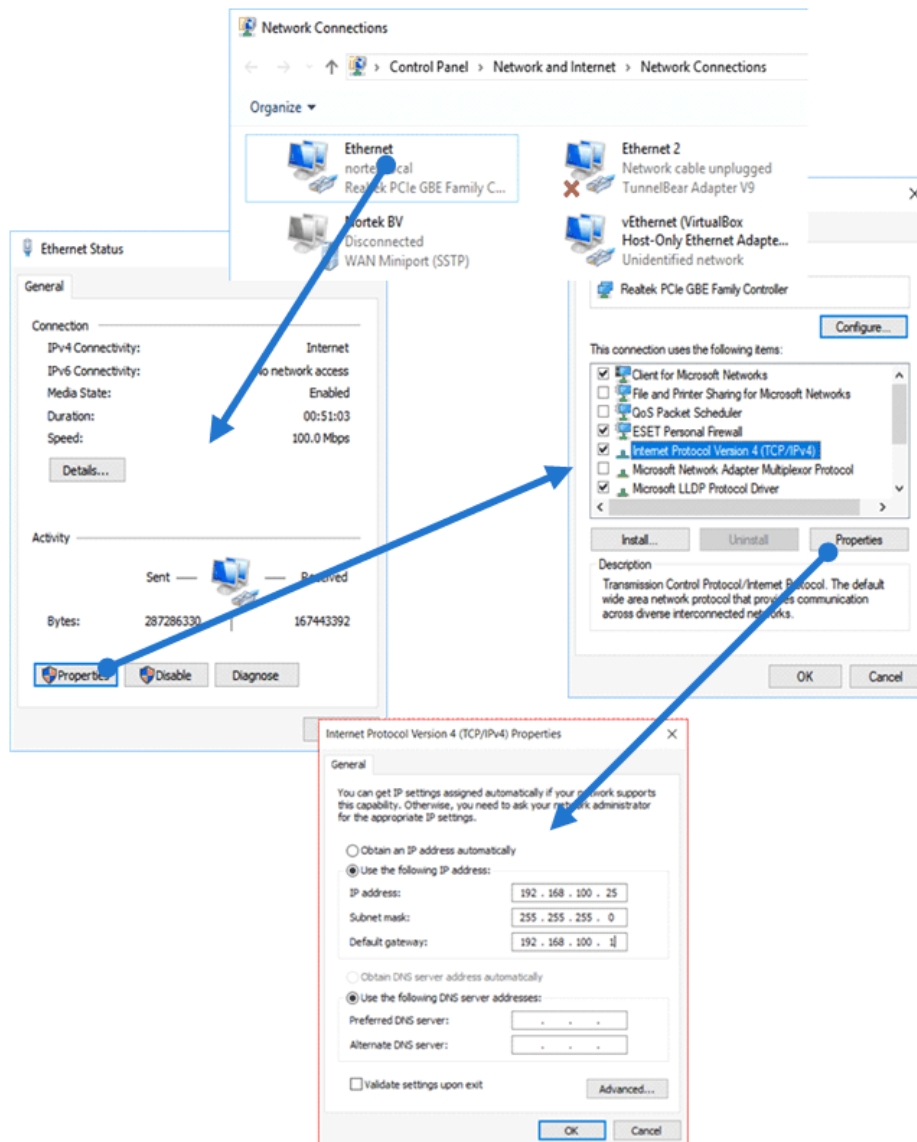


Figure 22: Configuring Windows for use with the Remote Desktop connection

In the "Properties" window, select "Internet Protocol Version 4 (TCP/IPv4)" and click the "Properties" button. In the next Properties dialog window, on the "General" tab, select "Use the following IP address", and fill in: IP address: 192.168.100.25, Subnet mask: 255.255.255.0, and Default gateway: 192.168.100.1. (In fact, you can fill in any IP address in the 192.168.100.xxx range, as long as it is not one of the IP addresses already in use, i.e., as long as it is not 192.168.100.1, 192.168.100.2, or 192.168.100.222).

Figure 22 illustrates the sequence of dialog windows for these steps, from the point "with your Ethernet adapter selected" on, via the double-click variant.

After this, close all the dialog windows via the appropriate "OK" or "Close" buttons.

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

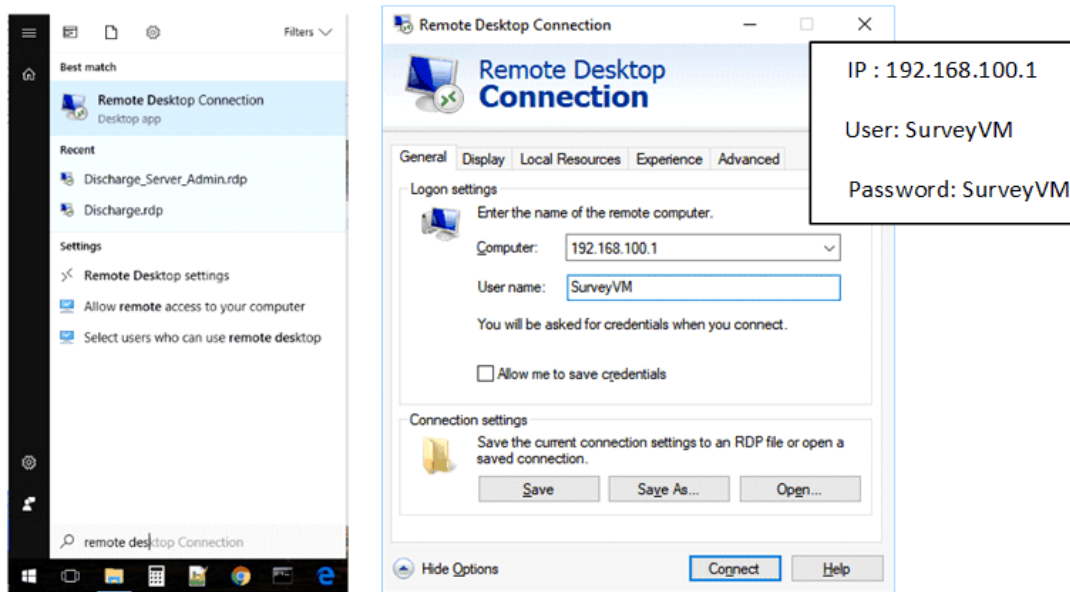


Figure 23: Setting up Remote Desktop

The address of the VM Operations Processing Unit 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 23).

Click connect. If all is correct, a popup will appear asking for the password. The password is 'SurveyVM'. Once connected the screen of the VM Operations processing unit will appear (figure 24).

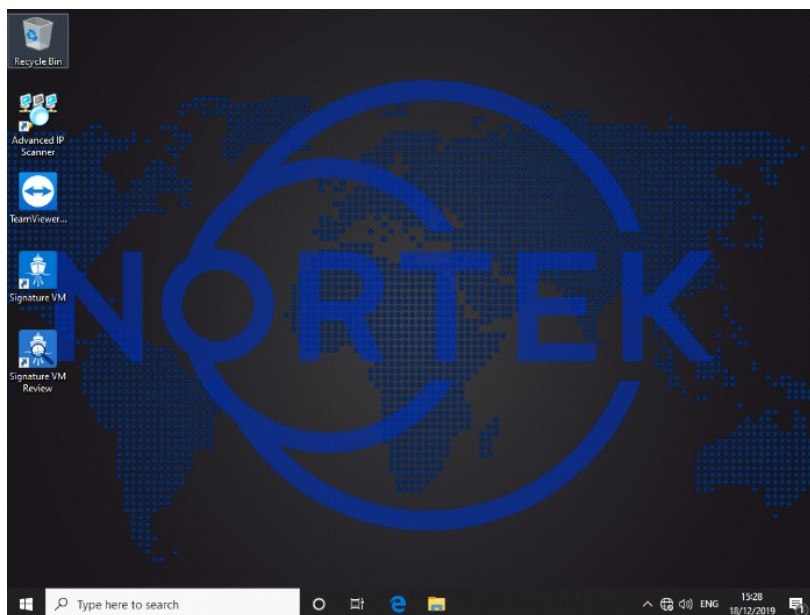


Figure 24: Dark Theme

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 (figure 25²⁹).

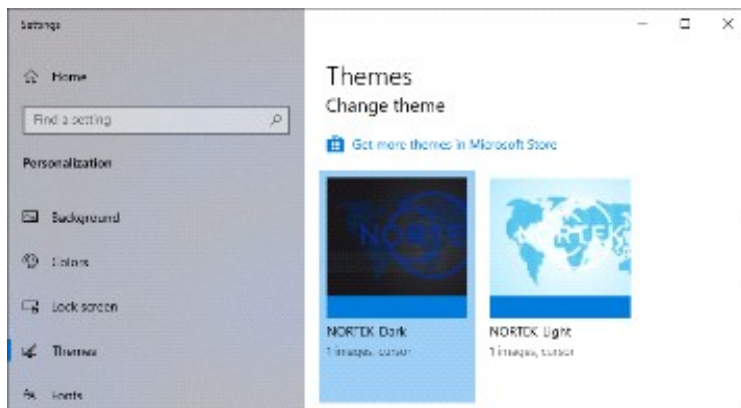


Figure 25: Desktop theme selection

5 Operations Software

Once everything is connected, start the VM Operations software.

Figure 26 shows the standard overall layout of the main window of the VM Operations software.

(Note that the look of the VM Operations software can be selected from several themes. Figure 26 illustrates the "Nortekblue dark" theme. Most screenshots in this manual depict the "Nortekblue light" mode. To change the (software) theme, see figure 35⁴¹ and table 5⁴² in section [Software Configuration](#)³⁹. Also note that this 'software theme' is separate from the Windows theme; for the latter, see figure 25²⁹.)

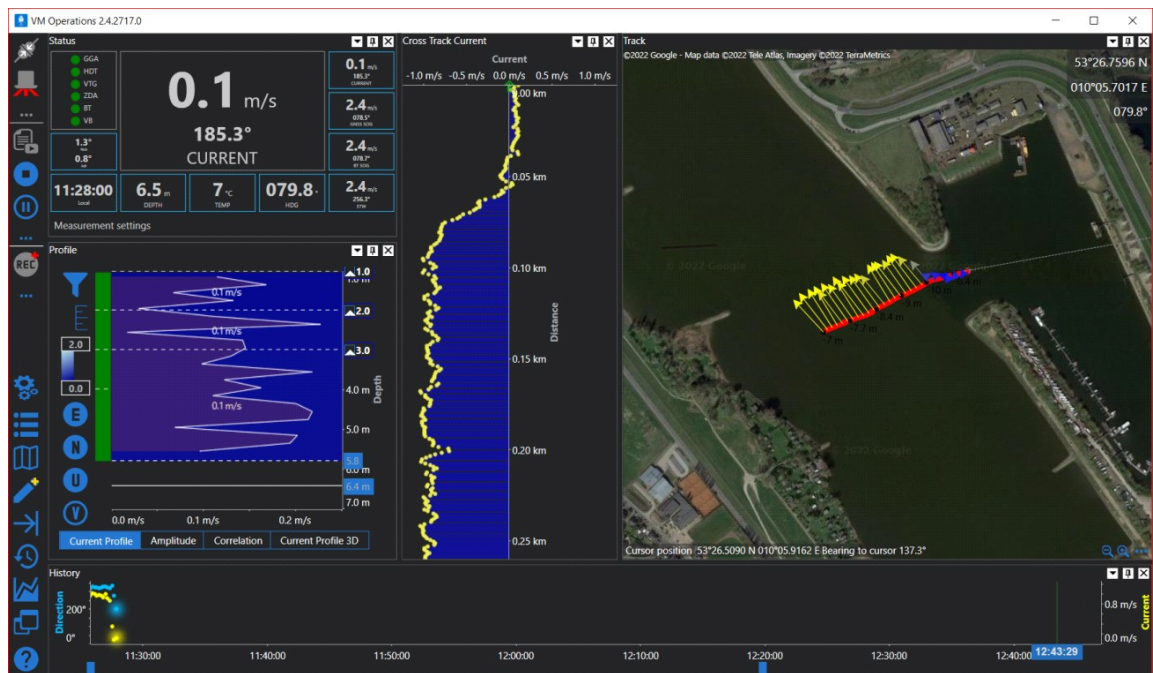


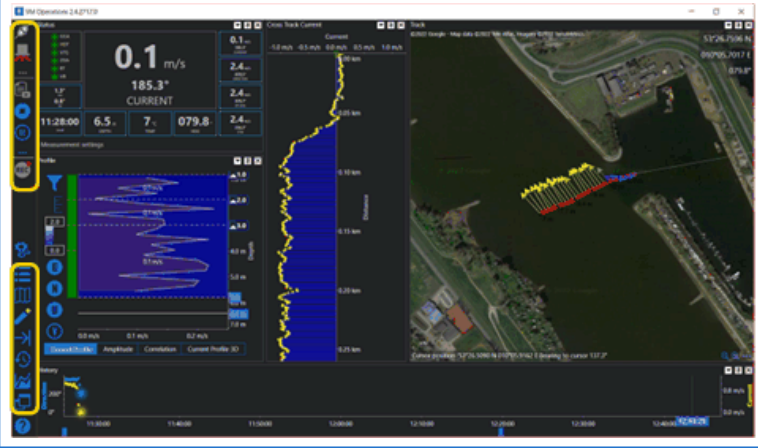
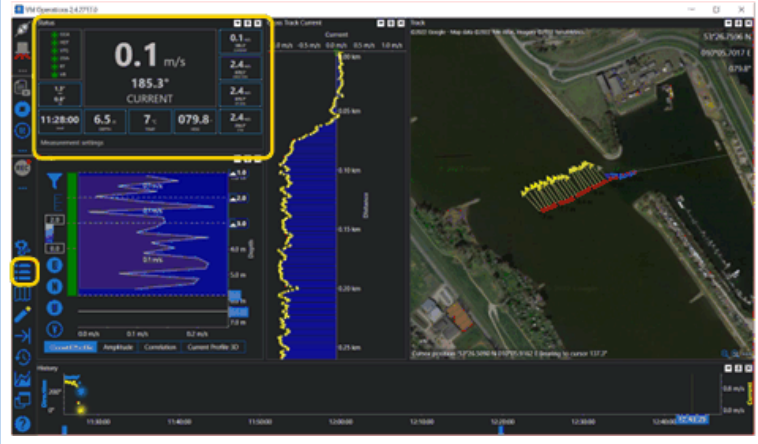
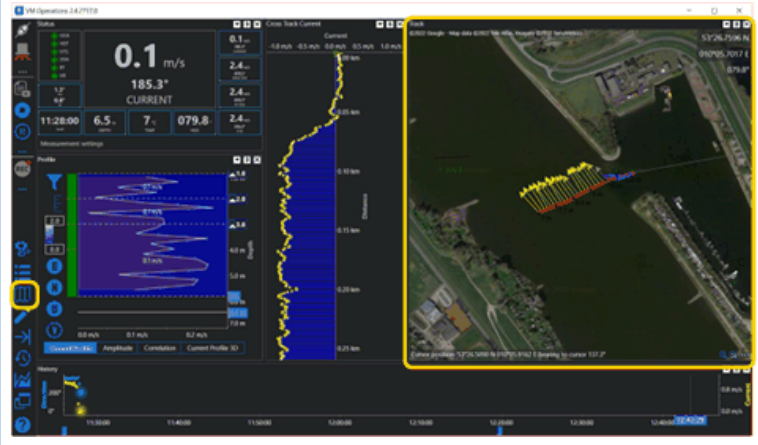
Figure 26: Main window of the VM Operations software (dark mode)

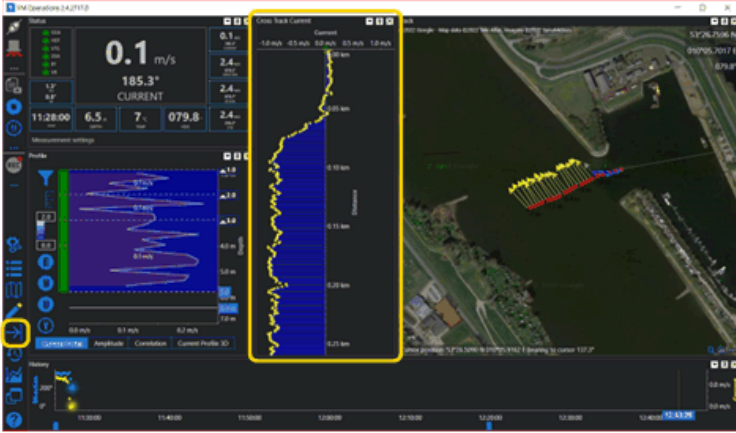

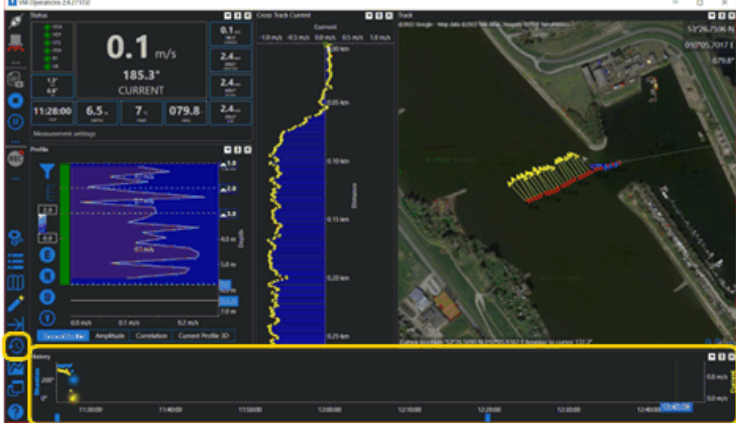
Table 3³¹ indicates the different sub-windows, their function, and what section in this document describes them in more detail.

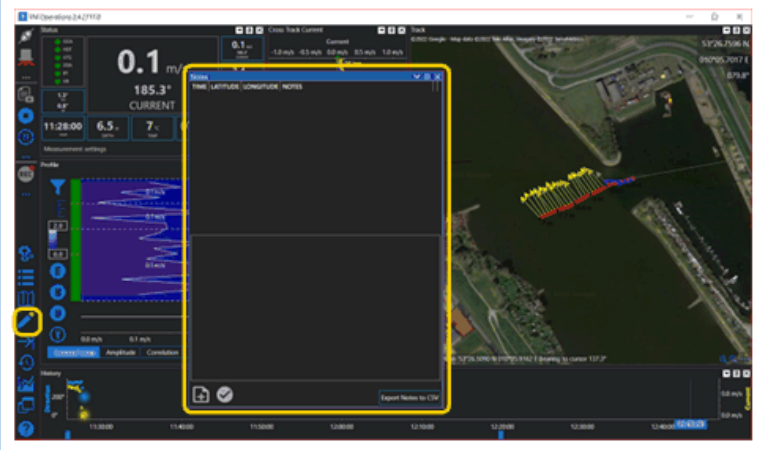
The different sub-windows may be moved, rescaled, or closed if required. To recover a window, or to reset the screen layout to defaults, click on one of the seven window recovery buttons in the lower left (see figure 62⁷⁶ in section [Buttons to show/hide the different windows](#)⁷⁶). Clicking the appropriate button will bring up the related window; clicking 'Restore Layout' will restore the default layout. When a certain window is hidden, the corresponding button shows a yellow '+' in the top right corner.

5.1 Sub-windows

Table 3: The different sub-windows and associated buttons

Sub-window indication + associated button	Description
	<p>Task/button bar</p> <p>Contains buttons for the main tasks in the software, see section "Task/button bar"³³ .</p> <p>The lower buttons control the sub-windows, see section "Buttons to show/hide the different windows"⁷⁶ .</p>
	<p>Status panel</p> <p>Contains indicators and fields to show the operational status of the system, and values of key parameters, see sections "Status panel"³⁷ " and "Status"⁴⁸ .</p>
	<p>Map/track window</p> <p>Shows a map of the region, most recent and previous positions, and the average measured current for each position, see section "Track display"⁵¹ .</p>

Sub-window indication + associated button	Description
	<p>Cross track current window</p> <p>Shows the magnitude of the component of the current perpendicular to the ship's track, see section "Cross track current window"⁷⁷ .</p>
	<p>Profile window</p> <p>Shows (in different tabs) the vertical structure of the current (and of some instrument data quality indicators), see section "Profile window"⁷⁹ .</p>
	<p>History window</p> <p>Shows yesterday's current value and direction (if recorded), see section "History window"⁸⁶ .</p>

Sub-window indication + associated button	Description
	<p>Notes window</p> <p>Allows addition of notes during operation, see section "Adding Notes"⁵⁴.</p> <p>(Normally not visible; open via the "notes" button)</p>

5.2 Task/button bar

The main task bar is on the left (figure 27). This contains the controls for starting and stopping the measurement, changing the settings, and replaying data.

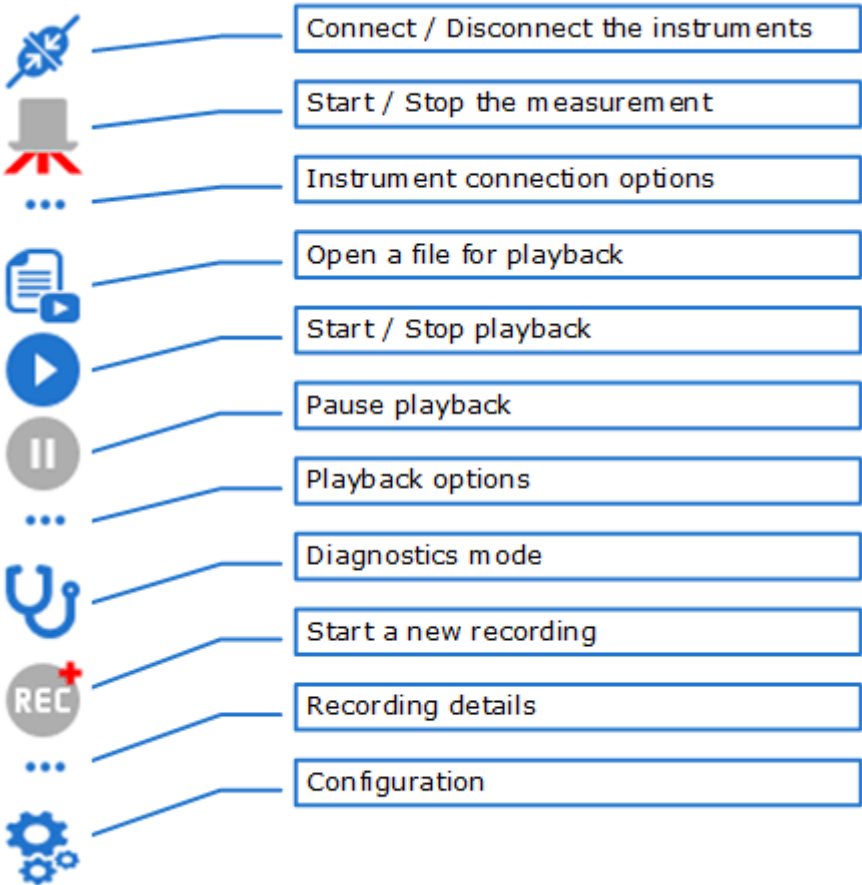


Figure 27: Taskbar explained

The buttons at the bottom left allow restoring the sub-windows (see section "[Buttons to show/hide the different windows](#)"⁷⁶). The bottom-left set also contains the Configuration button at the top of the list, and a button at the bottom of the list to open the manual.

5.3 Connecting the GNSS

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

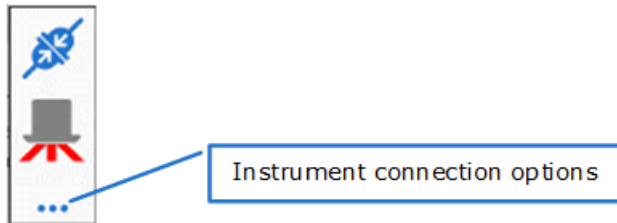


Figure 28: Instrument section of the task/button bar

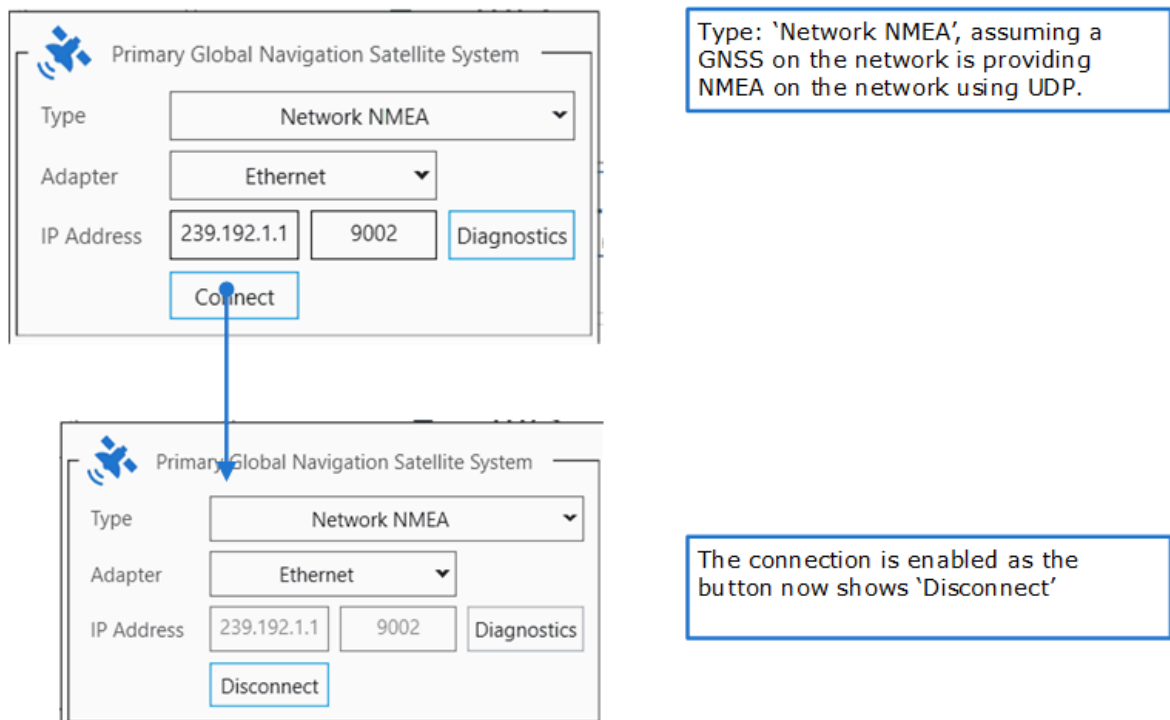


Figure 29: GNSS Connection

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'.

It is important that the GNSS is fully functional and has a correct position and heading.

5.4 Connecting the Signature

Next select the Nortek Sensor Communication (see figure [30](#)³⁵). 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](#)⁹¹.

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](#)⁴⁷, see the Nortek VM Frequently Asked Question "Custom deployment with raw bottom track" on the [Nortek Support web-site](#).)(You should not need to use this feature with the Operations version of the software.)

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.

The screenshot shows two panels of the software interface. The top panel shows the 'Local computer' selected in the 'Unit' dropdown, with a 'Discover' button. The bottom panel shows the 'Unit' dropdown populated with 'NepSig', and additional options like 'Disconnect', 'Web page', 'Triggering' (set to 'None'), and 'Clock source' (set to 'Internal') are visible. A checkbox for 'Use default deployment' is also present.

Where the Signature is connected. Standard is 'Local Computer'

If no serial number is shown, click 'Discover' to have the software search for connected sensors. Click the drop-down box to see the IP-Address of this sensor, or any other sensor attached to the network. Click 'Connect' to connect to the instrument

The connection is established. It detected a Signature100 sensor, the button shows 'Disconnect', and some other settings are available.

Figure 30: Signature connection

5.4.1 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.

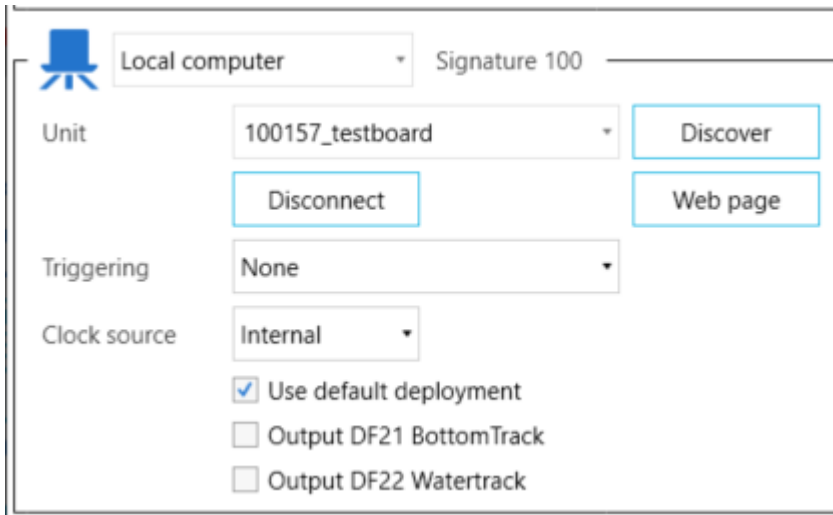


Figure 31: Special output options

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](#).

5.5 Checking the Signature

Once connected, click on 'Web page'. This will open the internal web-interface page of the Signature Sensor (figure [32](#)^[36]). 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.)

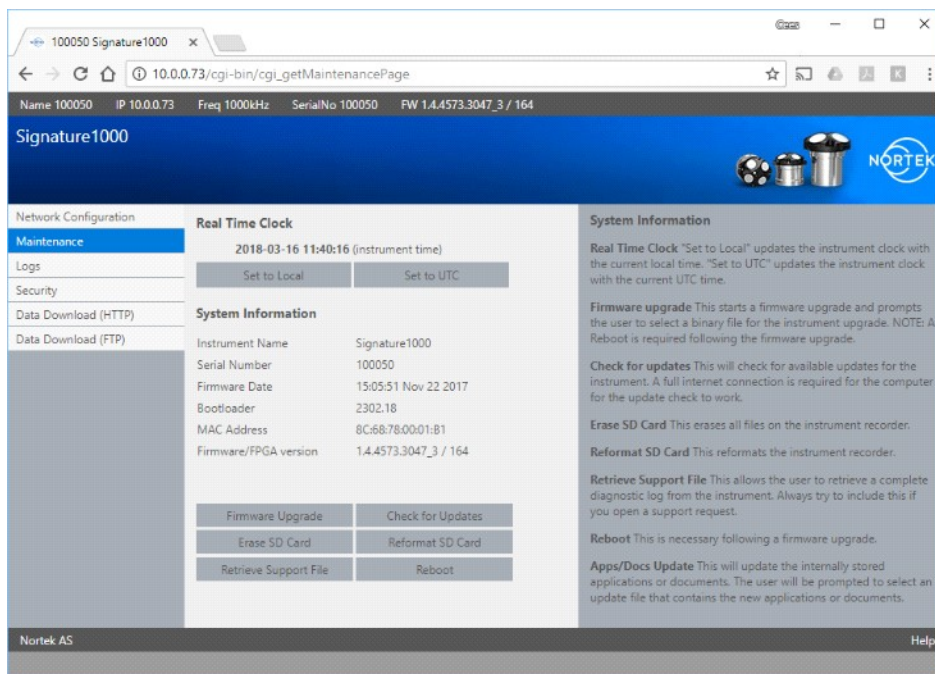


Figure 32: Signature web interface

5.6 Status panel

The 'Status' panel shows a quick overview of what is received and what is not.

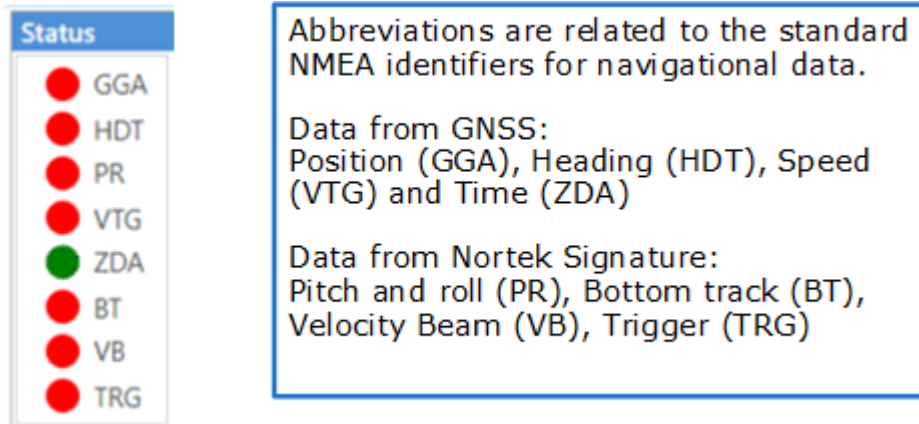


Figure 33: Status panel with status indicators

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 [4](#)³⁸ 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](#)⁴⁸.

Table 4: 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 instrument 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 VM Operations system.

- Larger cells provide more range and have a better velocity precision. Always choose the largest cell possible for your application. Smaller cells may 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 bottom track pings, reduce the number of velocity pings in time and thus reduce the velocity precision in time. If the depth is too large for the bottom track to work anyway: switch that off. (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.
 - It is 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 Software 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 [34](#)^{D40}). Click the small triangle to the left of a category of settings to switch

between the collapsed and the expanded view. For a very brief explanation of any settings option, hover the mouse over it for a pop-up help balloon.

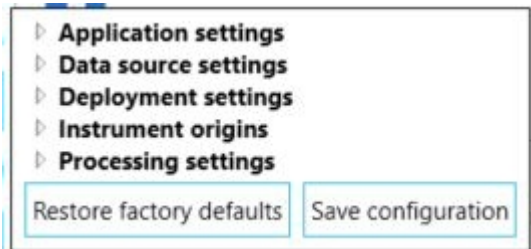


Figure 34: Configuration settings, collapsed view

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 [35](#)⁴¹ shows the full list of configuration settings.

Table [5](#)⁴² 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	00:10:00
<input type="checkbox"/> Internal Recording	
Note qualifiers	▾
<input type="checkbox"/> Show Time in UTC	
Recorder file location	C:\Caspar\Projects\2024\Signatur 📁
Data source settings	
Clock source	Primary channel ▾
Correction Source	Bottom-Track ENU ▾
Depth Source selection	Automatic ▾
Heading source	Primary channel ▾
Heading type	Advanced Navigation ▾
Navigation source	Primary channel ▾
Pitch Roll Source	Internal ▾
Speed over ground source	Primary channel ▾
<input type="checkbox"/> Use output channel	
<input type="checkbox"/> Use secondary channel	
Instrument origins	
▸ Diagram	
▸ GNSS mounting 0 m,0 m,2 m,0 °	
▸ Signature mounting 0 m,0 m,0 m,0 °	
Water line	0.75
<input checked="" type="checkbox"/> Lock gyro orientation	Auto align Signature
Processing settings	
Amplitude limit	
Average Interval [s]	10
Correlation limit	5
FOM Threshold	1000
Sensor timeout	
Layer(s)	Full profile ▾
Restore factory defaults	
Save configuration	

Figure 35: Configuration pop-up window

Table 5: Software configuration settings

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 " ⁵⁴ 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	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 multiple sources of pitch and roll 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 " ⁶³ 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 ⁵⁶ for details.
GNSS Mounting	0m,0m,0m,0°	Offsets of the GNSS from a reference point on the vessel. Check chapter Offsets ⁵⁶ for details.
Signature Mounting	0m,0m,0m,0°	Offsets of the Signature from a reference point on the vessel. See chapter Offsets ⁵⁶ 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 " ⁵⁹ 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.
Correlation limit [%]	50	Any measured cell where the correlation is lower than this limit is discarded.

<i>Setting</i>	<i>Default</i>	<i>Description</i>
		If left blank, no limit is applied.
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	Full profile	Select a horizontal layer to be used throughout the application. See section " Selected layer " ⁸² for details.

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 was checked and found to be working, as described in the previous section, the system can be started by simply clicking the 'Connect' button (see figure [36](#)⁴⁵).

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 setting (figure [36](#)⁴⁵). The contents of this window may vary, depending on the type of sensor that is connected or the available options within that sensor.

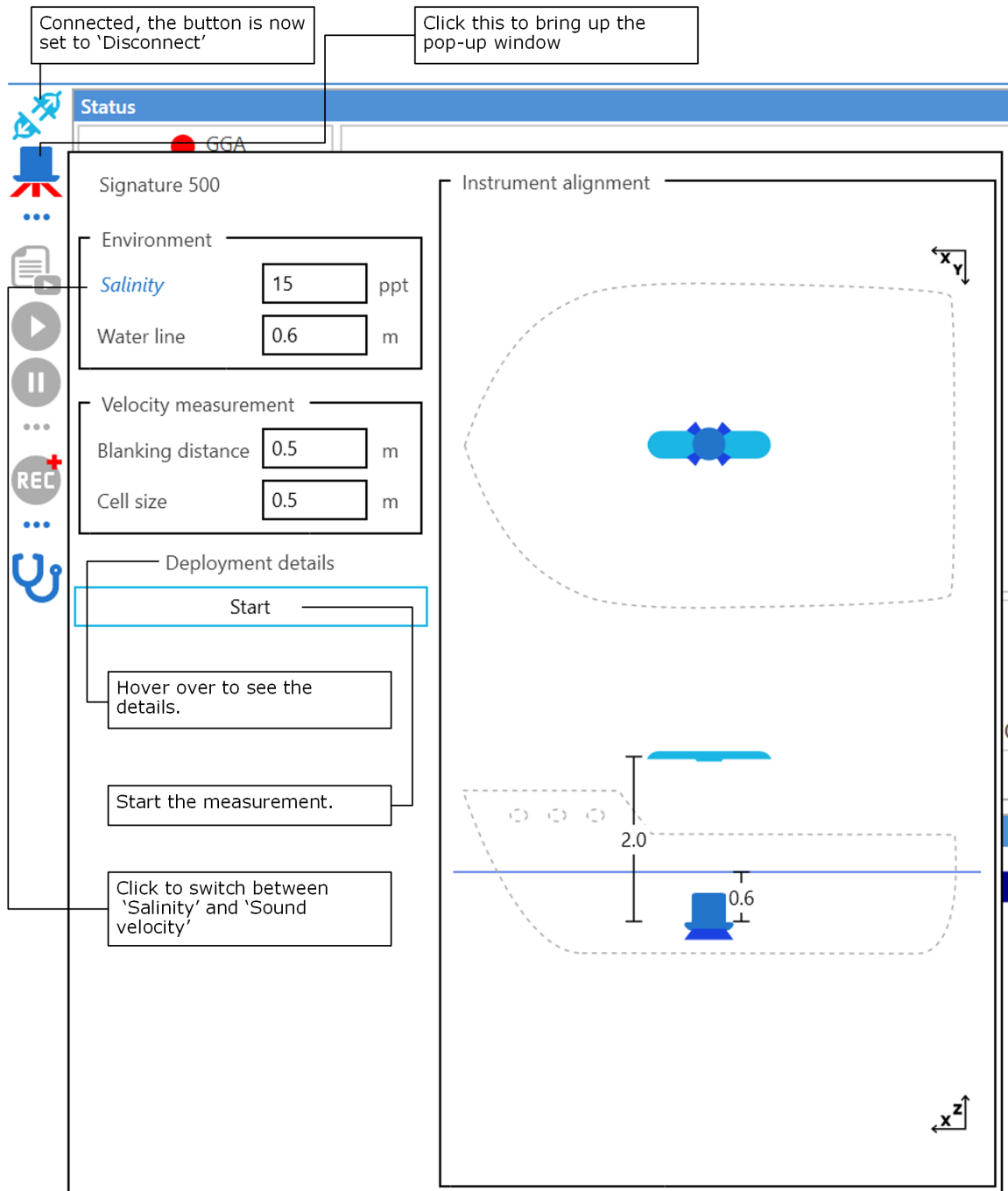


Figure 36: Start measurement pop-up window

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 6: Measurement settings for the Signature VM instrument

Setting ¹	Default ^{2,3}	Description
Environment		
Salinity / Sound Velocity	35 / 1500	Note that when using the concave Signature VM 333 kHz you have to enter 0 ppt for the salinity. Click on this field to switch between 'Salinity' or 'Sound-Velocity' 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	<i>Applies only to the Signature 250, 100 and 55.</i> Enable or disable the use of bottom track when calculating the velocities. If disabled, the velocity corrections are taken from the GNSS.
Enable Altimeter	N/A	<i>Not applicable for the Operations version</i>
Use broadband	ON	<i>Not applicable to the Signature 1000 and 500.</i> If disabled, the sensor uses the narrow-band doppler technique for measuring velocities. Narrowband may give a bit more range, but it is less accurate and noisier. Therefore, use of the narrowband setting is discouraged.

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. These details can be inspected or saved to file and used as a basis for constructing custom deployment files. Creating and using custom deployment files is an advanced feature. Please refer to the 'Nortek Signature Integrators Guide' for details.



Figure 37: 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. 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.

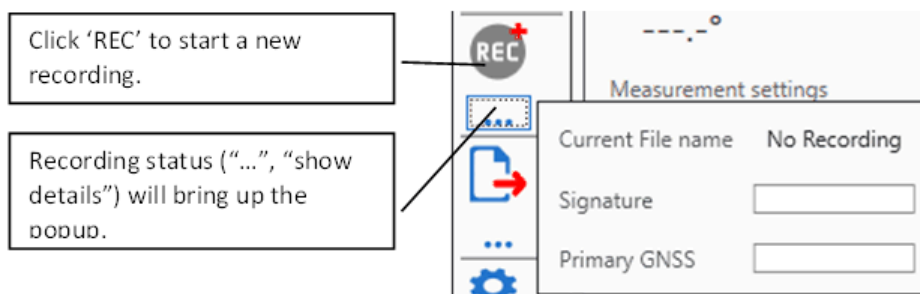


Figure 38: Recording and recording status

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.

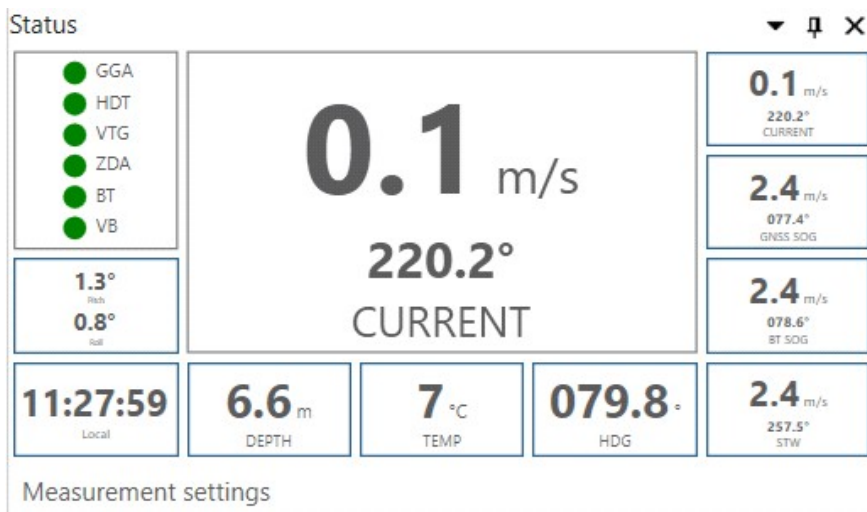


Figure 39: Status panel overview

The different parameters are (in figure 39, clockwise from top right):

Table 7: 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 ⁴³⁷ 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 42 ⁴⁵⁰ 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 40 shows an example.

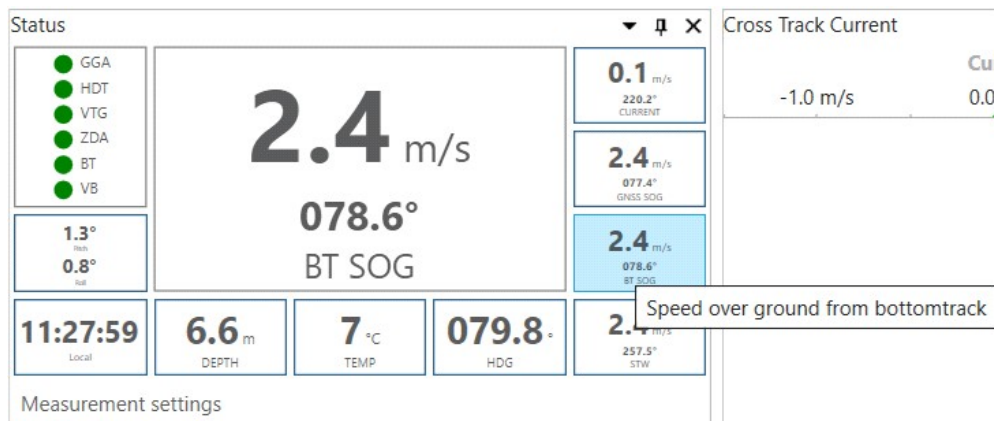


Figure 40: Hover over a sub-panel to show its values in the center panel and show an explanatory pop-up balloon

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 41 shows an example.

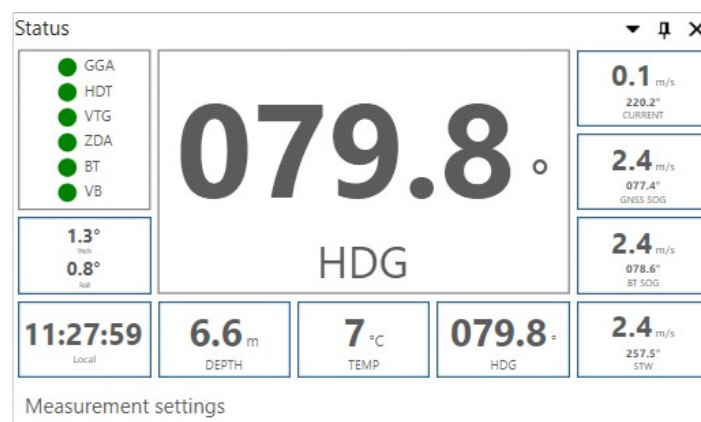


Figure 41: Click on a sub-panel and the center panel will display that panel's contents permanently

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 [42](#)⁴⁵⁰ 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.

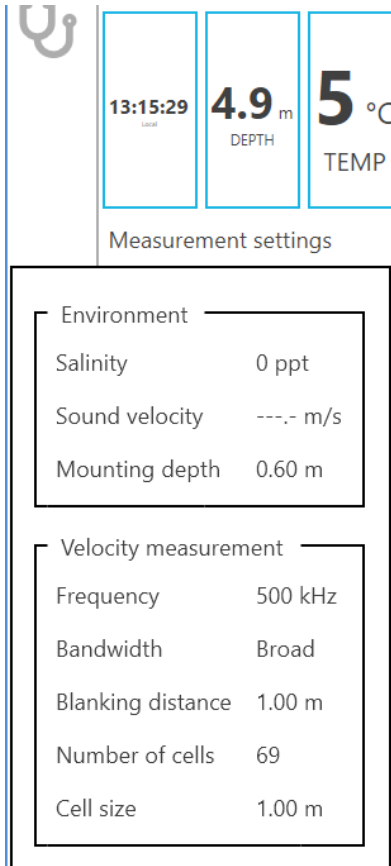


Figure 42: Hover over "Measurement settings" for a list of details

The values related to the water velocity (Current and STW) are averaged over the full water column by default. The selected layer can change this behavior.

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

6.4.2 Track display



Figure 43: 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](#)⁵².)

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 [8](#)⁵² for details on each option.

Table 8: 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 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.	
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.	

Figure 44: Map display options

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.

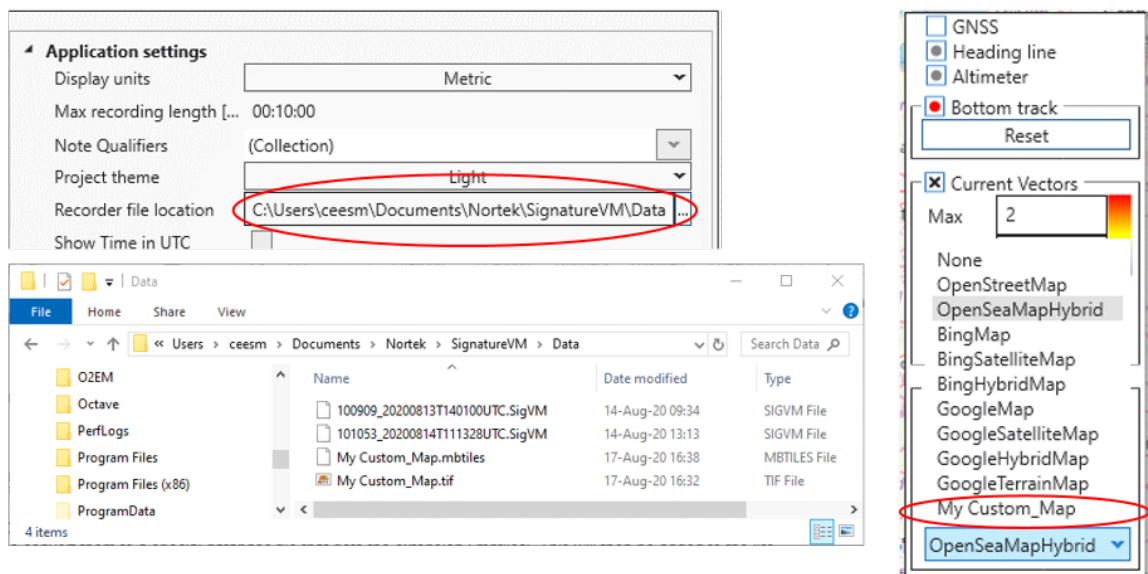


Figure 45: Custom map

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.

6.5 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

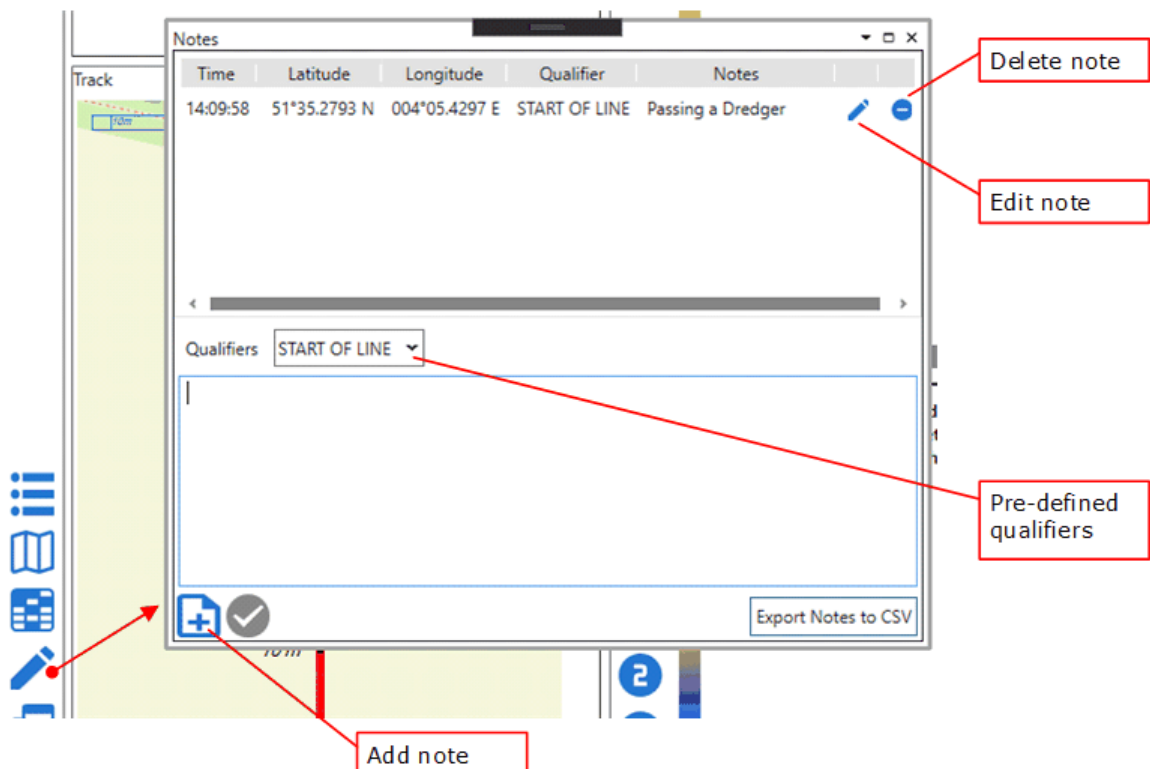


Figure 46: Adding notes

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.

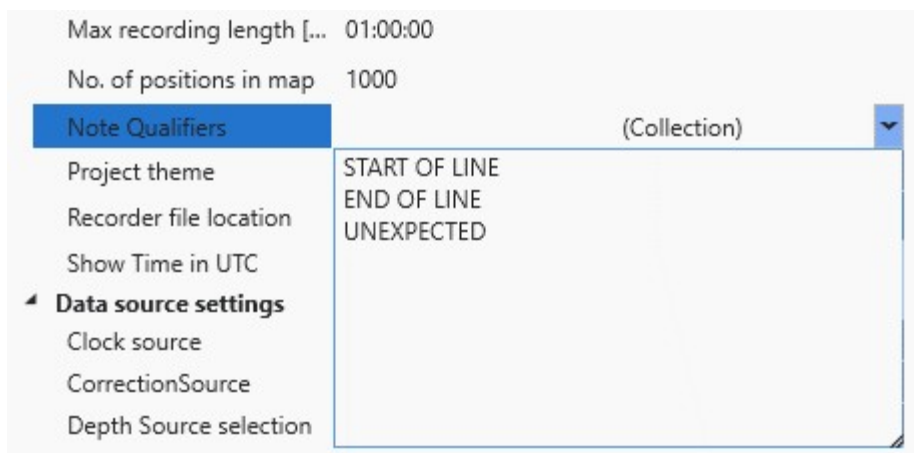


Figure 47: Adding the Notes-Qualifiers

Notes are stored in the .SigVM data file. 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'.

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.

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.

▷ Application settings	
▷ Data source settings	
▷ Deployment settings	
▲ Instrument origins	
▲ GNSS mounting :0 m, 0 m, 0 m, 0 °	
X offset	0
Y offset	0
Z offset	0
Orientation	0
▲ Signature mounting :0 m, 0 m, 0 m, 0 °	
X offset	0
Y offset	0
Z offset	0
Orientation	0
▷ Processing settings	
Restore factory defaults	Save configuration

Figure 48: Signature and GNSS mounting offsets

7.1 Vessel Coordinate system

The coordinates for permanent mounted systems are only required to be set once during the installation on the vessel and are set and documented during the STW, HAT or SAT phase. The illustration below visualizes a pole mount installation but the same applies to any permanent sea chest, blister, drop keel or gondola mounts.

As shown in the illustration (figure 49⁵⁶) there are three different coordinate systems that apply.

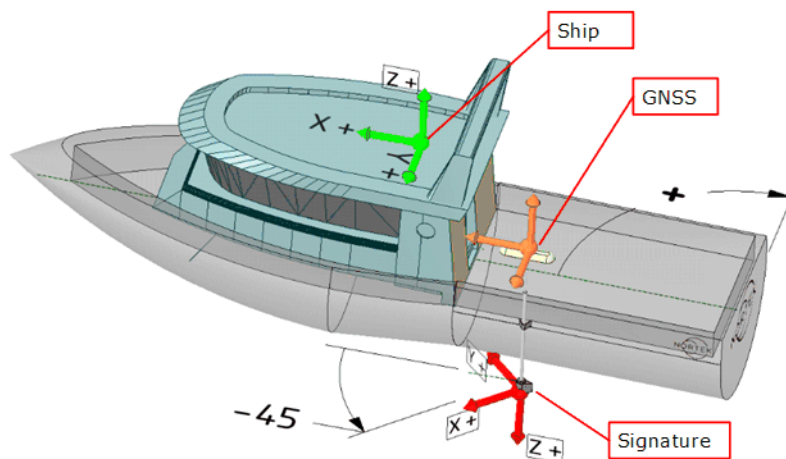


Figure 49: Vessel coordinate system

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. If installed according to the instructions in the Single Bottom or Double Bottom Installation manual, the Signature333 will be oriented with the sensors at 45° with respect to the vessel's forward direction. This 45° orientation is taken into account in the instrument firmware. For the Signature333, the orientation to be entered in the software is therefore 0° (barring a small misalignment).

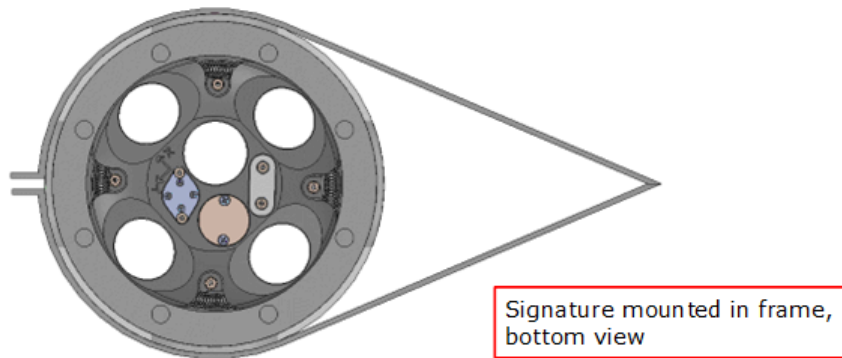


Figure 50: Signature mounted in frame (bottom view; Signature 1000 shown)

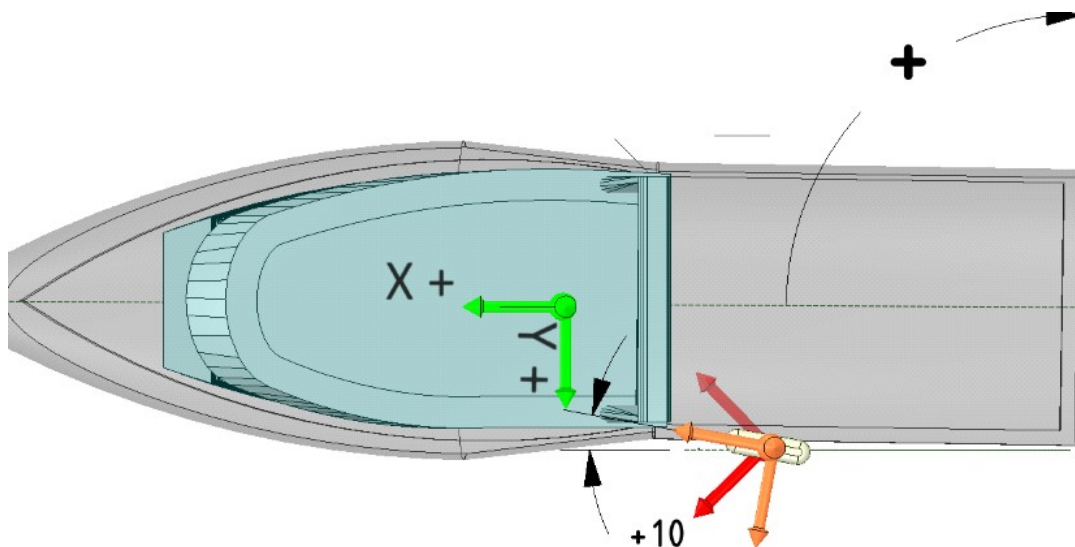


Figure 51: Signature and GNSS mounting coordinates

To illustrate the GNSS orientation offset it is shown here (figure 51⁵⁷) 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 49⁵⁶ and 51⁵⁷. 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 52⁵⁸) 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.

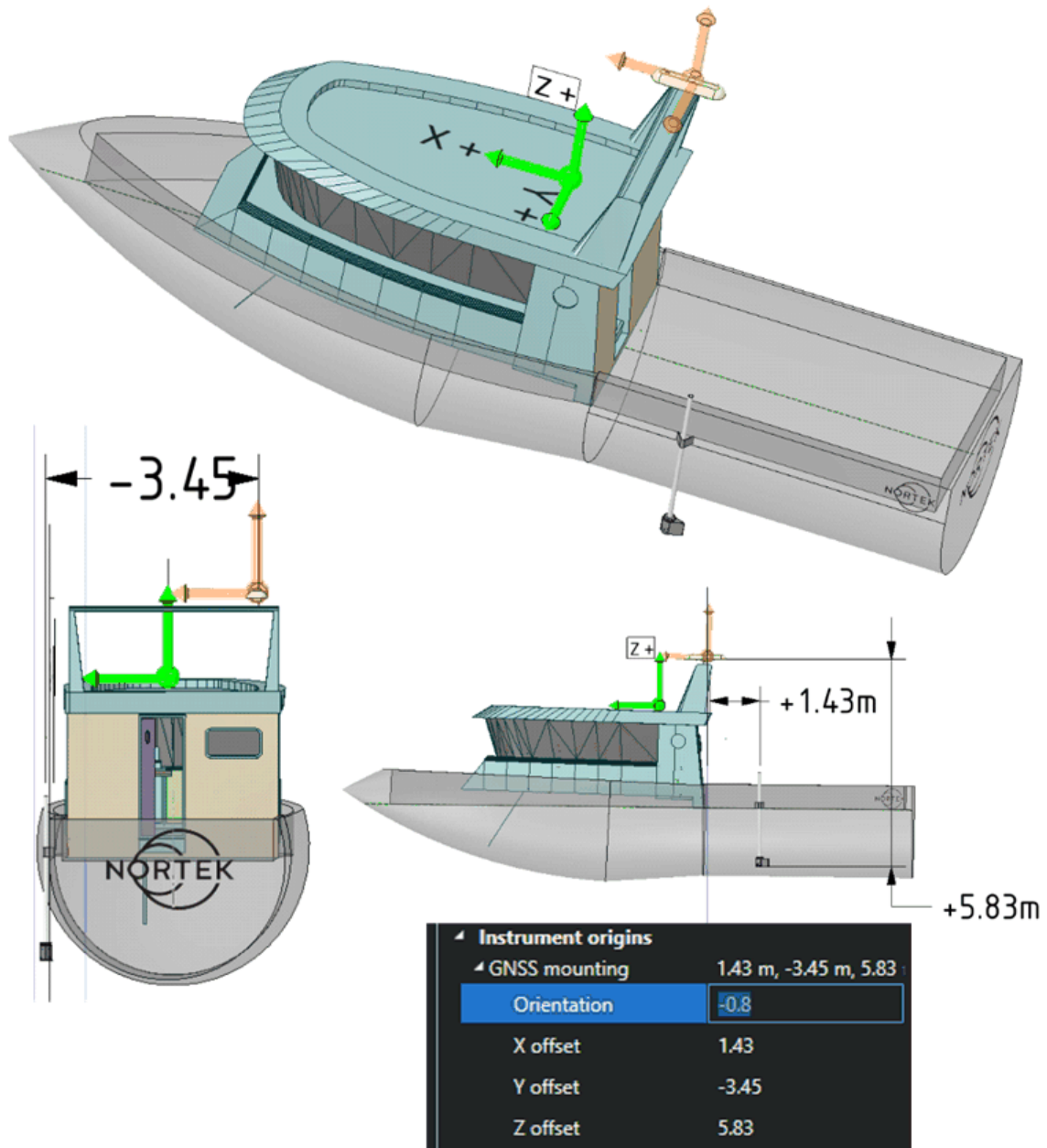


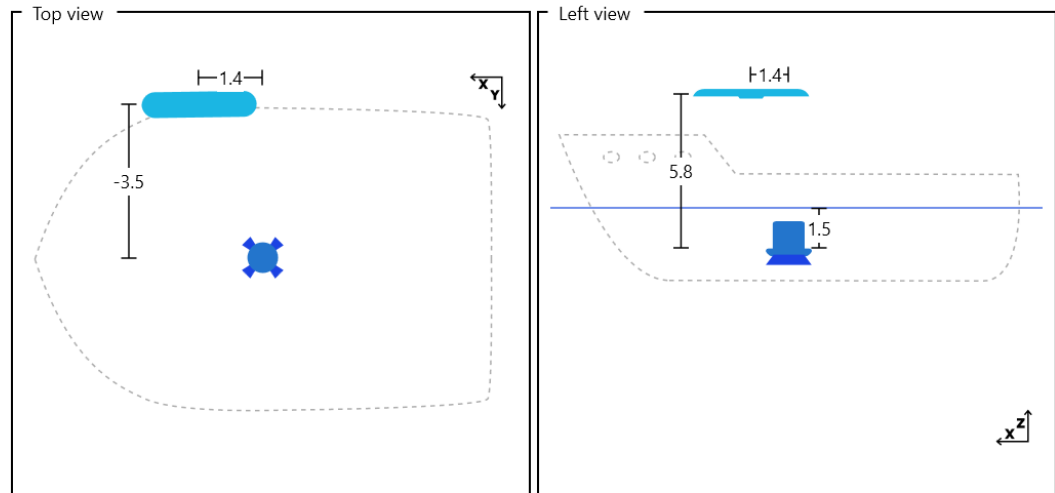
Figure 52: Offsets from the GNSS to the Signature

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 53.

- ▲ Instrument origins
- ▲ Diagram



- ▲ GNSS mounting 1.4 m,-3.5 m,5.8 m,-0.8 °

X offset	1.43
Y offset	-3.45
Z offset	5.83
Orientation	-0.80
- ▲ Signature mounting 0 m,0 m,0 m,-45 °

X offset	0.00
Y offset	0.00
Z offset	0.00
Orientation	-45.00
- Water level
- Lock Gyro orientation

Figure 53: Offsets diagram

In figure 53 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 54⁶⁰. 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](#)⁶¹.

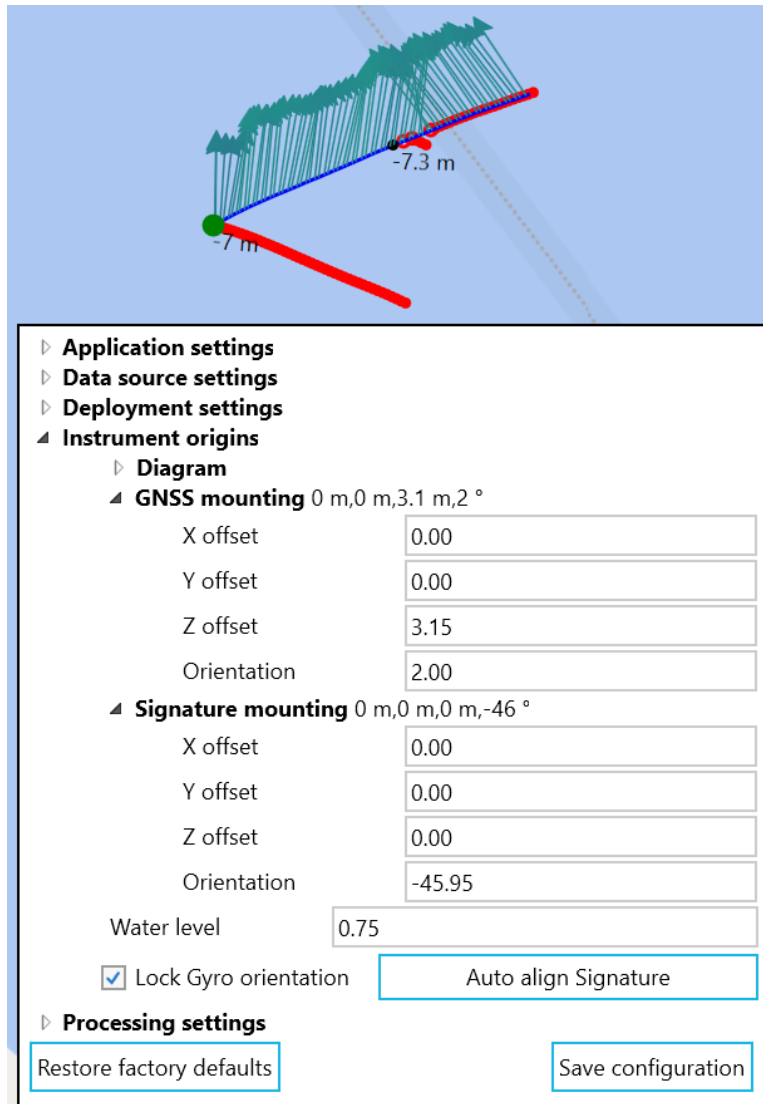


Figure 54: Automatic alignment

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.

This procedure should result in a good alignment in most situations, sometimes it might be necessary to manually adjust the orientation values.

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 55: Adjusting GNSS orientation and settings

Don't forget to click 'Save Configuration'!

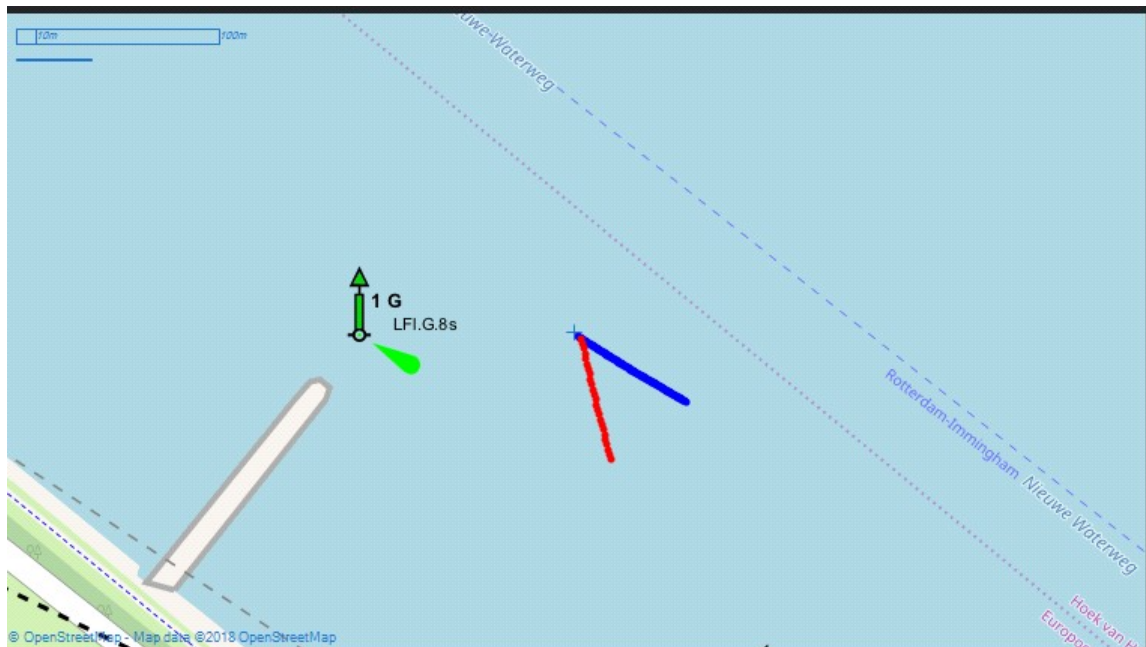


Figure 56: Bottom track and GNSS track deviation

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 57⁶²) this is not the case. This also shows up very clearly in the track plot (figure 56⁶¹). 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'.

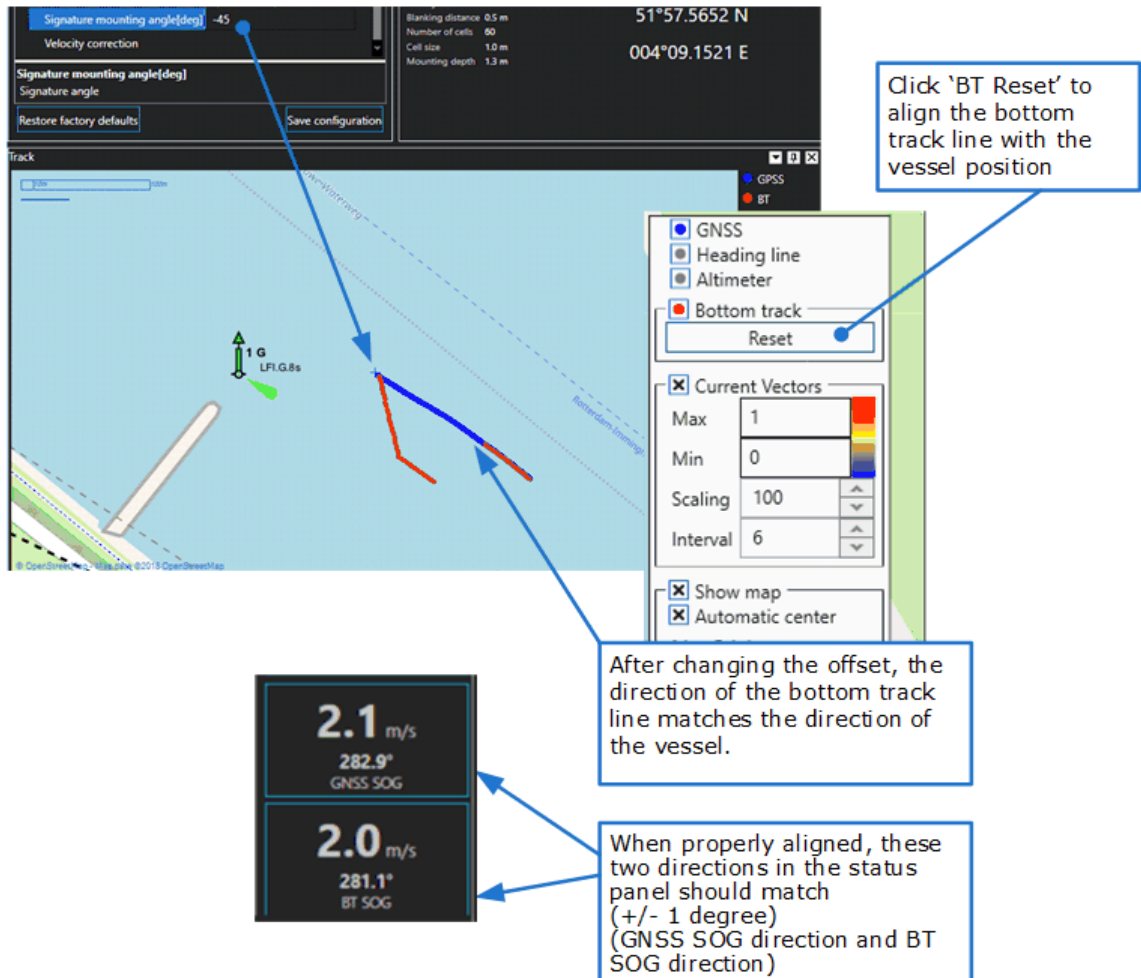


Figure 57: Aligning for bottom track

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 58th63). The details available in the 'Output' section will change in accordance with selections you make.

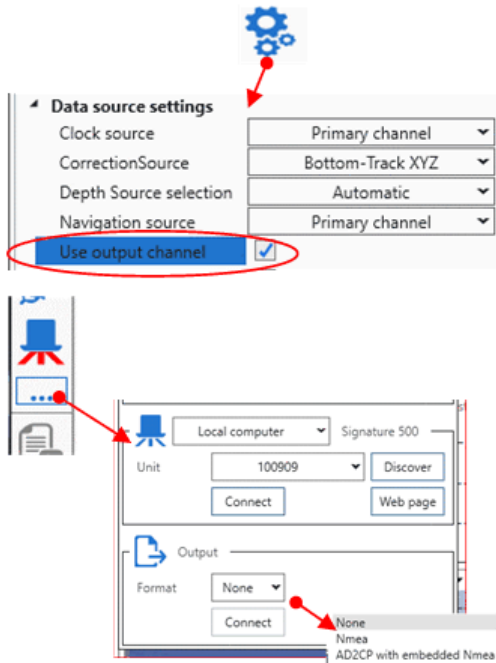


Figure 58: Enabling data output

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>.)

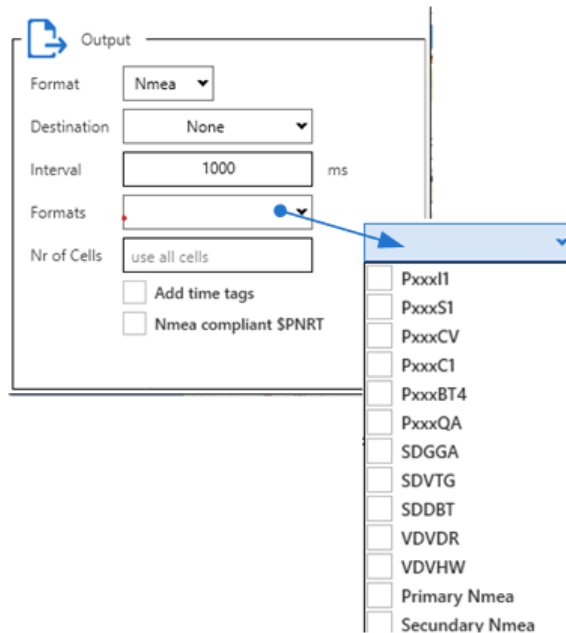


Figure 59: NMEA message options

In the NMEA options window (see figure 59⁶⁴) you can select the required messages in the dropdown menu "Formats". Sections "\$SDDBT -Echosounder- Depth Below Transducer"⁶⁷ through to "\$P---VL - Velocity data per layer"⁷⁵ 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 [60](#)⁶⁵ and [61](#)⁶⁵.)

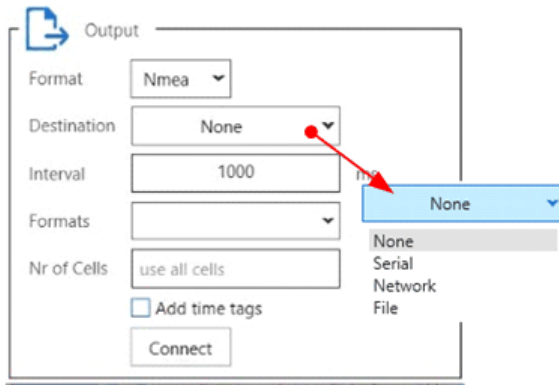


Figure 60: Output destination options

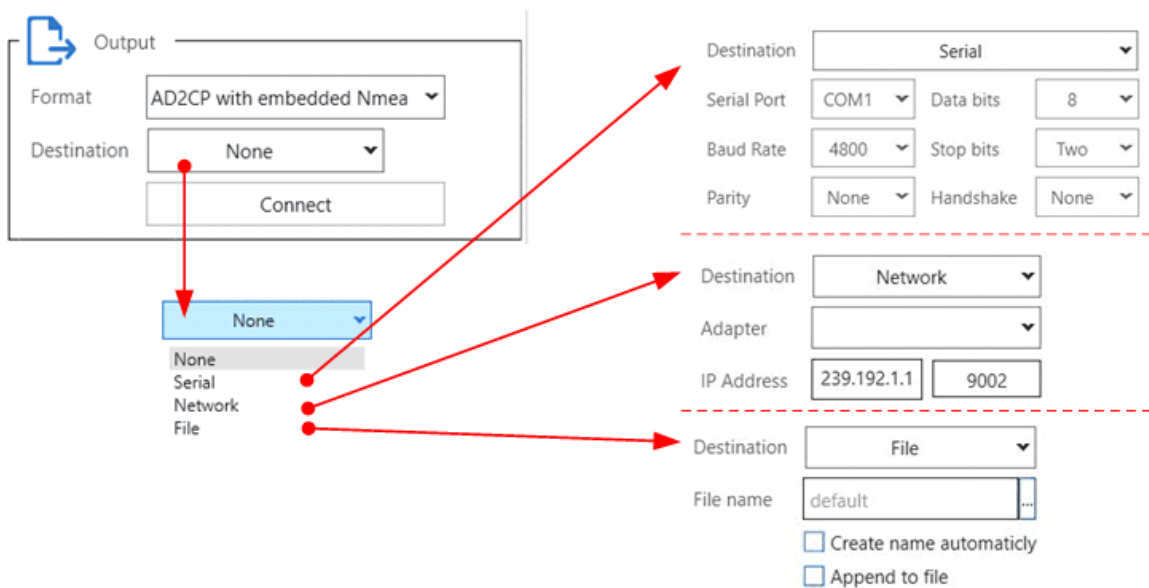


Figure 61: Configuration options for different output destinations

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 [61](#)⁶⁵ 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](#)⁶⁷), 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 "[Software Configuration](#)"³⁹ 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	dddddd.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

<i>Field</i>	<i>Description</i>	<i>Data Format</i>
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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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 layer 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 layer 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 is enabled, the STW is the speed through water in the selected layer.

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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 59^{h64} in section "[NMEA format](#)"^{h63} 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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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
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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
Date	Date	MMDDYY
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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
Instrument Type		N
Head Id	Serial number of instrument	N
Number of Beams		N
Number of Cells	Number of valid cells	N
Blanking Distance	[m]	dd.dd
Cell Size	[m]	dd.dd

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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.

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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).	"xxxxxxx"
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	dddd
FOM2	Figure Of Merit Beam2	dddd
FOM3	Figure Of Merit Beam3	dddd
FOM4	Figure Of Merit Beam4	dddd

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

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

<i>Character nr</i>	<i>Measurement</i>	<i>Source</i>
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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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
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

<i>Field</i>	<i>Description</i>	<i>Data format</i>
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
```

8.4.2.7 \$P---VL – Velocity data per layer

<i>Field</i>	<i>Description</i>	<i>DataFormat</i>
Date	Date	MMDDYY
Time	Time in UTC, 0-24H, 0.01 second resolution	hhmmss.ss
layer number	#	dd
Layer Size	Size of the layer[m]	dd.dd
layer Position	Distance from sensor to centre of the layer[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

8.5 Compliant NMEA

<i>Option</i>	<i>Default</i>	<i>Description</i>
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 " ⁷⁰ for details, and figure 59 ⁶⁴ in section " NMEA format " ⁶³ for the location of this tickbox).

9 Windows for Operational use

9.1 Buttons to show/hide the different windows

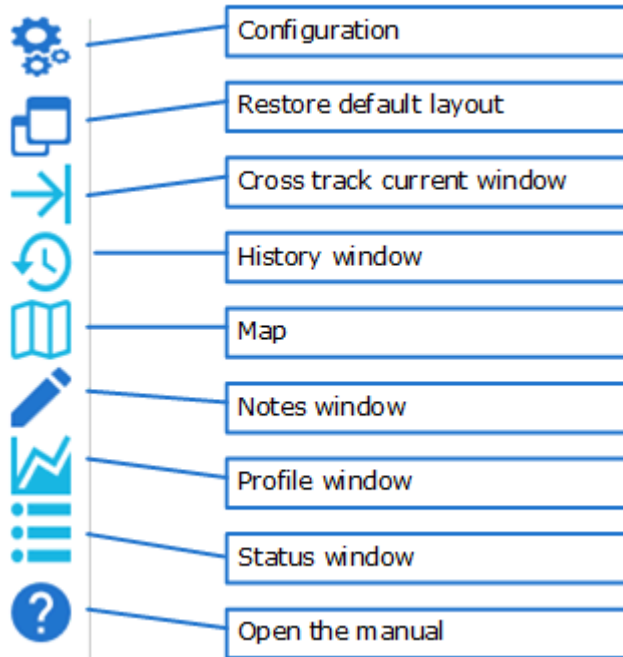


Figure 62: Lower left of the task/button bar

Figure 62 shows the buttons at the lower left side of the button bar, that control visibility of the different windows. Table 8 repeats the window names, and includes an indication of the section (if any) that gives more details about that window.

Table 9: Where to find details about each window

Window name	Section
Configuration	Software Configuration ³⁹
Restore default layout	(self-explanatory)
Cross track current window	Cross track current window ⁷⁷
History window	History window ⁸⁶
Map	Track display ⁵¹
Notes window	Adding Notes ⁵⁴
Profile window	Profile window ⁷⁹
Status window	Status ⁴⁸
Open the manual	(self-explanatory)

9.2 Cross track current window

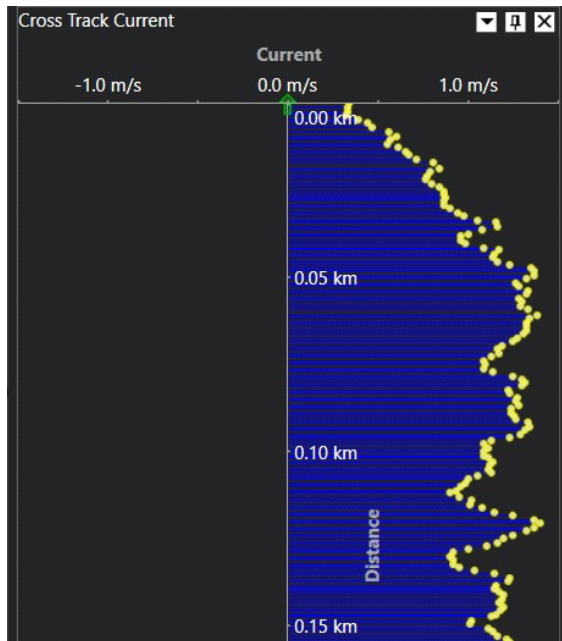


Figure 63: The cross track current window

Figure 63 shows the cross track current window. It shows the component of the current perpendicular to the ship's track. The positive direction is a current component from left to right across the track (facing in the direction of travel).

The top of the window shows the situation at the position the ship is in now. The figure shows the cross track current for previous positions along the ship's track going down in the figure. The vertical scale shows the distance back along the track. (You can choose the units in the configuration settings, see section "[Software Configuration](#)"³⁹).

Figure 64 shows an example of the cursor readout that shows when you hover the mouse over the window.

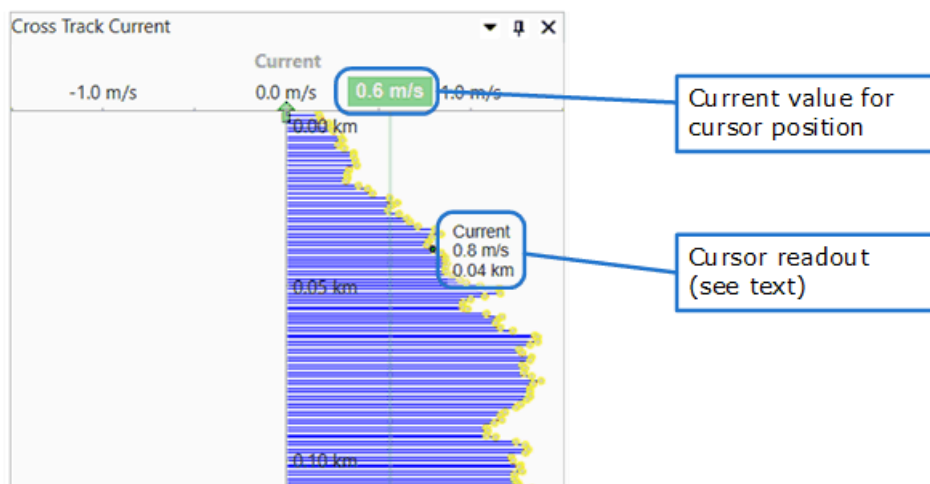


Figure 64: Cross track current cursor readout

Some notes:

- The cursor readout shows the cross track current at the location along the track of the ship that the mouse hovers over.
- The dot indicating the cross track current value at the selected distance back along the track of the ship changes colour from yellow to blue

- The current value that shows in the top axis is the value that corresponds to the cursor location, not the cross track current value at the selected distance. (On-screen you can see this better, as a vertical line goes through the cursor position and ends at that value. This line, and the cursor itself, do not show in the screenshot of figure 63.)

When a layer is used instead of the full profile, the cross track current vectors are averaged values from the selected layer. The depth range of the layer can be seen in the title of the cross track current plot.

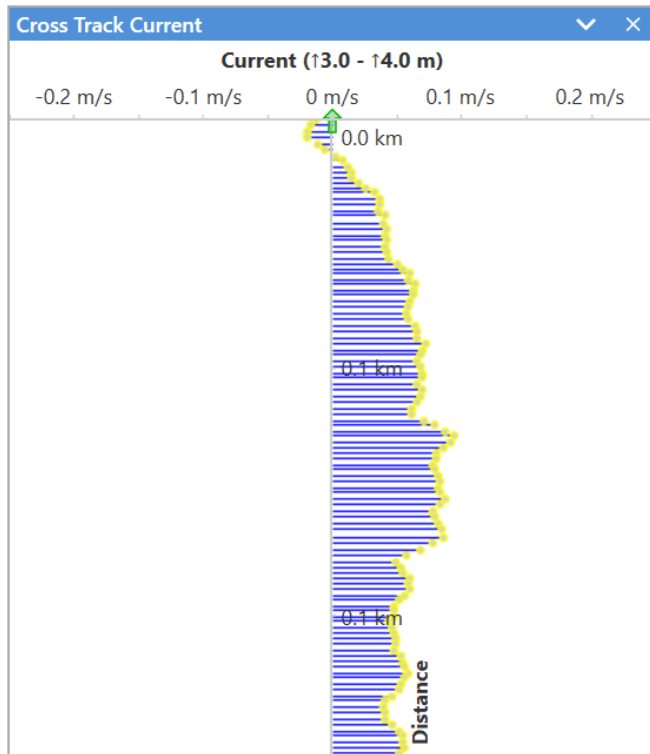


Figure 65: Layer for cross track current

The title of the plot in figure 65 shows that the used layer is 3 - 4 meters deep. It is also possible to lock the layer to the bottom, this will be shown by a change in the direction of the arrows in front of the minimum and maximum values in the title. For example, (12 m - ↓ 1 m) would mean a bottom locked layer 1 - 2 meter above the bottom.

9.3 Profile window

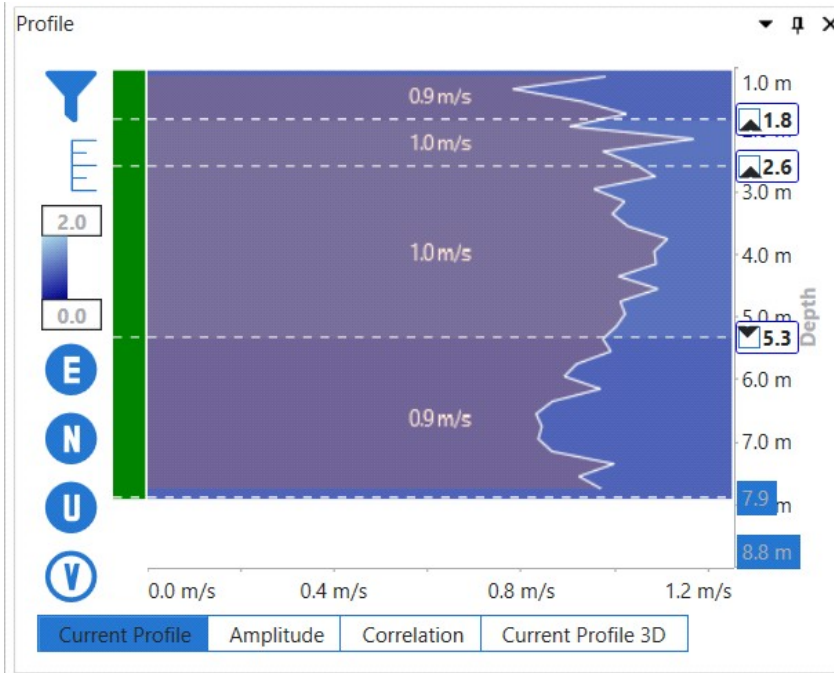


Figure 66: The Profile window, showing the Current Profile tab

Figure 66 shows the Profile window. The details this window shows depend on the tab you select. Figure 67 shows a small impression of each of the tabs. The following subsections describe each tab in more detail.

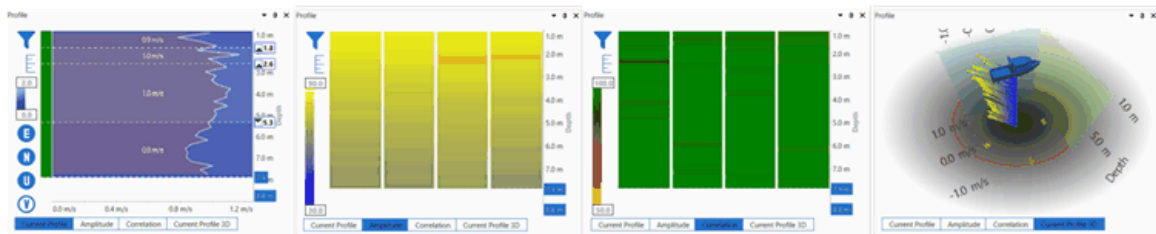


Figure 67: The different tabs of the Profile window

9.3.1 Current Profile tab

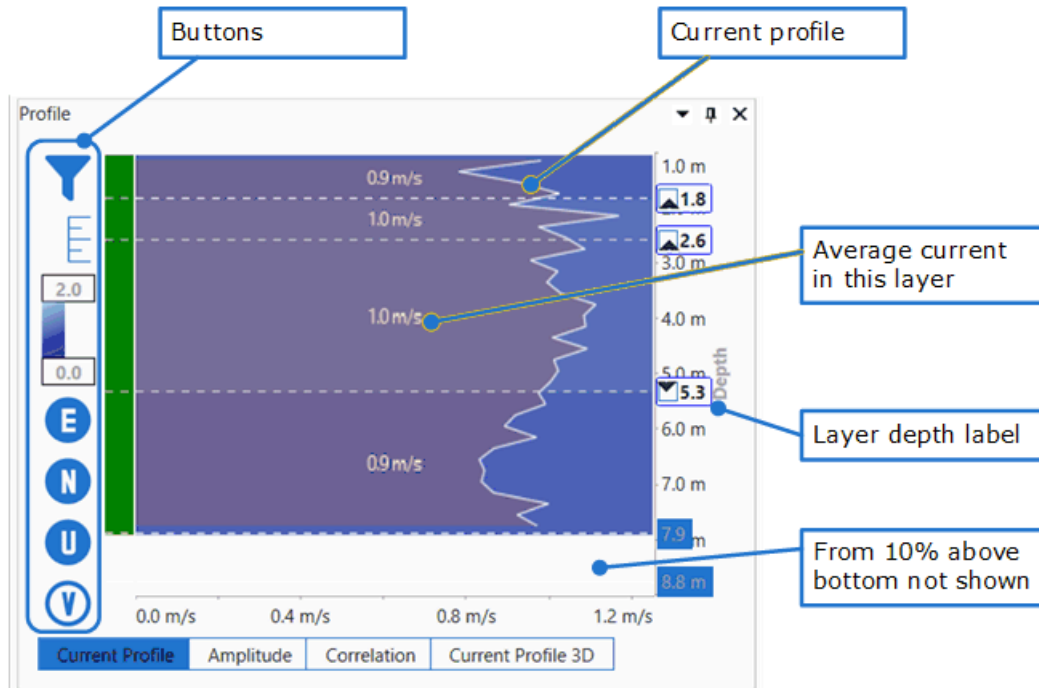


Figure 68: Details of the Current Profile tab

The Current Profile tab is the most complicated and richest of the tabs in the Profile window. The central plot shows the magnitude of the current (or current component) versus depth, normally omitting the last 10%. The plot also shows the average current in up to four separate layers; you can adjust the levels of these layers. A colour bar at the left of the plot gives an indication of the quality of the data for each layer. Buttons to the left of the central plot allow switching between the details visible in the plot. Table [10](#)^{b1} lists the buttons and what they do.

The vertical axis at the right-hand side of the plot shows the depth axis, as well as manipulator labels for the layer boundaries. The numbers in the blue boxes show the bottom depth and the "10% above the bottom" depth.

When you hover the mouse over the plot area a cursor read-out will pop up, showing the current (component) value for that depth, and, in case you selected the full current magnitude (V), its direction. A horizontal line through the cursor position indicates the depth. The depth value shows in a blue box on the depth axis to the right of the plot. Figure 69 shows an example.

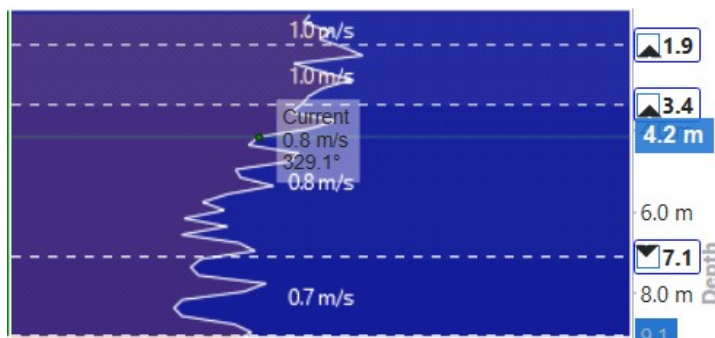









Figure 69: Cursor read-out pops up when hovering over the plot

9.3.1.1 Buttons

Table 10: Buttons on the Current Profile tab and their function

Button	Brief description	Description
	Show/hide values below bottom	<p>Toggles between not showing and showing the last 10% of the current profile, and including reflections from below the bottom.</p> <p>Note that this setting is synchronized between all three of the tabs "Current Profile", "Amplitude", and "Correlation".</p>
	Switch between automatic and manual depth scale adjustment	<p>Normally the depth scale adjusts automatically to the maximum depth measured. When switched to manual, you can click-and-drag the depth scale to where you want it.</p> <p>Note that this setting is synchronized between all three of the tabs "Current Profile", "Amplitude", and "Correlation".</p> <p>Also note that you can get the same effect by double-clicking the depth axis.</p>
	Adjust maximum and minimum of colour scale	<p>Adjusts the current values that correspond to lightest (for the highest values) and darkest colours (for the lowest values) in the plot.</p> <p>The value-boxes will display a pop-up showing a slider to adjust the value, as well as a button "Fit" that will select the maximum/minimum value in the plot.</p> <p>You can also just type a number into the box.</p>
	Show East component	<p>These buttons allow you to select which component of the current to show in the plot: East, North, or Up, or the full current magnitude (ignoring direction).</p>
	Show North component	
	Show Up component	
	Show current magnitude (selected)	

9.3.1.2 Layer adjustment

You can adjust the boundary between two layers by clicking and dragging the dotted line that indicates this boundary. The number in the label box to the right shows the depth of this line.

The triangle inside the label box indicates whether this boundary is fixed (anchored) relative to the surface (triangle pointing up) or relative to the bottom (triangle pointing down). Click on the triangle to switch between these options. Note that the value in the label still shows the depth of the boundary relative to the surface, whichever of these options you choose.

If you need fewer layers, you can either drag two (or all three) of the boundaries on top of each other, or drag the top or bottom boundary to the edge of the plot. You cannot drag a boundary beyond another boundary. If you have dragged two or all three boundaries on top of each other, this may make it a little confusing to drag them away from each other later, or adjust the depth of the combined boundary. The lower boundary is always on top, so drag that one down first.

If the depth along the track varies, layers may run into each other as the depth becomes more shallow, especially if the lowest layer boundary is anchored to the bottom.

In the latter case, the height of the lowest boundary relative to the bottom remains fixed (for as long as this is possible). The converse also happens: if the water deepens, layer thicknesses may change, in accordance with which boundaries are fixed relative to surface and bottom.

9.3.1.3 Selected layer

By default the current values used throughout the application are averaged values over the full depth of the profile. In some cases it might be useful to instead use current values from one of the layers in the [Profile](#) ⁷⁹ window. This is possible by changing the "Layer" field in the "Processing settings" section in the configuration, see figure 70 below.

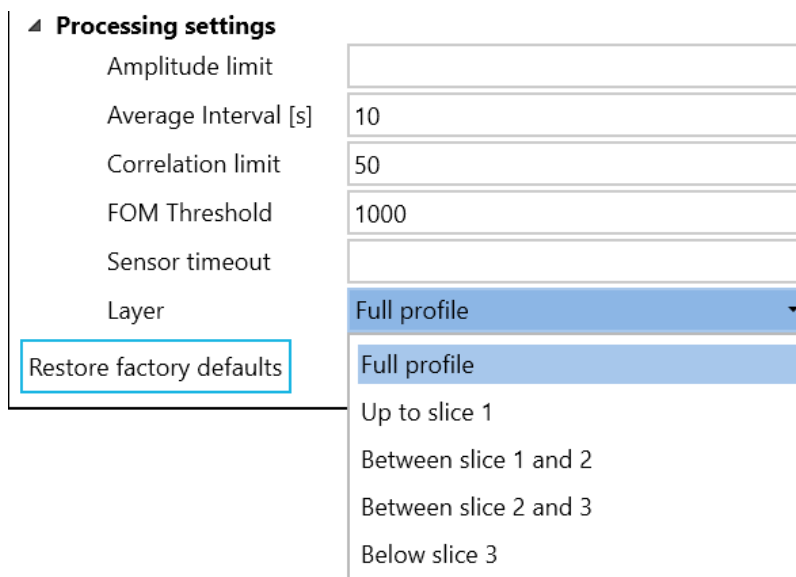


Figure 70: Layer options

When changing the selected 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
- Current data on the Cross track current window
- Newly added data in the History window

- NMEA messages
 - [\\$VDVDR](#)⁶⁹
 - [\\$VDVHW](#)⁶⁹
 - [\\$VDVBW](#)⁶⁹

9.3.2 Amplitude tab

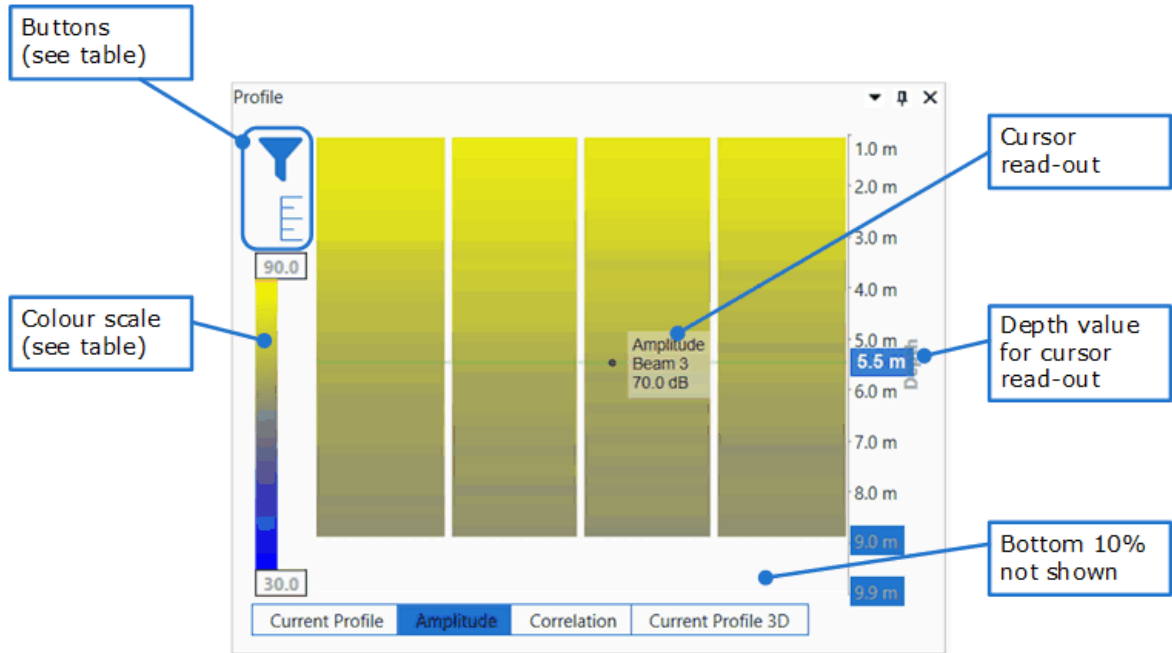


Figure 71: Details of the Amplitude tab

The Amplitude tab shows the received signal amplitude of each of the transducers of the Signature VM sensor, as a function of depth. The colour scale indicates the amplitude values in dB. Hovering the mouse over one of the sub-plots shows the beam number and amplitude value in a cursor read-out pop-up. A horizontal line through the cursor position indicates the depth, while a blue box shows the corresponding depth value.

The two buttons at the top left work the same as (and are synchronized with) the corresponding buttons in the Current Profile tab; see table [10](#)⁸¹ in section "[Buttons](#)⁸¹" for details.

Adjusting the colour scale also works the same as in the Current Profile tab; for details see table [10](#)⁸¹ in section "[Buttons](#)⁸¹".

The amplitude values can ascertain the quality of the sensor measurements. Amplitude values above 35 dB generally give trustworthy results.

9.3.3 Correlation tab

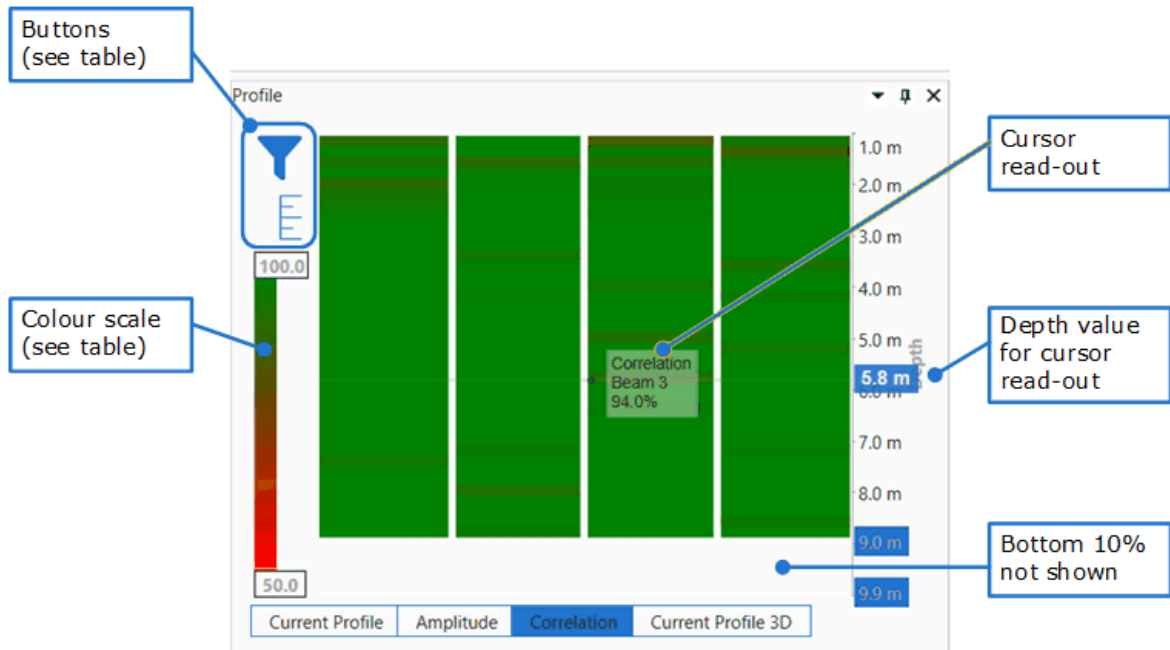


Figure 72: Details of the Correlation tab

The Correlation tab shows the correlation values for each of the transducers of the Signature VM sensor, as a function of depth. The colour scale indicates the correlation values as a percentage. Hovering the mouse over one of the sub-plots shows the beam number and correlation value in a cursor read-out pop-up. A horizontal line through the cursor position indicates the depth, while a blue box shows the corresponding depth value.

The two buttons at the top left work the same as (and are synchronized with) the corresponding buttons in the Current Profile tab; see table [10⁸¹](#) in section "[Buttons⁸¹](#)" for details.

Adjusting the colour scale also works the same as in the Current Profile tab; for details see table [10⁸¹](#) in section "[Buttons⁸¹](#)".

The correlation values can ascertain the quality of the sensor measurements. Correlation values above 50% generally give trustworthy results.

9.3.4 Current Profile 3D tab

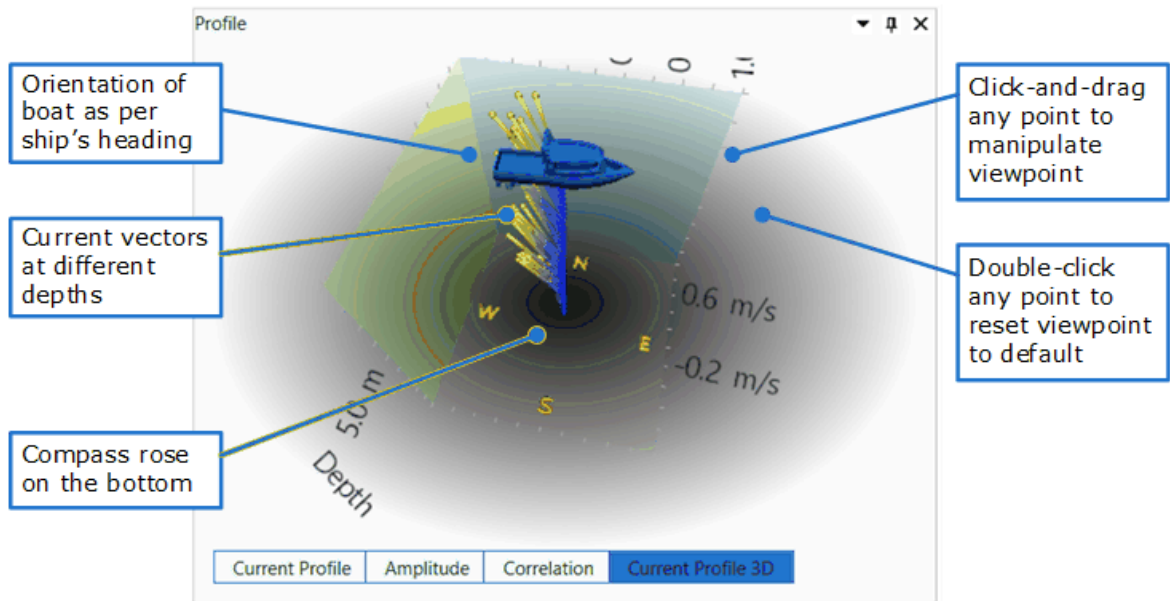


Figure 73: Details of the Current Profile 3D tab

The Current Profile 3D tab shows a three-dimensional impression of the currents underneath the ship. You can change the viewpoint by clicking and dragging any point in the image. You can zoom in and out using the mouse scroll wheel. You can reset the viewpoint (and zoom-level) to the default by double-clicking any point.

The orientation of the boat's image with respect to the compass rose drawn at the bottom corresponds to the real ship's heading.

When you hover the mouse close to one of the current vectors' end point, a cursor read-out pop-up will show the East- and North components of the current, as well as the depth. A set of projection lines show the vector East- and North components, and its depth. Figure 74 shows an example.

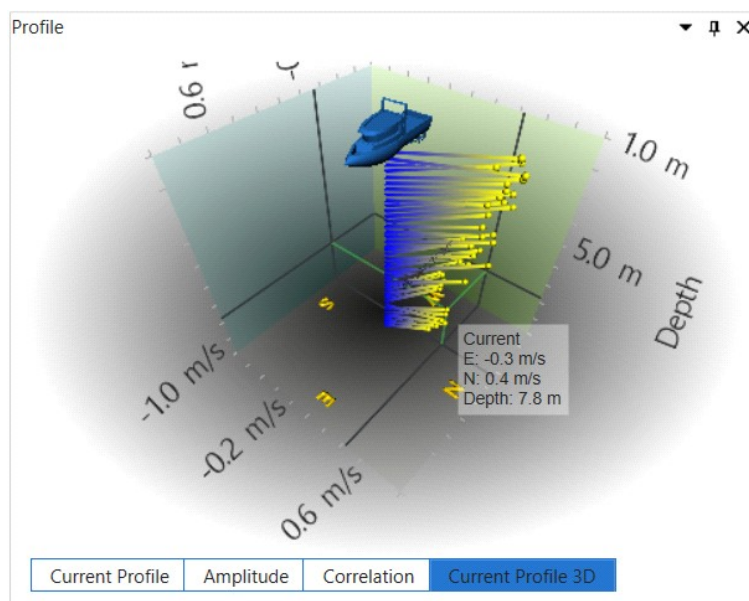


Figure 74: Cursor read-out and current vector component and depth projections when hovering close to a current vector endpoint

9.4 History window



Figure 75: The History window

The History window shows recent values of current magnitude, averaged over the water column or selected layer (yellow dots), and direction (blue dots), as a function of time, progressing from the left-hand side. If available, it also shows current and direction values as measured the day before, from the right-hand side. The purpose of this is to make it possible to take into account tidal variations and similar repetitive variations over time for the area of operation. As mentioned, this information is only available if the ship performed measurements in the same area the day before. Note that this window does not use a tidal model or anything like that: it just shows yesterday's values, if available, as measured by the ship itself.

Hovering the mouse near the dots results in a cursor read-out pop-up, showing values for current and direction, with the corresponding time in a blue box at the axis below. Figure 76 shows an example.

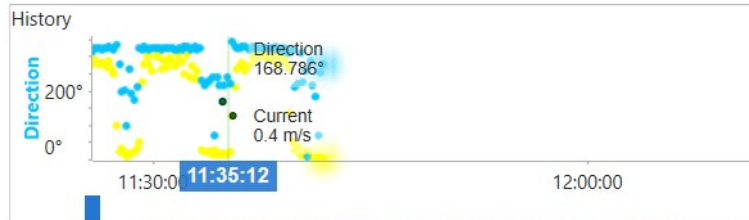


Figure 76: Cursor read-out in the History window

The two blue blocks underneath the time axis allow some manipulation of the time-window for which the values are displayed. Just click-and-drag these sliders to adjust the time-window. Alternatively, you can click-and-drag the time axis itself. Figure 77 shows an example.

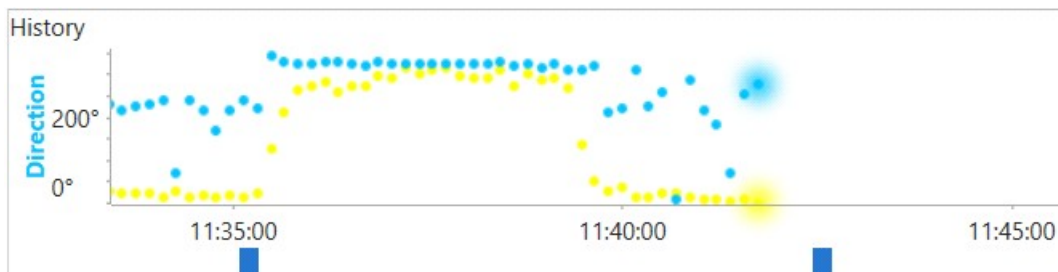


Figure 77: Narrow the time-window by clicking-and-dragging the blue sliders

Note that the history of the current magnitude and direction are from the [layer](#)⁸² that was used at the time the data point was recorded. Changing the layer will not update previously recorded data points, only newly added data points will be from the changed layer.

10 Installation

10.1 Instrument orientation

When mounting the Signature sensor to the vessel it is important to note the orientation. For the Signature VM 333 sensor, follow the separate installation instructions.

10.2 Mounting Considerations

10.2.1 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. If 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.

10.2.2 Grounding

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

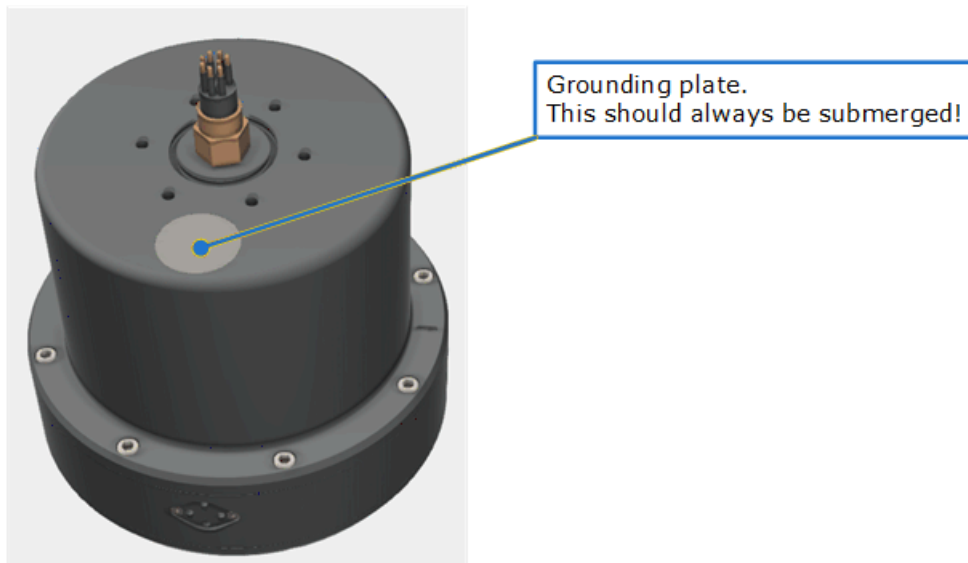


Figure 78: Signature 333 with grounding plate

10.2.3 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.

10.2.4 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.

11 Maintenance

11.1 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.

11.2 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.

11.2.1 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 advises 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. At order Nortek offers the option to coat the instrument with a permanent antifouling solution, please inquire at Nortek Netherlands for more information.

11.3 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.

11.4 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.

11.5 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.

12 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 VM Operations software, offer several options for triggering. Figure 79 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](#)^[91] 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 79. Section [Time synchronization](#)^[96] provides further details on these options. To use the PTP or NTP option, an appropriate time-source needs to be available on the network.

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](#)^[35].)

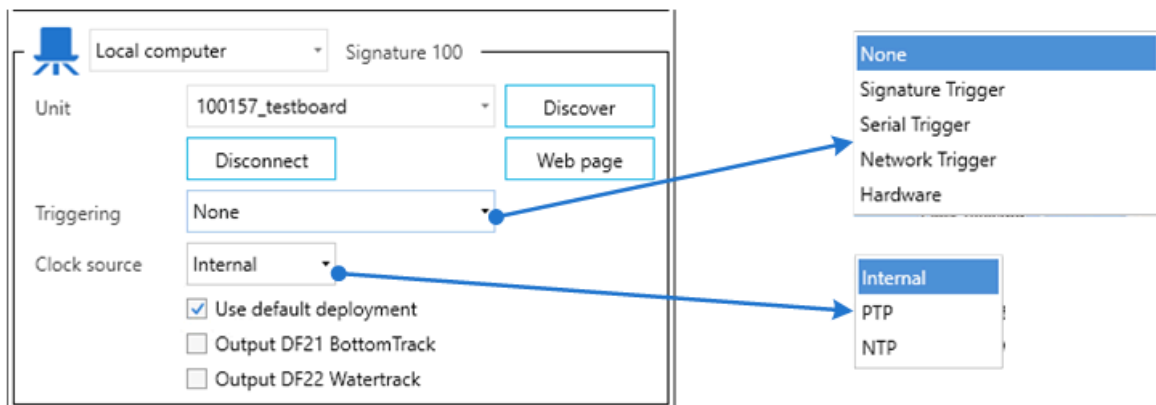


Figure 79: Trigger and clock source options in the Signature connection dialog window

12.1 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 79. Section [Ping-based triggering \(Signature triggering\)](#)^[92] 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 VM Operations 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 [Ensemble-based triggering](#)^[93] provides further details.

12.1.1.1 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 80). See the next sub-sections for details on the different menu selections.

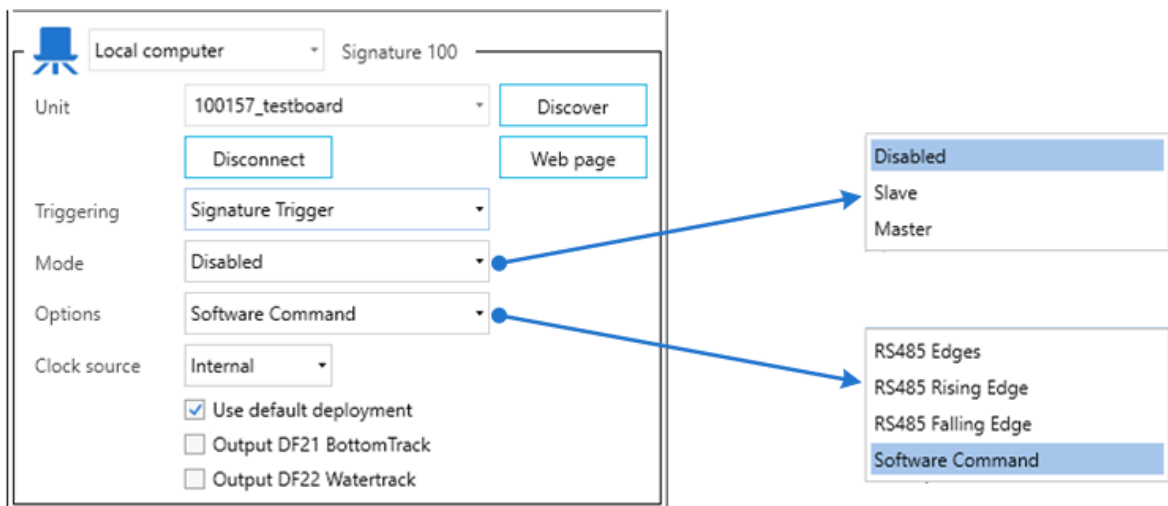


Figure 80: Mode and option menus for "Signature Trigger" style triggering.

12.1.1.1.1 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).

12.1.1.1.2 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."

12.1.1.3 Signature Triggering: RS-485 options

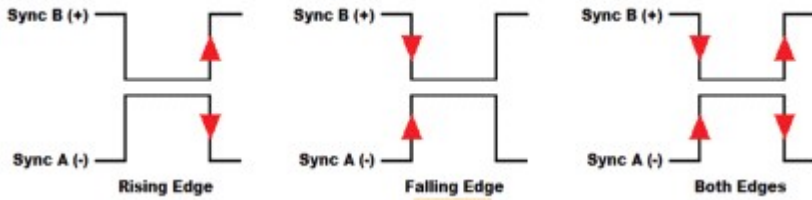


Figure 81: RS-485 trigger signal details

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 81 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.

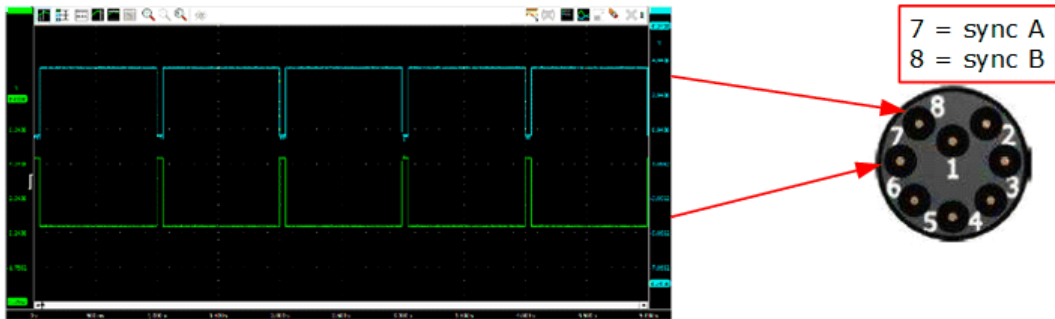


Figure 82: RS-485 triggering oscilloscope trace and connection pins

12.1.1.4 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 VM Operations 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.

12.1.2 Ensemble-based triggering

The ensemble based triggering mechanism is built into the VM Operations 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) .

12.1.2.1 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 83 shows the connectors, including the labels.

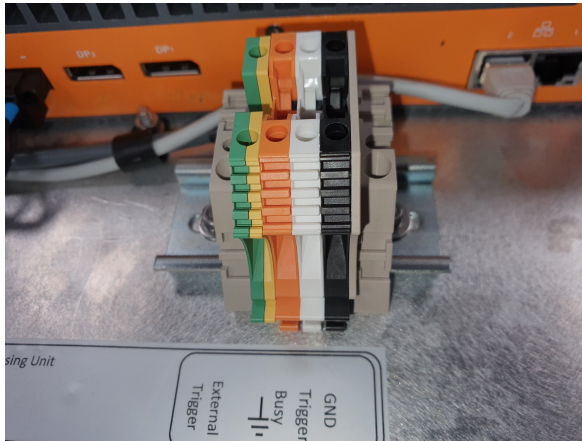


Figure 83: Hardware trigger connectors at the back of the Processing Unit model 4420.

Figure 84 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 11 gives an overview of the options for the trigger and busy signals.

Triggering

Serial Port Trigger

Busy

Figure 84: Hardware trigger options

Table 11: 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 [Start measuring](#)⁴⁴). 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".

12.1.2.2 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 85 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 85: Network trigger options

Figure 86⁹⁵ 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 86: 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 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.

Also note that if you would want to use the MOXA Serial server that is part of the Ocean/Operations Processing Unit for triggering purposes, this serial server actually connects through the internal network in the Processing Unit. So from the software perspective, you would need to handle this as a Network Trigger, and make sure you configure the port you want to use on the serial server appropriately (see section [Serial interface configuration](#)²⁰).

12.2 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.

12.2.1 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.

12.2.2 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.

12.2.3 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 \(nortekgroup.com\)](https://www.nortekgroup.com/support/using-windows-10-as-ntp-server).

For an external NTP server the IP address of the Server needs to be supplied (see figure 87⁹⁶). 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.

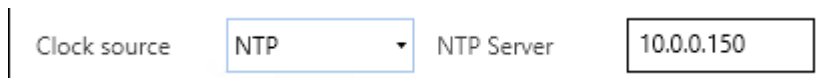


Figure 87: NTP server IP address

13 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.

13.1 Instructions

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

Steps:

1. Open the VM Operations software
2. Turn on the Diagnostics mode by clicking on the stethoscope icon
3. [Connect](#)³⁴ 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)

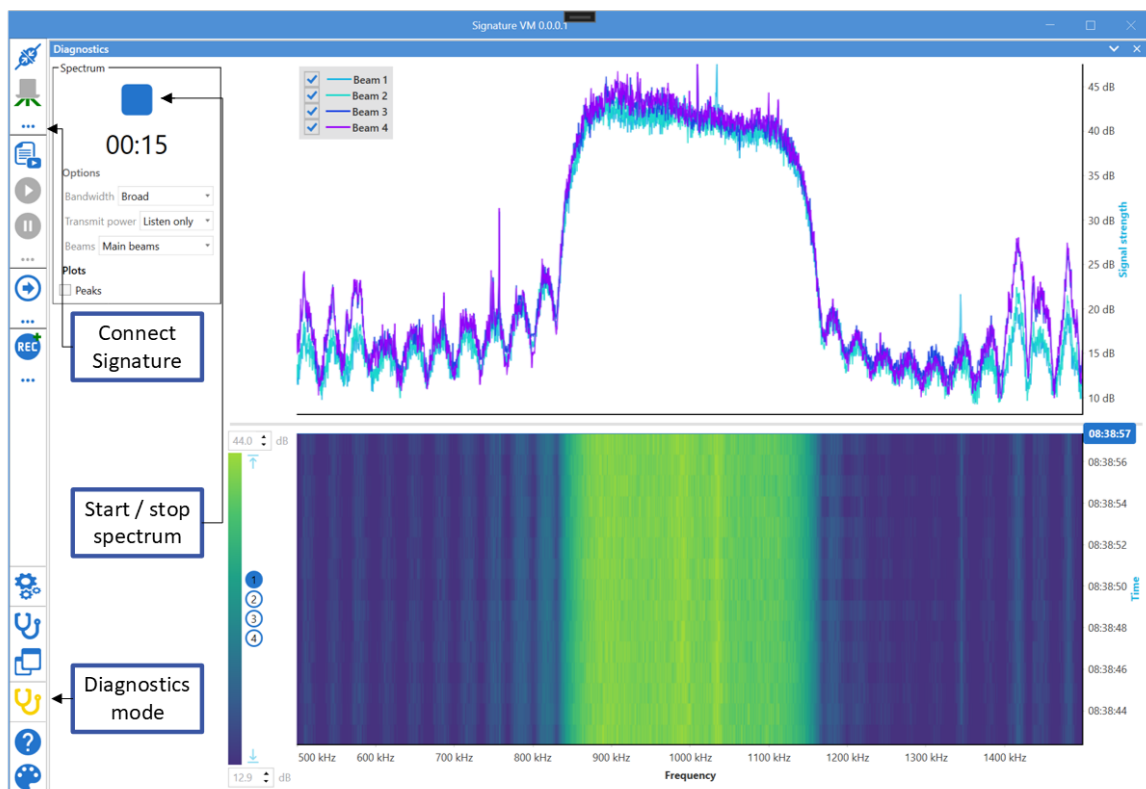


Figure 88: Recording a spectrum

13.2 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.

13.3 Interaction

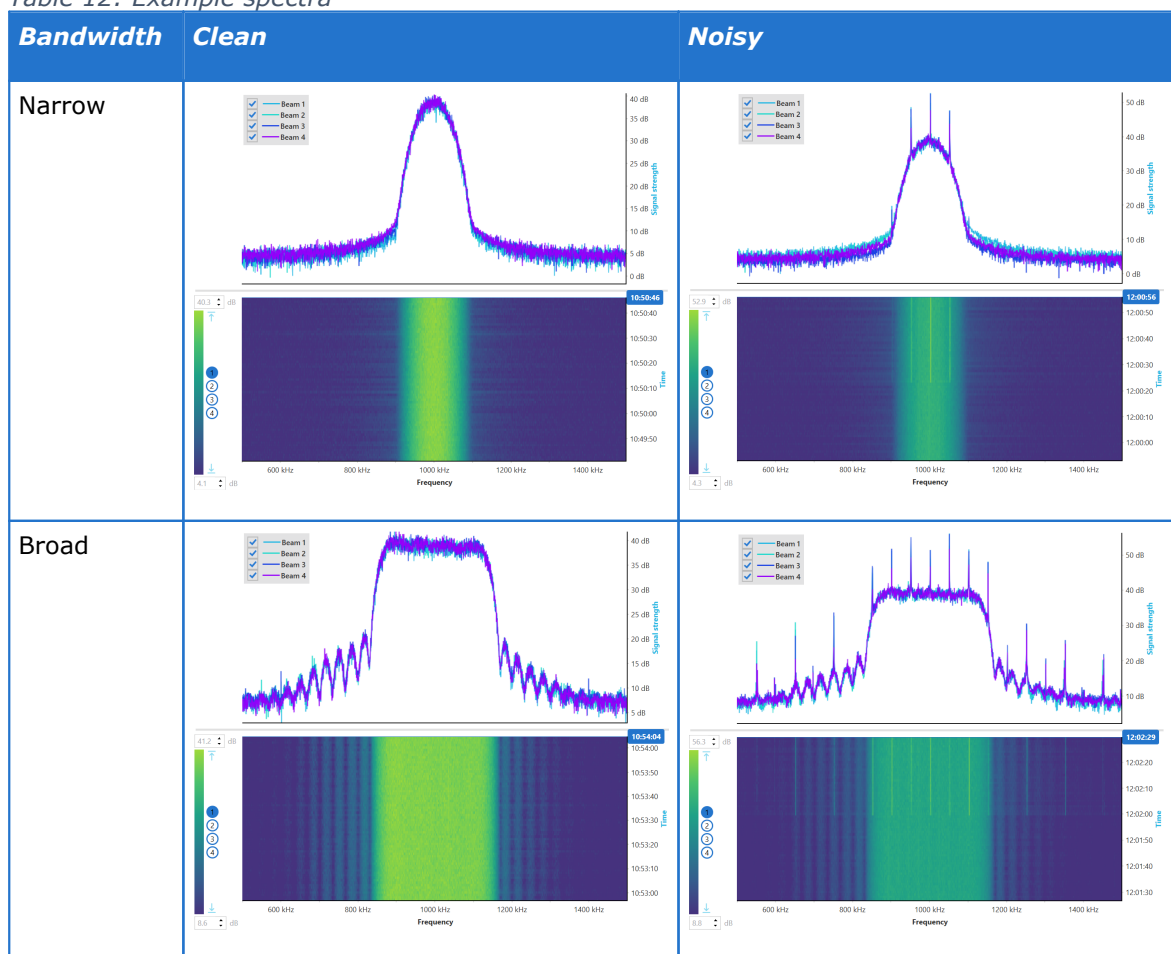
The spectrum is shown in two different plots. The bottom heatmap shows the spectrum over a period of time, the top line plot shows a instant spectrum for the time selected using the horizontal line in the bottom heatmap. The horizontal line can be moved (by means of the time-label on the right-hand side)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

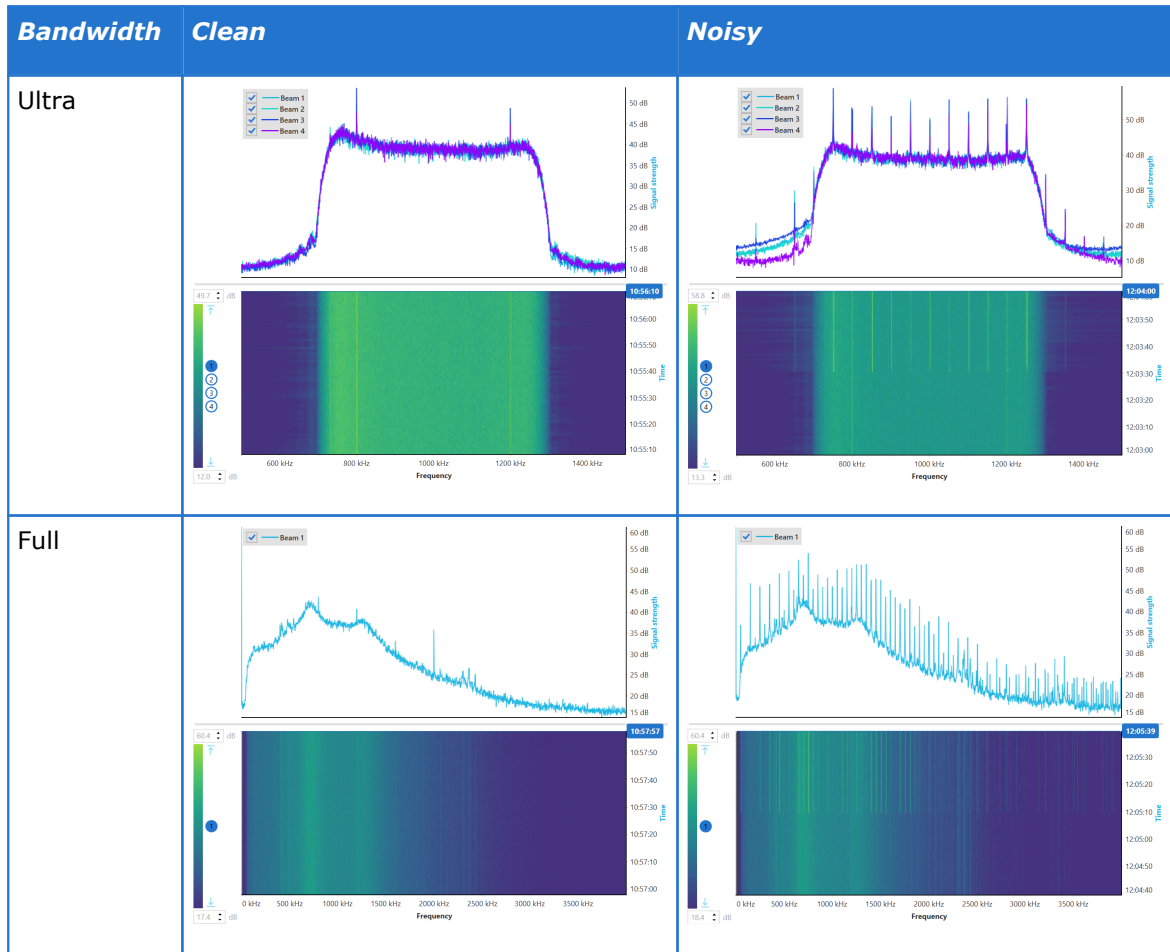
Use the "Peak hold" check-box to show the maximum values in the top line plot.

13.4 Example spectra

Table [12](#)⁹⁸ 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 12: Example spectra





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 12⁹⁸ 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.

13.5 Replaying a recorded spectrum

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

14 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.

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.

14.1 Remote Support through TeamViewer

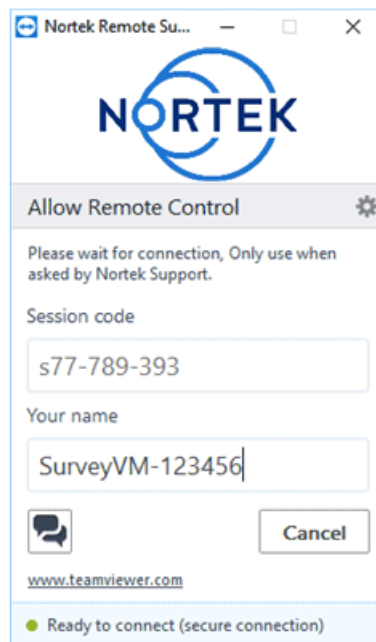


Figure 89: Starting the TeamViewer session

In general, every VM Operations 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.

14.2 Communication

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.

15 Processing Unit configuration

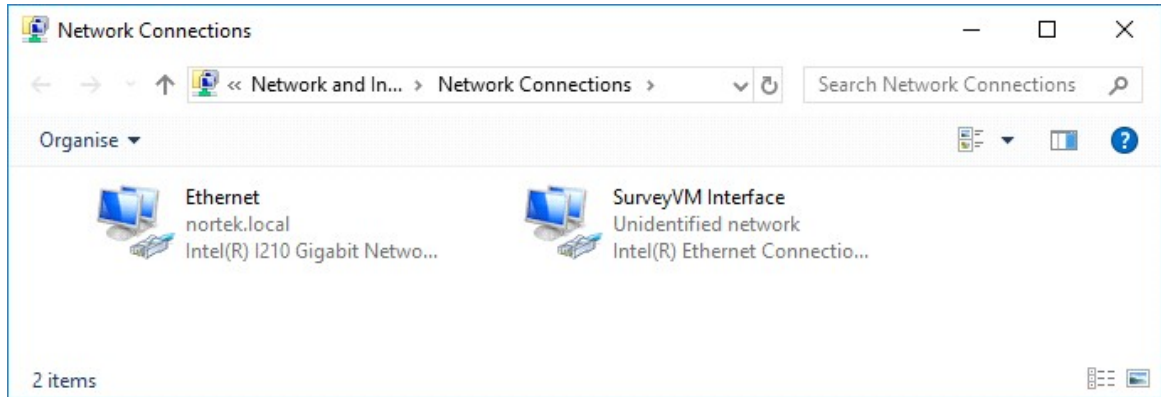


Figure 90: Configuration of the ethernet connections on the VM Operations Processing Unit

Two Ethernet ports are available on the back of the Processing Unit. One is named 'Ethernet' and is a general-purpose port that may be used to connect to the ship network.

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 processing unit. The Signature sensor is connected to this switch (via the Junction Box). The network connector on the front of the processing unit is also connected to this switch. Do NOT use this network port to connect to the ship network !

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, that is, to the network connector on the front of the processing unit. Remote desktop is not possible over the 'Ethernet' port.

15.1 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 firewall 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)'.

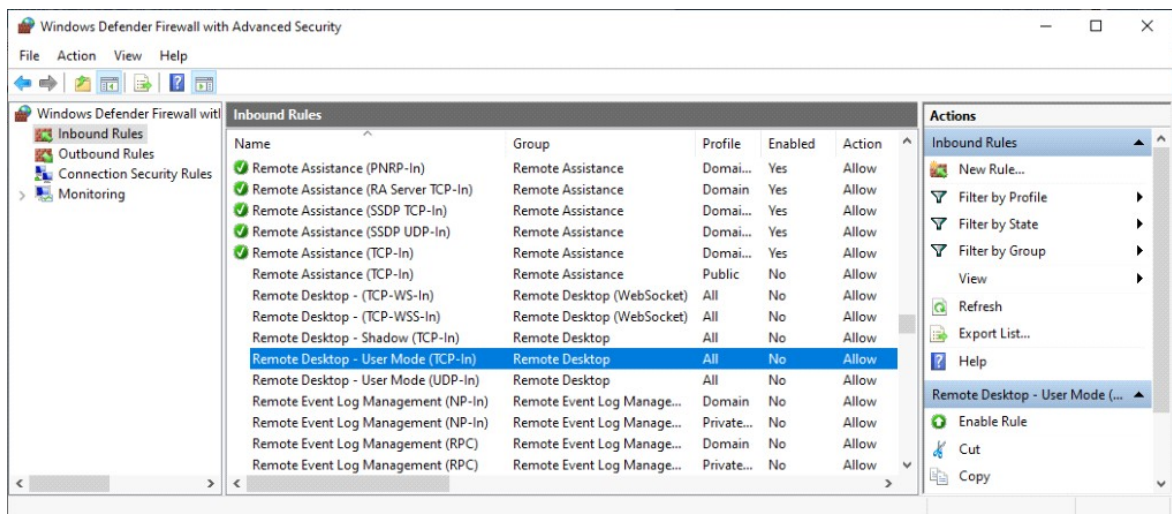


Figure 91: Firewall settings for Remote Desktop

To change the settings, double-click on the settings, and change the Local IP address to 'Any Address' (see figure 92¹⁰²). Click OK to confirm, and repeat for the other setting as well.

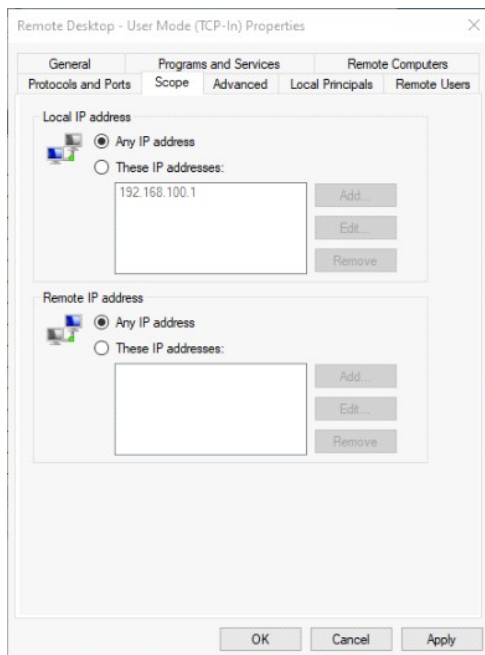



Figure 92: Changing the firewall rule for Remote Desktop

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

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 ¹⁰⁵
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.
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.
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.

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  ¹⁰⁵
Internal sampling rate	Rate of sampling for internal sensors. Refer to the specific instrument brochure for details.
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. 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 Spare parts

Table 13 lists available spare parts for the Nortek VM 333 and their order codes.

Table 13: Spare parts for the Nortek VM 333

Description	Nortek Netherlands item code	Nortek Norway reference	Recommended spare part item
20 m Ethernet cable MCIL8F to MCIL8M 333 kHz Operations (if the ADCP is used without the seavalve)	VM4400-5006	320217	yes
10 m 8 pin Ethernet cable AD2CP MCIL8F w/RS232 out (If used i.c.w. seavalve)	VM4400-5007	650194	
Toolkit VM OPERATIONS 333kHz containing 8 pin female Dummy, Tools, O-rings, Syringe and Screws	VM4400-3605		
8 pin dummy for 333 kHz OPERATIONS instrument (female)	VM4400-3622	340085	
8 pin dummy for 333 kHz OPERATIONS for end of 20m subcon terminated cable (female)	VM4400-3625	340085	
Wrench for Skindicht cable gland	VM4400-3100		
Skindicht CN M63x1.5 F50 cable gland	VM4400-8620	514314	yes
Spare set for extension pipe (Includes O-ring 1x 39.6x2.4, 6x 35.0x2.0, 24x Flat head Phillips Screw M5x10, 6x ¼"-20x7/8" Socket Cap Screw)	VM4400-8610	420055 & 420113 & 400066 & 400008	yes
NSO adapter housing pipe 212 mm	VM4400-8605	524304	
NSO End pipe 330 mm	VM4400-8606	524306	
NSO Extension pipe 455 mm	VM4400-8607	524303	
Roxtec RS31 cable gland	VM4400-8630	514311	yes
Set of screws 333 kHz ADCP backside adapter housing pipe 212mm	VM4400-8651		yes
Set of screws 333 kHz ADCP backside mounting bracket	VM4400-8652		yes
Set of screws 333 kHz ADCP head	VM4400-8653		yes

<i>Description</i>	<i>Nortek Netherlands item code</i>	<i>Nortek Norway reference</i>	<i>Recommended spare part item</i>
NSO "Glass" Ring 333 kHz ADCP (delrin/POM window retention ring)	VM4400-8510	524307	
Window Polycarbonate 333 kHz ADCP	VM4400-8511	524302	yes
Gasket DN 200 PN10, set of 2	VM4400-8640	420102	yes
NSO 333 kHz ADCP Pole or Blister mounting frame (Excl. transport case)	VM4400-3005		

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