



NORTEK MANUALS

# DVL Operations

500 | 1000kHz





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# 1 Introduction

This manual is designed to help users of the Doppler Velocity Log (DVL) to get familiar with the system. The manual includes chapters covering how to get the instrument up and running as quickly as possible, functional testing, basic software and web interface information, and tips for maintenance and troubleshooting.

## System Integration

For system integrators, there is a [DVL Integrator's Guide](#) available, covering modes of operation, commands and data format.

## Nortek online

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

## Nortek FAQ

Our old forum where users from all over the world met to discuss and shared their experience with Nortek instruments has been converted to an FAQ section. If you have comments, questions, application tips, suggestions for improvements, or simply want to learn from others or share your own experience, we encourage you to [comment on the relevant FAQ](#) or [start a topic in our new forum](#).

## 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.

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## Document Revisions

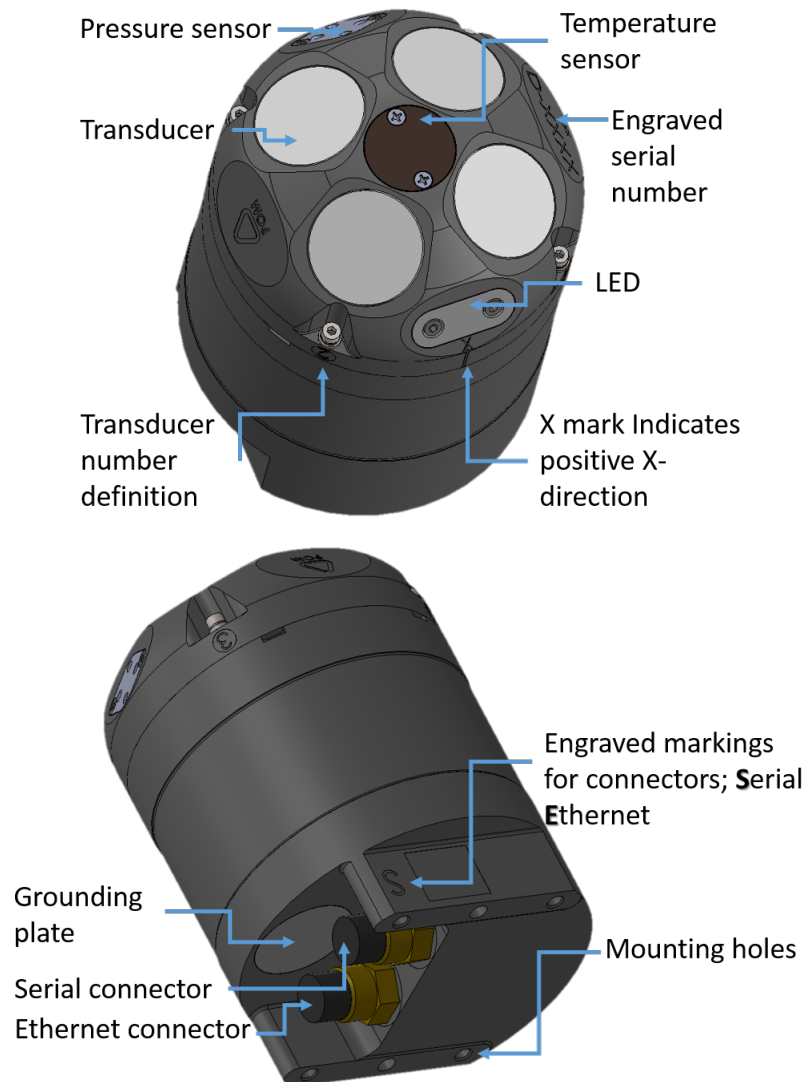
Version/revision	Date	Comments
Version 2016.1	01.03.2016	Initial version
Version 2016.2	15.11.2016	
Version 2017.1	05.07.2017	
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Version/revision	Date	Comments
Version 2022.1	28.02.2022	Minor additions, format changes
Version 2022.2	28.07.2022	Maintenance procedure additions

	<p>The system is designed and produced to comply with the council directive of 2014/108/EC relating to electromagnetic compatibility. The instrument has passed the following tests according to EN61000-6-2:2005 and EN61000-6-3:2007/A1:2011/AC:2012 (practically similar to US FCC 15 part A in US): Conducted and radiated emission, voltage flicker, harmonic current, conducted radio frequency immunity, radiated electromagnetic field immunity, fast low energy transients/bursts, slow high energy transients/surges, voltage dips and interruptions, electrostatic discharge and power-frequency magnetic field. The design is also 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). This symbol indicates the 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 (address above).</p>
	<p>Relevant plastic parts on the product is marked for end of life recycling (Directive 2008/98/EC on waste)</p>

## 2 System Overview

A DVL (Doppler Velocity Log) is an acoustic Doppler instrument which has the ability to estimate the velocity relative to the bottom (Earth being the frame of reference) or relative to the water.



**Displayed is a Shallow Water 1 MHz DVL (DVL1000-300m) and differs from the deep water variants by having the Grounding Plate.**

The DVL comes with a high precision pressure sensor, which provides a means to estimate depth, and a temperature sensor that provides data used for calculating speed of sound. Further to this, it has acoustic beams oriented in a diverging, convex configuration, and each beam provides an estimate of range so that the altitude over the bottom may be estimated. The system comes with two 8-pins connectors, for Serial and Ethernet communication. Refer to the [Connector Pin Configuration](#) section for pin outs.

The blue LED will start flashing when power is applied, the flashing means that the DVL is in measurement mode. There are three settings for the LED: ON allows the LED to indicate operation and modes; OFF disables the LED completely. ON24H enables the LED for 24 hours after the instrument starts pinging.

The Nortek DVL family has four main variants as specified below, which each have a shallow and a deep water version. Full technical specifications are available on [our website](#).

Specification	DVL1000	DVL500 Compact	DVL500	DVL333
Frequency	1 MHz	500 kHz	500 kHz	333 kHz
Minimum altitude	0.2 m	0.3 m	0.3 m	0.3 m
Maximum altitude	75 m	175 m	200 m	375 m
Long-term accuracy	$\pm 0.1\%$ / $\pm 0.1$ cm/s	$\pm 0.1\%$ / $\pm 0.1$ cm/s	$\pm 0.1\%$ / $\pm 0.1$ cm/s	$\pm 0.1\%$ / $\pm 0.1$ cm/s
Maximum ping rate	8 Hz	8 Hz	8 Hz	8 Hz
Velocity resolution	0.01 mm/s	0.01 mm/s	0.01 mm/s	< 0.01 mm/s
Depth rating shallow (deep)	300 m (4000 m)	300 m (4000 m)	300 m (6000 m)	300 m (6000 m)
Weight in air/water shallow (deep)	1.3 kg / 0.15 kg (2.7 kg / 1.7 kg)	1.3 kg / 0.15 kg (2.7 kg / 1.7 kg)	3.5 kg / 0.5 kg (5.9 kg / 3.1 kg)	3.5 kg / 0.5 kg (5.9 kg / 3.1 kg)



## 3 Getting Started

This chapter is useful when connecting to the DVL for the first time, and deals with connecting the PC to the instrument and other information that is important for first time use.

### 3.1 Checking the Inventory

Check the content of the received package against the packing list included in the shipment. See the [Appendix](#) for an example. Do not hesitate to contact us if you find any part of the delivery missing.

### 3.2 Connecting the DVL to PC

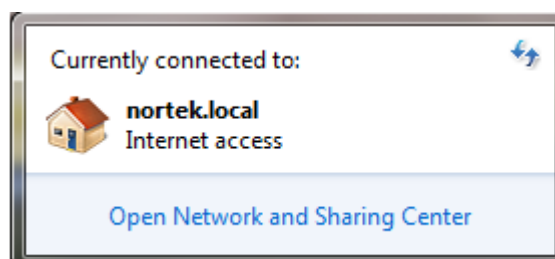
The Nortek DVL offers serial communications and Ethernet to be used separately. If both protocols are connected then the channel with the greater voltage will be the operating communications channel. For a first time use, connect using the Ethernet communication.

#### Ethernet communications

The Ethernet communication has been implemented by using a dedicated network processor, and needs to be powered by connecting a power supply to the external power breakout on the cable. Note that powering through the Ethernet cable will also power the rest of the electronics. Note also that if power is supplied only through the Serial connector, the Ethernet processor is unavailable.

**Note:** DVL instruments cannot use Power over Ethernet (PoE) technology. Using PoE with your DVL will damage the electronics board and require repair.

- Connect the supplied test cable to the Ethernet connector and apply power to the breakout cable. The blue LED should start flashing after a short period of time.
- The first time using the instrument, the network address needs to be properly configured for the network. For new users who are unaware of how the network is set up, the instrument should be plugged either directly into a computer (Ethernet cable) or via an Ethernet switch connected to the computer. For more information consult the [Appendix](#).
- If you use a computer Ethernet port that has status lights, verify that the link is active by looking for a stable green light on the port. If an Ethernet switch is used, the Ethernet port should also show an active Ethernet link. If the status light is not lit refer to the Troubleshooting chapter.
- Check the internet access status at the notification area in the taskbar of your PC (see image below)
- Continue reading the next section on how to [find the instrument on the PC](#)



#### Serial communications

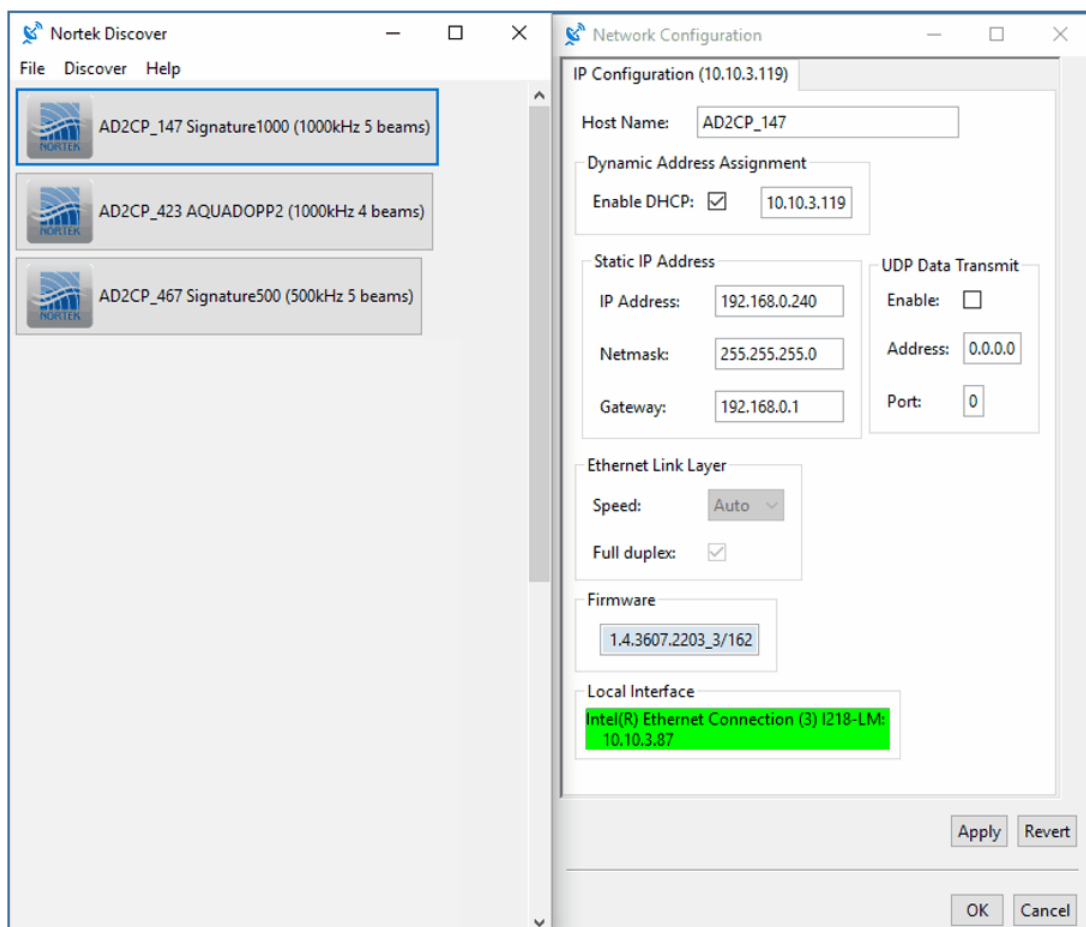
- Connect the Serial communication cable to the serial connector.
- Use a Serial-to-USB converter to connect the cable to the PC. If the converter has light indicators, confirm that they are lit. It is recommended to connect the cable and instrument to the converter before plugging the converter into the PC. In this order the possible problem related to automatic detection of driver is avoided. If necessary, check that the correct software driver is installed.
- Apply power along the line. The blue LED should start flashing the moment power is applied.

- To change the baud rate and serial protocol, the command line interface can be used. Refer to the Integrators Guide for the specific commands, and use a terminal emulator (see next section). The correct serial port and baud rate can also be specified through the web browser interface or in the MIDAS software (see next section).

### 3.3 Finding Instrument on PC

#### Nortek Discover

The Nortek Discover application is a small Windows program that provides a means to locate and configure the network information for instruments (NortekDiscover.exe is available on the flash disk that came with the instrument). Note that it may take minutes the first time connecting. The search application requires an up-to-date version of Java installed on the computer. All instruments discovered on the network will be displayed:



Once found, addressing information can be retrieved from the instrument so that a connection can be initiated. Note: If the Local Interface is highlighted in red, then it will not be possible to connect to the instrument because the IP configuration does not match that of the computer running the Discover protocol. The IP settings must then be changed either in the computer or in the instrument to allow IP connectivity.

**Host name:** A user defined name assigned to the host. Unless your network or host machine is configured to specifically associate an IP address with this name, this name cannot be used for standard network operations (e.g. ping).

**Dynamic Address Assignment:** Use a dynamically assigned IP address from a DHCP server or from AutoIP instead of a user supplied IP address. The IP address that gets assigned is also shown

in this panel. AutoIP allows a local domain dynamic IP address to be assigned without the presence of a DHCP server. An instrument connected directly to the host will be assigned a special address in the 169.254.xxx.xxx address range. In order for the Windows host to also select an appropriate address in this case, the Automatic private IP address option in the Internet Protocol Version 4: Alternate Configuration menu must be enabled.

**Static IP address:** *IP address:* The IPv4 address to manually assign to the network interface. *Netmask:* The network mask used to identify the local subnet for the network. *Gateway:* The router address used to connect to machines that are on a different subnet from the instrument. The gateway must be on the same subnet as the IP address selected.

**UDP Data Transmit:** This toggles UDP data transport on and off. UDP transport may be required if the client receiving the data doesn't want to have to re-connect to the instrument after the instrument has been power cycled. *Address:* This is the address of the receiving client. *Port:* This is the port of the receiving client.

**Ethernet Link Layer:** *Speed:* The desired speed of the Ethernet interface (not changeable). *Full Duplex:* Whether or not full duplex mode for the Ethernet interface is enabled (not changeable).

**Firmware:** The version of firmware currently running in the instrument.

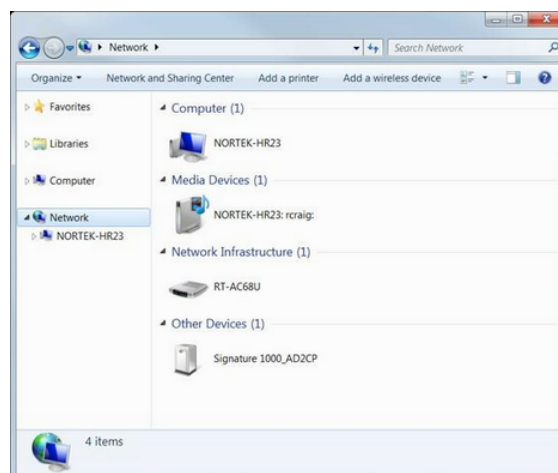
**Local Interface:** Shows which network interface on the computer is being used to communicate with the instrument and whether or not full IP communications can be established. If the interface is highlighted in red, then it will not be possible to connect to the instrument because the IP configuration does not match that of the computer running the Discover protocol.

Note that you can right click in the configuration window to get access to the support file, open the web browser, browse data disk, change instrument picture, settings for blink location LED or reboot the network processor.

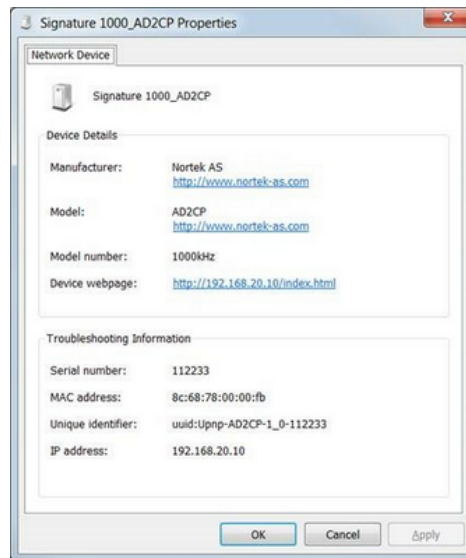
If you have a specific IP address for the instrument, you can search for it directly under Discover > Search for Address. Simply type the IP address or domain name. This will open the IP configuration pane (to the right in the figure above).

### Universal Plug and Play

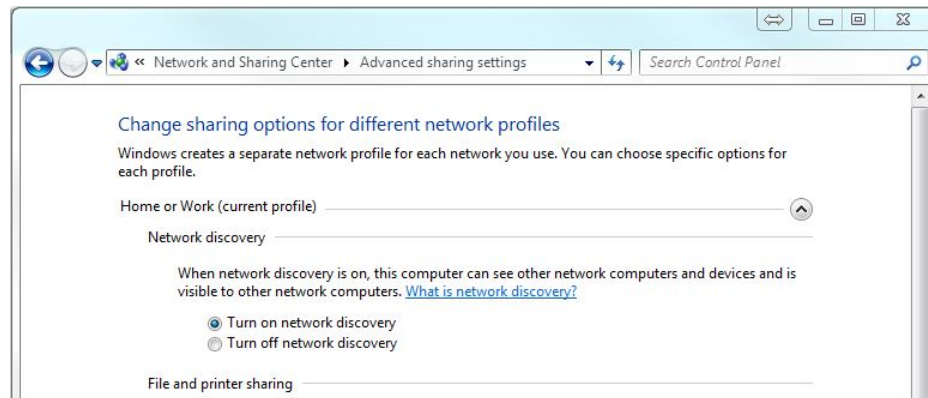
In addition to the proprietary discovery protocol, the UPnP (universal plug and play) protocol is supported by the DVL's platform. This allow the operating systems which are UPnP capable to discover the instrument with no need for proprietary software. Note that UPnP will only operate correctly if the IP address of the instrument is correctly configured for the network. For more information consult the [Appendix](#). To find the instrument icon in Microsoft Windows, open the Network view of the computer.



Double clicking on the instrument icon brings up the web page interface. Right clicking and selecting Properties gives the IP address and other instrument configuration information.



In order for UPnP to operate on Microsoft Windows platform, Network Discovery needs to be enabled. This is normally enabled by default on "Home" and "Work" networks but disabled on "Public" networks. To see if Network Discovery is enabled, open the Network and Sharing Center (Control Panel: Network and Internet: Network and Sharing center) and click on the *Change advanced sharing settings* selection. This will bring up the various network types (Home/Work/Public). Select the network type that the instrument is connected to and ensure that *Turn on network discovery* is selected for that network.



If the network is a public network, it is recommended that network discovery be turned off after interaction with the instrument has been completed.

## 4 Interfaces

You have the option of communicating with the DVL through either a web browser interface or through a command line interface. If you want to use the command line interface, please refer to the [DVL Integrator's Guide](#) for further information. The web browser interface offers a much more intuitive experience when configuring the DVL for operation. It is not possible to communicate with the instrument from two different interfaces at the same time.

### 4.1 Web Browser Interface

By using the IP address for your instrument you can access the browser interface. The first step is to find the assigned IP address for your system, which implies that you are properly connected to an instrument. There are two ways to do this:

1. You will find the IP address in the Microsoft Windows dialog, under Network. Double clicking the instrument icon brings up the browser interface. Right clicking and selecting Properties gives the IP address and other instrument configuration information. If you are not able to find your instrument, check out our tips in the section about [UPnP](#).
2. Use the "[Nortek Instrument Search](#)" application (NortekDiscover.exe available on the flash disk that came with the instrument)

Once you have discovered the instrument, find the IP address and type it into your browser. The instrument specific web site is divided into the following menu options:

- Measurement Configuration
- Instrument Settings
- Additional Online Data Formats
- Display Data
- Network Configuration
- Maintenance
- Logs
- Security
- Data Download

Each parameter within each menu is described in detail in the overview to the right-hand side of the browser page:

The screenshot shows the NortekDVL web interface. The top navigation bar includes the Nortek logo and the text 'NortekDVL'. The left sidebar contains the following menu items: Measurement Configuration (selected), Instrument Settings, Additional Online Data Formats, Display Data, Network Configuration, Maintenance, Logs, Security, Data Download (HTTP), Data Download (FTP), Applications, Documentation, and Log out.

The main configuration area is titled 'Measurement Configuration' and is divided into several sections:

- DVL Configuration:** Includes fields for Trigger Mode (INTSR), Sample Rate (Hz) (1), Speed of Sound (m/s) (Measured), Salinity (ppt) (35.0), Blanking Distance (m) (0.02), Range (m) (100.00), Transmit Power (dB) (MAX), Bottom Track Data (DP21 DVL BT Binary), Enable Water Track (checked), and Water Track Data (DP22 DVL WT Binary).
- Current Profiling:** Includes checkboxes for Enable Current Profiling, Interleave Ratio (0), Cell Size (m) (1.00), Blanking Distance (m) (0.50), Range to Last Cell (m) (70.50), Velocity Range (m/s) (1.50), Transmit Power (dB) (0.0), Co-ordinate System (XYZ), and Data (DP3 Binary v3).

The right-hand side overview panel provides detailed descriptions for the following parameters:

- DVL Configuration:**
  - Trigger Mode:** Describes the trigger mode (INTSR) and hardware triggers (TI or O483 input leads).
  - Sample Rate:** Describes the data sampling rate (controlled by internal timers).
  - Speed of Sound:** Describes the speed at which sound travels through the water.
  - Measured:** Describes the estimated salinity based on temperature and pressure.
  - Fixed:** Describes the use of external estimates for salinity.
  - Salinity:** Describes the estimated salinity in parts per thousand.
- Bottom Track:**
  - Blanking Distance:** Describes the distance the DVL begins to search for bottom.
  - Range:** Describes the maximum distance at which bottom is detected.
- Table:** A table showing 'Rate (Hz)' for 8 different channels, with 'Max Range (m)' values ranging from 80.00 to 61.62.
- Transmit Power:** Describes the amount of acoustic energy output from the DVL.
- Bottom Track Data:** Describes the data output format for the DVL's Bottom Track.
- Enable Water Track:** Describes the checkbox to enable velocity estimates relative to the water.
- Water Track Data:** Describes the data output format for the DVL's Water Track.
- Current Profiling:** Describes the checkbox to enable current profiling.

## 4.2 DVL Diagnostics

The most straight forward means of visualizing a DVL data stream is to open the Data Display tab within the DVL's web browser interface. This is simplified presentation of a running time series of the data output from the DVL. It includes Pressure, Velocity (beam), Figure Of Merit (beam), Distance, Velocity (XYZ), and Figure Of Merit (XYZ). Note that invalid data is not displayed and such data is very common when attempting to operate in a bucket or tank with poor acoustic conditions. Refer to the section on [Functionality tests](#) for general DVL checks.

For a more complete data visualization, the MIDAS software (Multi-Instrument Data Acquisition System) is useful if you are interested in looking at data online for short periods of time. The installation file can be downloaded directly via the Applications web page (see previous section). The software requires a Java Virtual Machine (JVM) to be installed. The software has been tested with the Sun JVM available from <http://www.java.com> but it is also known to be fully functional with other JVMs. Note that MIDAS has a software manual available for download (Click **Help > SW Manual**).

The Nortek DVL, together with the MIDAS software, offers a Spectrum Analyzer function. This is particularly useful when trying to identify sources of acoustic or electronic noise onboard a vehicle. Consult the MIDAS help files to learn more about this feature.

### System requirements:

1 GHz x86 based host machine (dual-core recommended for imaging)
Windows NT, Vista or Windows 7 (32- or 64-bit) with Java Virtual Machine installed (the software will operate with both 32- and 64-bit JVMs. Using a 64-bit JVM greatly increases the size of the MATLAB data files that can be exported by the software.
1 GB of RAM (2 GB or higher is recommended)
USB port
Minimum display resolution of 1024x768, 256 color

After a successful installation, continue with the following steps if you connect through the network. If you are using Serial port communication, jump directly to the next paragraph.

- Open the software and click **Connect > Network Discover**. This Discovery tool lists all instrument available on the network, and presents the following:
  - IP address: A green background indicates that the IP address is properly configured for the network it is connected to. If the background is red, the IP address must be reconfigured using the **Discover** option from the menu bar. Refer to the MIDAS manual for more details on this (Click **Help > SW Manual**)
  - Port timeout is the length of time the software will wait for a response from the instrument before timing out and issuing an error message. Default: 2000 ms
  - Username/password fields. Username is the command interface user name to use for connection. Default username/password: "nortek"/" " (blank).
  - Note that it may not be possible to "discover" instruments that are connected to the local network through a router.
- You can also select **Connect > Network parameters** if you need to set the IP address and name explicitly. This mode of operation is useful on networks in which the discovery protocol might not work (e.g. through multiple routers, firewalls or through VPN connections).
- Click Apply. You will typically be prompted to switch to command mode. An instrument display panel is created showing the associated data displays for the current configuration as well as the action buttons for the instrument. Pressing the play button will directly start a measurement with

the current configuration. Check out the MIDAS software manual (Click **Help > SW Manual**) for more detailed information about the general operation and functionality of the software.

If you are using Serial port communication:

- Open the software and click **Communication > Serial AD2CP**. The dialog lists the following:
  - Instrument name. Can be specified if desired.
  - Serial Port: Shows the available serial ports detected in the system.
  - Port speed shows the requested baud rate for connection to the instrument. A baud rate of 115200 is recommended. Note that not all RS232 USB serial converters support data rate above 115200.
  - Port timeout is the length of time the software will wait for a response from the instrument before timing out and issuing an error message. Default: 2000 ms. If you experience connection problems you may try to increase the timeout value, e.g. 10000 ms.
- Click Apply. The software will then start searching for the instrument by issuing commands on the selected serial port at various ports speed (starting with the chosen speed). The baud rate will be changed to the elected baud rate during this process. After the instrument has been connected, an instrument display panel is created showing the associated data displays for the current configuration as well as the action buttons for the instrument. Pressing the play button will directly start a measurement with the current configuration. Check out the MIDAS software manual (Click **Help > SW Manual**) for more detailed information about the general operation and functionality of the software.

### 4.3 Command Line Interface

The command interface makes it possible to communicate with the instrument using a terminal emulator and a set of commands. The [DVL Integrator's Guide](#) is the recommended manual to consult for guidance, but as an introduction here are some highlights:

- The interface is ASCII based and line oriented. Commands are terminated with CR/LF.
- Optional encapsulation of commands using NMEA style prefix and checksum to ensure data integrity
- NMEA style commands will return argument names in their response
- Argument limits can be retrieved through commands
- Comprehensive validation and error handling is implemented
- Invalid configurations return the erroneous argument with limits directly, so that each subsequent error can be handled until a valid configuration is achieved
- A single command can be used to retrieve the complete configuration of the instrument with optional output to file
- Commands to set default parameters
- External controllers can use commands to store external data in the raw data file (e.g. GPS position)
- Note that Telnet is disabled on the newer Windows systems (>Win 7). Consult Microsoft support for simple steps on how to enable it

### 4.4 Data output

The DVL can be configured to include both water track and current profile in addition to the standard bottom track. These three modes have different output data formats and can be output in either binary or ASCII format. The [DVL Integrator's Guide](#) contains a detailed format description for all the different data outputs. The Nortek DVL supports older protocols which have been available (PDxx variants). Otherwise, system integrators may choose to use native Nortek data formats which offer

expanded information (independent beam information and quality parameters) and are delivered in efficient data packets.

**Stream data serially:**

The easiest way to stream data from the DVL is to:

- Use the Ethernet cable to connect the instrument to the PC and open the web interface.
- After you have configured the DVL, go to the instrument settings option. Select the correct serial port type (RS232) and serial port baud rate.
- Click Submit. The DVL should enter measurement mode as indicated by the blue LED flashing at the sampling rate.
- Disconnect the Ethernet cable and power.
- Connect the serial cable and power. Data will stream out over the serial port immediately.



## 5 Preparation

From this point on it is assumed that a stable, reliable connection with the instrument has been established. This is necessary to continue onwards for the next few sections of the manual. If the instrument is unable to connect with your PC please revisit the [Getting Started](#) chapter or consult the [Troubleshooting](#) chapter.

### 5.1 Functionality Test

Before every mission, it is strongly recommended that a functionality test is performed to ensure that the various components work as intended. Before continuing make sure that your instrument is connected as described in [Initial Ethernet Connection](#). The Functionality Test for the pressure and temperature sensors may be performed by observing the data output in the Display Data (as plots or text) page of the web browser interface.

#### Temperature

To test the temperature sensor simply read off the corresponding value and compare with your room temperature.

#### Pressure

The pressure sensor outputs the absolute pressure value in units of dBar. During production, the sensor is adjusted to 9.5 dBar to output the gauge pressure (pressure relative to the atmospheric pressure). The pressure sensor cannot output negative values. In air, the pressure sensor will output a value of 0.2-0.7 dBar, depending on atmospheric conditions. Test the pressure sensor by submerging the instrument in approximately 0.5 m of water. The value should read 0.5dBar + the ambient pressure of 0.2-0.7. An alternative way to test whether the sensor is functioning is by forming a seal around the sensor with your mouth and blowing to observe an increase in pressure.

#### Recorder

Note: We recommend starting new missions with an empty recorder if you plan to store data internally. Before you erase the recorder, make sure that you have transferred all the data you want to retain.

- Go to the Web interface > Maintenance > Erase SD card.
- Or use the ERASE,9999 command (ref. DVL integrator's Guide)

#### Firmware

The firmware should be the latest version for your instrument. You can check to see if there is an update on the Maintenance tab of the web interface. Release notes can be found on the [Nortek website](#). The firmware is upgraded on both the DSPs used within the instrument; the SEC (Serial Ethernet Converter) and the BBP (Broadband Processor). A progress page on the web interface showing the status of the firmware upgrade is automatically updated until the process is complete. Note that after upgrading the SEC, the SEC must be re-booted to use the new firmware. The BBP automatically re-sets itself when the new firmware has completed loading.

#### Transducers

A functionality test of the bottom track is often difficult in a laboratory setting. This is because the acoustic conditions of buckets or tanks are not representative of in-field conditions and more often than not it just does not work. What is most important to evaluate is the response of the transducers and not the bottom track capabilities in bucket. The following outlines how one can confidently evaluate each of the four transducers

In order to confirm that the transducers are functional, one will need to evaluate the change in response as the DVL pings in the air verses how it pings in the water. This may be done by enabling the current profile mode in the measurement configuration and to include only a single cell (no current profiling license required). The configuration is illustrated in the screen shot below. Once the configuration is complete and the DVL is pinging, you may submerge the DVL in water (a bucket will do). You will see that the amplitude in this first cell will increase from its noise floor (approximately 27 dB) to a large amplitude (approximately 85 dB). Screen shots for measurements in-air and in-water are shown below.

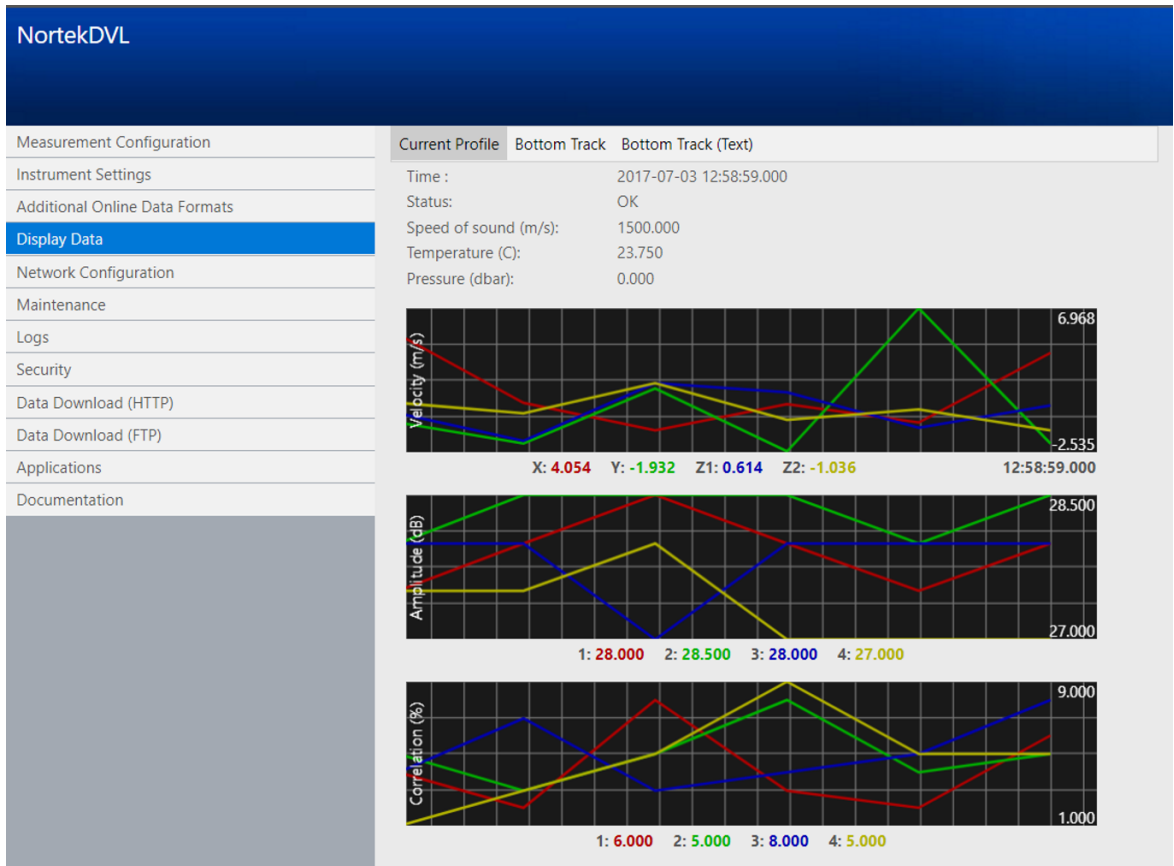
The screenshot shows the NortekDVL Measurement Configuration interface. The left sidebar lists various configuration categories, with 'Measurement Configuration' selected. The main panel is divided into two sections: 'DVL Configuration' and 'Current Profiling'.

**DVL Configuration:**

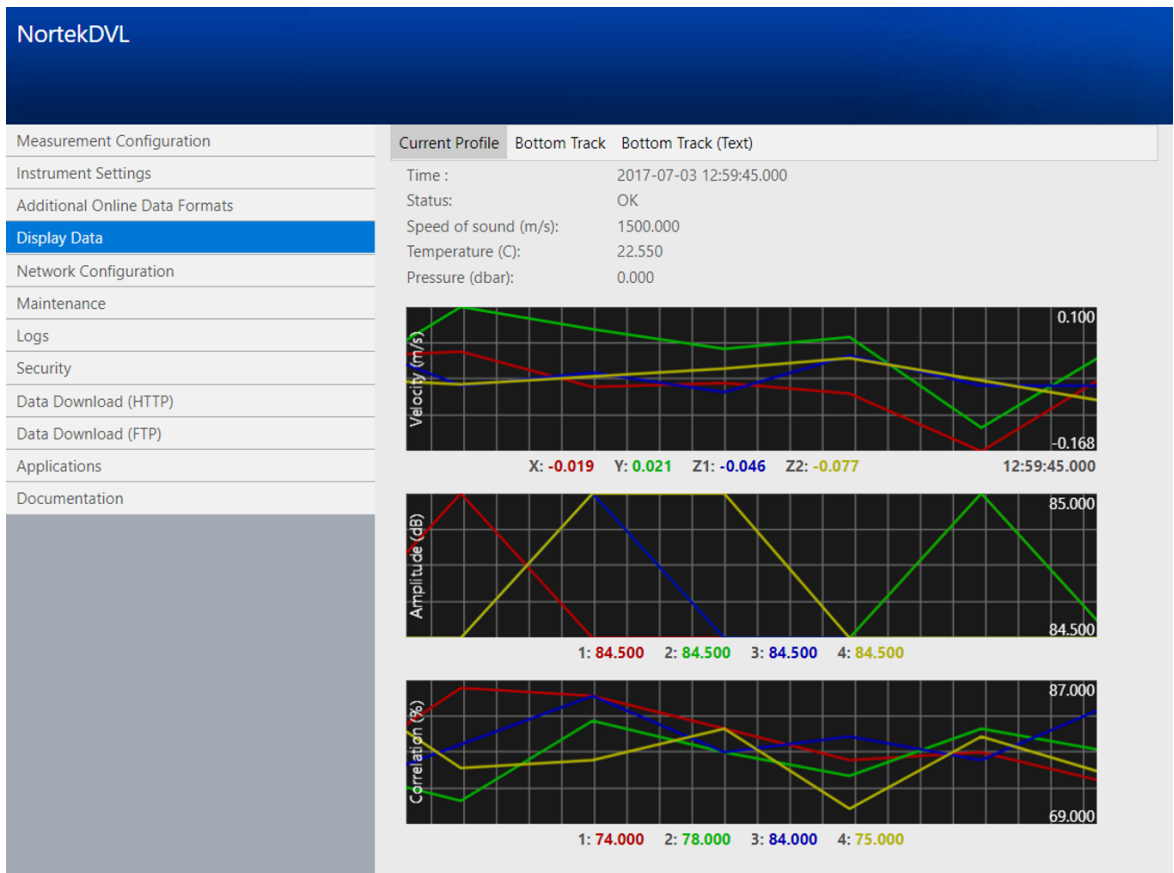
- Trigger Mode: INTSR (dropdown)
- Sample Rate (Hz): 1 (dropdown)
- Speed of Sound (m/s): Measured (radio button selected), Fixed (radio button), 0.0 (input field)
- Salinity (ppt): 35.0 (input field)
- Enable Data Recording:
- Data Recording Filename: (empty input field)
- Bottom Track:**
  - Blanking Distance (m): 0.02 (input field) (0.02 - 10.00)
  - Range (m): 70.00 (input field) (2.02 - 200.00)
  - Transmit Power (dB): MAX (dropdown), 0.0 (input field) (-20.00 - 0.00)
  - Bottom Track Data: DF21 DVL BT Binary (dropdown)
  - Enable Water Track:
  - Water Track Data: DF22 DVL WT Binary (dropdown)
- Current Profiling:**
  - Enable Current Profiling:
  - Interleave Ratio: 2 (input field) (2 - 20)
  - Cell Size (m): 1.00 (input field) (0.50 - 4.00)
  - Blanking Distance (m): 0.50 (input field) (0.50 - 68.00)
  - Range to Last Cell (m): 1.50 (input field) (0.50 - 70.50)
  - Velocity Range (m/s): 2.50 (input field) (1.00 - 5.00)
  - Transmit Power (dB): 0.0 (input field) (-20.00 - 0.00)
  - Co-ordinate System: XYZ (dropdown)
  - Data: DF3 Binary v3 (dropdown)

Buttons at the bottom: Submit, Reset, Set Defaults, Upload Config, Save Config.

**Enable the current profile mode in the measurement configuration and include only a single cell.**



In air, the amplitude in the first cell will be at the instrument's noise floor, approximately 27 dB.



In water the amplitude in the first cell will increase to a large amplitude, approximately 85 dB.

## 5.2 Before Mission

With the previous sections of this chapter successfully completed you are now ready for your final preparations before deployment.

- It is vital to remember to connect the dummy plug in case the connector is not to be used, to protect it. Before mating, ensure that the connectors are dry and free of debris, look for water inside the female connector.
- When properly mated, the engaging nut on the cable plug will thread smoothly onto the receptacle shell until it rather abruptly reaches a point where it cannot be hand-tightened any further. At this point the mating surfaces of the plug and receptacle are in contact, and have formed a good seal. The amount of force required to tighten the engaging nut should stay the same throughout (up until the point where it cannot be further hand-tightened). Otherwise, the connectors are not mating properly and will not form a good seal.
- We recommend starting new missions with an empty recorder if you plan to store data internally. Before you [erase the recorder](#), make sure that you have transferred all the data you want to retain.
- Set a pressure offset. The DVL measures absolute pressure. The pressure offset selected is the pressure reading for offsetting absolute to relative pressure. Atmospheric pressure is typically 10.0 dBar, while factory setting is 9.5 dBar to get non-zero readings out of water. Change this offset through the web site (under Instrument settings - see screenshot below).
- Online connectors should be lubricated with silicone spray.
- The Mounting Angle should be set to the non-zero value if the DVL's X direction is different from the vehicle's or INS's forward direction. See the section on [Coordinate System](#) for further clarification.

The screenshot displays the 'Instrument Settings' page of the Nortek DVL web interface. The page is divided into several sections:

- Measurement Configuration:** Includes links for Instrument Settings, Additional Online Data Formats, Display Data, Network Configuration, Maintenance, Logs, Security, Data Download (HTTP), Data Download (FTP), and Log out.
- Instrument Settings:** Contains input fields for:
  - Mounting Angle (degrees): 135.000 (range: -180 - 180)
  - Pressure Offset (dBar): 9.50 (range: 0 - 11) with a 'Set Zero Depth' button.
  - LED Selection: OFF
  - Serial Port Type: 232
  - Serial Port Baud Rate: 115200
- Instrument Settings (Help/Info):**
  - Mounting Angle:** Positive increasing angle from the vehicle/INS forward axis to the x-axis. This setting should only be used with non-standard mounting angles or to compensate for mounting errors when not used with an INS that supports mounting offset calibration. In the illustration the mounting angle is +6 degrees.
 

Note: The mounting angle is not to be confused with the rotational angle used in an external INS or software when a PDV format is used.
  - Pressure Offset:** The instrument measures absolute pressure. This setting is the pressure reading for offsetting the absolute to relative pressure. The standard atmospheric pressure at sea level is 10.13 dbar or 10.13 mbar. The default factory setting is 9.5 dbar in order to output a non-zero value over varying atmospheric pressures. For reference, 1 dbar is equivalent to the pressure at a depth of 1 meter in fresh water.
  - Set Zero Depth:** Sets the pressure offset to the current absolute pressure reading from the instrument.
  - LED Selection:** This controls how the LED operates. There are three settings: ON allows the LED to indicate operation and mode; OFF disables the LED completely; ON24H enables the LED for 24 hours after the instrument starts pinging.
  - Serial Port Type:** This sets the serial communication to either RS232 or RS422. The intention is to allow the end user to configure the instrument through the web interface, remove power, and then have it ready for serial communications the next time it is powered up through the serial interface cable. Serial communication is not possible when power is applied through the Ethernet interface cable.
  - Serial Port Baud Rate:** This is the baud rate of serial communication when powered through the serial interface cable. Serial communication is not possible when power is applied through the Ethernet interface cable.
  - Submit:** This sends the configuration to the instrument and starts measurement immediately. The submit must be done independently for each page which has undergone changes.
  - Reset:** This resets the values changed since opening the Instrument Settings web page. There is no communication with the instrument when this button is pressed.

## 6 Practical Elements of Operation

### 6.1 Start and Stop

The DVL retains both its configuration and mode of operation when power is removed. This means that if the DVL was actively measuring when power was removed it will recommence measurement using the exact same configuration when powered up again. If the DVL was in command mode when power was removed it will enter command mode again when powered up. The various modes of operation are described in the DVL Integrator's Guide.

When the DVL is configured from the instrument web page it will generally be measuring and outputting data all the time, except for the short time when a new configuration is applied. When configured manually or through the serial interface, the measurement must be started manually after the reconfiguration. Once started, the DVL will stay in measurement mode until it is explicitly stopped. This is also true through power cycles as explained above.

One may note that when the DVL starts in measurement mode During a power up sequence, there is a short (1-2 second) period when the DVL stops pinging to evaluate its network state.

### 6.2 Power Supply

#### Selecting power supply to a Nortek DVL

The DVL input voltage range is 12-48VDC; we recommend 24VDC. The power supply must be able to deliver an absolute minimum of 15W continuously. 15W is the peak (one-second average) power consumption of the DVL; we recommend using 20W minimum for power supplies.

The power supply should be made with a continuous current limit. The current limit should not be less than 1.5A. The DVL will not draw any currents above 1.5A during normal operation. Power supplies with a hiccup-mode current limit should be avoided.

**Note:** DVL instruments cannot use Power over Ethernet (PoE) technology. Using PoE with your DVL will damage the electronics board and require repair.

The switching frequency and harmonics must be outside the DVL's acoustic bandwidth. Stay away from the following bands:

- DVL500: 430 kHz – 570 kHz
- DVL1000: 870 kHz – 1130 MHz

#### Inrush current

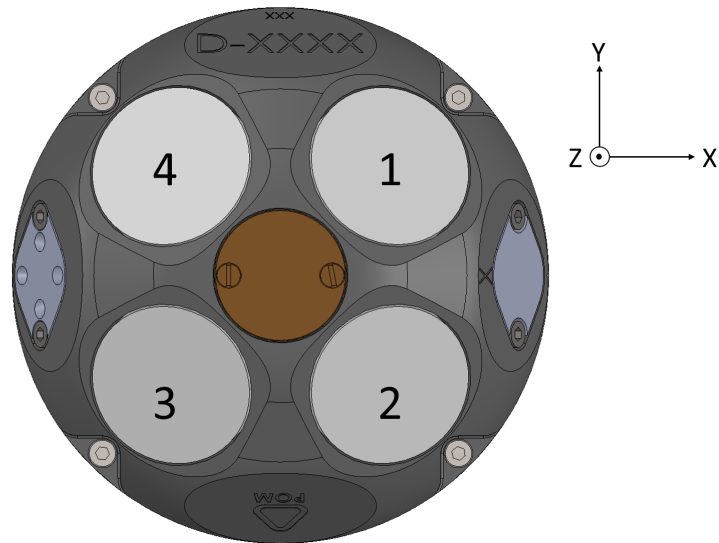
On the DVL you can see an inrush current when power is applied, and every time the systems wakes-up from sleep mode. The reason is a 50 $\mu$ F capacitor that is charged up during the first 100 $\mu$ s. This can make trouble for some power supplies. If the DVL inrush current makes the voltage drop during startup we recommend a 220 $\mu$ F capacitor at the output.

### 6.3 Coordinate System

**BEAM:** Bottom track: The reported velocities are positive when the motion is towards the transducer.  
Current profile: The reported velocities are positive when the motion is away from the transducer.

**XYZ:** 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

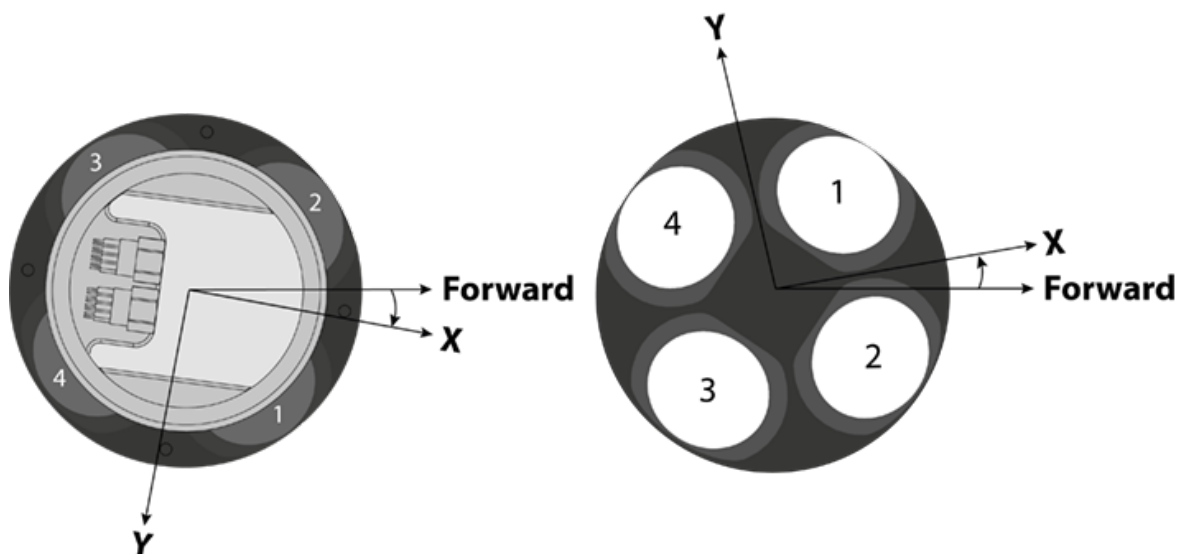
(index) finger to point in the direction of positive X-axis and the second (middle) finger to point in the direction of positive Y. The positive Z-axis will then be in the direction that the thumb points.



**DVL beam numbering and axes convention. Note that positive Z is pointing out of the page.**

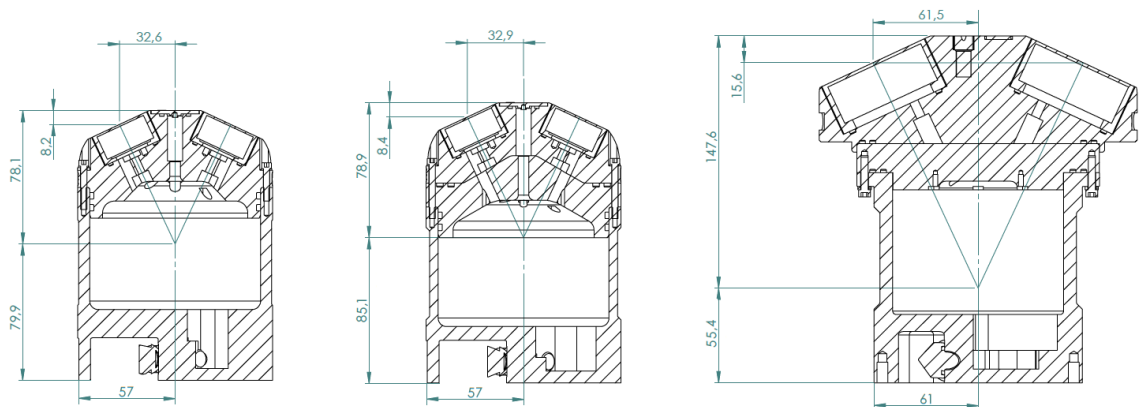
The coordinate system definitions differ between DVL manufacturers. The end user does not need to take any special consideration of the coordinate system. The correct coordinate system is dictated by the selection of which data format is used. This means the selection of the correct coordinate system and all necessary conversions are handled by the Nortek DVL.

The only matter which requires attention is that the X-direction is oriented in the vehicles forward axis. Rotational offsets may be applied to the DVL within the Mounting Angle parameter. The angle is defined as positive increasing from the vehicle/INS Forward axis to the DVL's X-axis. In other words, looking down on a DVL mounted downward-looking on a vehicle, the mounting offset is positive *clockwise* from the X-axis.



#### DVL Origin

Those requiring a reference origin for the DVL may use the figure below. This information is typically used for the moment arm calculations with an INS. All measurements are in mm.



Origin for different DVL models: DVL1000 300m, DVL1000 4000m, and DVL500 300m/6000m.

## 6.4 Control and Timing

The Nortek DVL allows for external clock synchronization of millisecond precision through IEEE 1588/PTP. The time stamp for individual beams is provided with 1 millisecond resolution. Precision timing is yet another feature that permits high precision navigation.

## 6.5 Trigger

The trigger mode specifies what controls the acoustic pinging. This is either the instrument and its internal timing mechanism (INTSR), trigger from a command (SERIAL) or a hardware based trigger (TTL or RS485 input lines). The hardware triggers will be ignored if they occur at a faster rate than what is possible to process for the configured range.

### Internal

1, 2, 3, 4, 5, 6, 7 or 8 Hz

### Serial

Trigger option through command (Ethernet or serial)

### External

TTL or 485 electrical interfaces.

Configurable trigger polarity (configurable Rising edge/Falling edge/Both edges)

Check out the [Nortek DVL Integrators Guide](#) for examples showing how to setup the instrument to use a specific trigger.

When triggered the instrument will perform a complete ping (Tx and Rx) before it goes back to monitoring the trigger. Any triggers asserted during an ongoing ping will be ignored.

- The pulse length should be minimum 1 ms.
- The latency (trigger to start of transmit pulse) is 8.4 ms
- The max length of transmit pulse is 13.3 ms for the DVL1000, and 26.6 ms for the DVL500. The actual length of the transmit pulse varies with the distance to the bottom.

## 6.6 DVL Configuration

**Trigger Mode** The trigger mode specifies what controls the acoustic pinging. This is either the instrument and its internal timing mechanism (INTSR), trigger from a command (SERIAL) or a hardware based trigger (TTL or RS485 input lines). For the hardware trigger there are three options: rising edge, falling edge or both edges. The hardware triggers will be ignored if they occur at a faster rate than what is possible to process for the configured range.

**Sample Rate:** The data sampling rate (controlled by internal timers) used when INTSR is selected. The sample rate is ignored for all other configured triggers. The permissible sample rate is limited by the travel time of the pulse through the water. This means higher sampling rates will have a reduced maximum range.

**Speed of Sound:** This is the speed at which sound travels through the water and is important for estimating velocity in the Doppler processing. The user may select between "Measured" which is estimated from the measured temperature, the measured pressure and the configured salinity or "Fixed" which is a fixed value. End user using external estimates of speed of sound wishing to apply the linear corrections outside of the DVL estimation process should use the fixed setting.

**Salinity:** This is the estimated salinity (in parts per thousand) for the location the DVL will be operating. The typical value is 35 ppt for sea water. Configuration of this value is only relevant if the end user sets the speed of sound configuration to Measured.

**Enable Data Recording:** Check this box if you wish to log data to the internal SD memory card.

**Data Recording Filename:** This is the name of the file for the data recording file. If the same name exists on the recorder then data is appended to the existing file. If the recorder gets full, the measurement continues but data is no longer stored to the recorder.

### 6.6.1 Bottom Track

**Blanking Distance:** This is the distance where the DVL begins to search for bottom. Check out the section about false detects and blanking distance below.

**Range:** This is the maximum distance at which bottom is detected (along the DVL's Z-axis). The maximum range may be reduced if a high sample rate is selected (the new limits will then be shown after you click submit). If the vehicle is to operate in an environment with multiple reflections (e.g. shallow waters) it is recommended to set the range accordingly.

**Transmit Power:** This is the amount of acoustic energy that is output from the DVL. Lower power is sometimes desirable if there is an interest in reducing power consumption or if only a short profile shall be measured. The maximum power level is range dependent, so the user may either let the firmware select the maximum (MAX) given the current configuration or choose a value (USER). If USER is selected, a power level of 0 dB represents maximum power output. In some configurations, the maximum power is given as -2. Power is decreased by entering negative values.

**Bottom Track Data:** This is the data output (and recording if selected) format for the DVL. The DF21 binary data format includes complete DVL data products, while variants of PD# are available for platforms limited to this legacy format. A complete description is found in the DVL Integrators Guide.

**Enable Water Track:** Check this box to enable velocity estimates relative to the water.



**Water Track Data:** This is the data output (and recording if selected) format for the DVL's Water track. The DF22 binary data format includes complete DVL data products, while variants of PD# are available for platforms limited to this legacy format. A complete description is found in the DVL Integrators Guide.

### 6.6.2 Current Profiling

**Enable Current Profiling:** Check this box to enable current profiling.

**Interleave Ratio:** This determines how frequently current profile data is measured (bottom track and current profiling do not operate concurrently). The ratio, N, specifies that every Nth measurement is a current profile measurement. An interleave ratio of 2, for example, will provide alternating pings between bottom track and current profiles whereas a ratio of 3 will configure two consecutive bottom tracks measurements followed by one current profile measurement.

**Cell Size:** This is the size of the cell (along the DVL's Z-axis) for which velocity estimates are performed.

**Blanking Distance:** This is the distance at which the current profile begins. Note that position of the first cell is the sum of the blanking distance and cell size. This follows standard ADCP principles.

**Range to Last Cell:** This is the distance along the DVL's Z-axis to the last measurement cell.

**Velocity Range:** This is the velocity range (positive and negative) along the beam axes to estimate currents. The corresponding horizontal velocity range is scaled the same way as the Bottom Track velocity range.

**Transmit Power:** This the amount of acoustic energy that is output from the DVL. Lower power is sometimes desirable if there is an interest in reducing power consumption or if the DVL will only be operating close to the bottom. The value of 0 dB represents maximum power output. Power is decreased by applying negative values.

**Coordinate System:** This specifies if the data is output in beam coordinates or the DVL's XYZ coordinates.

**Data:** Selects the data format for outputting current profile estimates. The DF3 data format is the most complete and efficient format while the PD0 is complete but contains irrelevant fields and thus consumes more space. NMEA formats are also available. A complete description is found in the DVL Integrator's Guide.

### 6.6.3 Fast Pressure

The Fast Pressure feature is a licensed mode for enabling rapid data output from the integrated pressure sensor. Note that higher data rates do not impact the resolution of the individual pressure estimates.

Fast Pressure is enabled using commands only. Please see the [DVL Integrator's Guide](#) for more information, and contact your local Nortek representative if you wish to purchase the license.

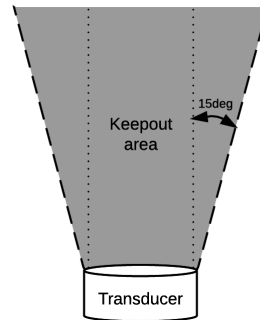
## 6.7 Installing DVL on Vehicle

### Mechanical alignment

It is recommended to install the DVL so that the X-axis points in the vehicles forward direction.

**Beam clearance**

Make sure to keep the area illuminated by the main beam, and a cone of 15 degrees around it, clear from any physical obstacles. These will interfere with the acoustics and bias the measurements.

**Calibration**

No calibration of the DVL is required before installation. Once installed, the navigation system will require that any heading misalignment between sensors is addressed through calibration. Similarly, the scaling errors of the system and its mounting errors need to be addressed through calibration, to ensure maximal accuracy. Please refer to your INS manual for calibration procedures.

## 7 Mechanical Aspects and Maintenance

Preventive maintenance is your primary tool to keep your instrument in shape and ready for action and deployment. 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.

### Doppler Velocity Logs

In general, there should be no reason to open a DVL housing since they do not require batteries. **Do not open the DVL housing unless instructed by Nortek.**

If you are instructed to open the DVL housing the electronics will be exposed, so you must keep water out of the housing and pay special attention to replacing the [desiccant bag](#) and [O-rings](#). We recommend conducting a Functionality Test after the maintenance procedure has been finished, to ensure that the instrument's functionality is as expected. We also recommend adding an entry in the internal log that is kept within the instrument. This can be helpful in assessing service intervals etc. The "Add Deployment Log Entry" box on the Logs tab in the web interface can be used for this. This log will also keep a record of things like formatting or erasing the recorder and firmware upgrades.

Only qualified personnel are allowed to perform corrective maintenance activities. Please [contact Nortek](#) for further assistance if in any doubt.

### 7.1 Instrument Care

All Nortek instruments are intended for use in water. Other fluids may have an adverse effect on the 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 your instrument has an accessible pressure case).

A preventive maintenance routine should include regular cleaning of the instrument. Use a mild detergent and pay special attention to the transducers. Check the pressure sensor and remove any dirt from the holes in the cap. Be careful when opening the pressure sensor cap as it is easy to dent the sensor.

Do not use the molded head or endbell as a clamping surface, always clamp to the instrument housing.

When opening the instrument, great care should be taken to keep the sealing surfaces clean and protected from mechanical damage. Keep water out of the open pressure case. Both fresh and salt water can corrode the circuitry.

If the instrument has been subjected to environmental conditions outside the specified design limits (refer to the [Technical Specification](#) for your instrument for the limits), mechanical tolerances of non-metal components may be affected.

### 7.2 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 lubricating spray on the pins before you plug it into the instrument. We recommend the 3M Silicone Spray. Do not use the silicone grease included in the toolkit on connectors, as this is intended for O-rings only.

Before deployment:

- Demate the connector set.

- Flush both halves of the connector set with compressed air and remove any dirt.
- Check that both connectors are dry. If not, let them air-dry.
- Inspect for damage, corrosion and cuts.
- Apply a thin film of 3M Silicone Spray or equivalent.
- Mate the connector halves, and mate any unused connectors with dummy plugs. Ensure the rubber part of the female connector is properly seated over the pins before screwing on the locking sleeve.

After deployment and before storage:

- Flush both halves of the connector set with compressed air and remove any dirt.
- Check that both connectors are dry. If not, let them air-dry.
- Inspect for damage, corrosion and cuts.
- Mate with a dummy plug.

### 7.3 Cable Care

To keep your cables in good condition:

- Avoid nicks and cuts around contacts, as these are the sealing surfaces.
- Do not pull on the cable to disconnect connectors; pull the connector itself.
- Avoid sharp bends at cable entry to 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.

### 7.4 Replace Desiccant Bag

Humid air can condense enough water to do damage to the electrical circuitry. At least once a year, replace the desiccant located in the pressure case or the external battery canister. You may wish to replace the desiccant bag more regularly if the instrument is exposed to multiple significant changes in temperature (e.g. from a hot/humid surface environment to cool water). Refer to the battery installation procedure for your instrument for instructions on opening the pressure case.

### 7.5 O-ring Care

O-rings are the critical component that keeps water out of the housing and thus the instrument dry. Watertight sealing of the instrument housing is provided by double O-rings on the head and end cap sub-assemblies. The outer O-ring forms the primary seal and the inner forms a secondary (or backup) seal. If the integrity of the O-rings is degraded the instrument should not be re-deployed. In this case, [please contact us](#).

If the instrument has never been opened, O-ring inspection is not necessary. However, when changing batteries, the O-rings on the endbell are exposed. Make a routine of inspection, maintenance and replacement of exposed O-rings.

- Check the O-rings and the O-ring grooves for grit, hair, lint, sand, or anything that could potentially breach the O-ring seal.
- After frequent deployments or if O-rings or grooves appear dirty, remove O-rings and clean the grooves. To remove O-rings, use finger pressure or the rounded edge of a plastic card to lift the O-ring out of the groove. Caution! Never use a metal object to remove an O-ring. It may cause damage to the O-ring or the sealing surface.
- To check O-rings for damage, place the O-ring between the middle and index finger and thumb. Then pull the O-ring through your fingers, feeling for any debris or wear.
- If O-rings are dirty, it is best to replace them. Washing dirty O-rings with soap and water is not recommended. Soap breaks down the lubricants and will compromise the integrity of the seal.
- Properly greased O-rings will help maintain sealing integrity and minimize O-ring degradation. Use enough grease to lubricate the O-ring thoroughly, but not so much that it will attract additional debris.
- Clean the groove with a lint free swab or the folded edge of a paper towel.

NOTE: Do not open the transducer end on your instrument to check O-rings. Opening the whole instrument means exposing the electronics, and this shall not be done unless Nortek has approved and provided guidance on how to do it.

## 7.6 Securing Screws

When installing end caps and sensor heads, care should be taken when tightening the screws. Just a little tension on the screw is needed; when the O-ring starts to be compressed, turn each screw a little at a time until the O-ring is fully compressed.

Tightening one screw fully before continuing on to the next may cause improper O-ring seating and very high mechanical stress concentrated around the screw hole. This may cause leaks and/or damage to the head or the endbell. The screws need only be tightened sufficiently for the O-ring and spring washers to be fully compressed. Instead, use the cross tightening sequence: tighten one screw slightly, then move to the screw opposite. Tighten that one slightly, then change to the next pair of opposing screws and repeat. Continue in this pattern until the screws are sufficiently tightened.

Over-torquing has no positive effect and may damage the threads and/or area around the screw holes on the head and end cap. Keep in mind that ocean pressure holds the end cap tightly; all the screws have to do is to secure the end cap from falling out when the system is above water.



Figure: a) "Two-fingers" tightening of screws. Indicator arrow shows position before final tightening. b) Final tightening 30-45 degrees from "two-fingers" tightening.

## 7.7 Biofouling

Marine growth, or fouling, on moorings should be considered when planning long-term mooring systems. Current profilers used in long term monitoring projects will be 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 achieve 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 months, 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.

When calculating forces, the marine growth is accounted for by increasing the expected weight and diameters of the mooring line and all instrumentation attached, in addition to increasing the drag.

Antifouling paints and other agents are often used to avoid transducers being covered with barnacles or other evil crustaceans during long deployments. The important thing when it comes to antifouling is that the paint is not too thick, otherwise the signal strength may be affected. Nortek has tested the effect of antifouling paints on the profiling range of the 2 MHz Aquadopp and no appreciable change was found when a thin (1 mm or so) layer on the transducers was applied. You can probably use most anti-fouling paints as long as 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.

Nortek has run a test with three different zinc oxides, a zinc paste with 40% zinc oxide, Silulen (Nycomed) with 20% zinc oxide and Desitin (Pfizer) 40% zinc oxide. They all work quite well but the Silulen a little less so. Our conclusion from the test was that a higher zinc oxide percentage is probably better. Other options are use of thin plastic bag or Pettit's Trinidad anti-fouling paint (75.8% cuprous oxide). A different approach is to use an anti-fouling adhesive patch that covers each transducer. These patches have doubled deployment lengths in warm, biologically-active waters by keeping the transducers clear for longer and greatly increasing the required maintenance interval to remove biofouling. They have no detrimental effect on the quality of the measurements from covered transducers. Contact your local Nortek representative for more information.

We realize barnacles have to be removed mechanically, but we strongly advice against using sharp objects capable of harming the polyurethane surface. We also recommend staying away from strong organic solvents such as acetone. A common, easy, and inexpensive way to keep the Delrin housing on the Aquadopp and Aquadopp Profiler clean is to wrap the housing in either clear packaging tape and/or clear plastic wrap (such as the brand name "Saran Wrap"). At the end of the deployment, simply unwrap the protective coating to find a clear instrument. Tapes such as "Duct Tape" can leave a sticky residue that is very difficult to remove (although it does not actually harm the Delrin housing).

## 8 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:

- Get a good overview of the problem; make notes during the troubleshooting process
- 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.
- If the setup uses custom cables, power supply, etc. first assemble and test the instrument using the cable 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.
- If your instrument behaves strangely try updating both your software and firmware to the latest versions. There may be incompatibility between an older version of firmware and newer version of software, and vice versa. The maintenance page will show if the versions of firmware and Applications/Documentations are up to date when accessed from a computer that is also connected to the internet. Clicking on the Check for Updates button will make sure the version status is downloaded over internet. MIDAS has a similar option in the Help menu > Check for updates. This will check for new releases of the MIDAS software when the computer is connected to Internet. The release state of the instrument firmware is checked at the same time if MIDAS is connected to an instrument.

To help us give good support, please

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

- Include a sample file showing the error, if possible
- Include information about firmware and software version used
- Include serial number (Head ID, Hardware ID or order number)
- A **Support file** can be downloaded from the instrument and is used to assist you in the best possible manner. To retrieve this file through the web browser interface, find it under Maintenance. A \*.gz file is then downloaded and can be sent directly to Nortek for diagnosis.

If it turns out that the instrument will have to be sent back to Nortek for repair, check out [this link](#) for more information, and contact Nortek Support. There is a copy of the required Proforma Invoice for the return in the [Appendices](#).

For shipping; The Nortek DVL follows the standard codes, and the HS code is 9015.80.80 Oceanographic instruments. The export restrictions list code for the Dual Use functionality is 6A001.b.2.

## 8.1 Communication

### Instrument connected through Ethernet cable

- Does the Ethernet cable have a source of power?
- Check network cabling connection: If your computer has light emitting diodes (LEDs) next to the connection where the Ethernet cable plugs into the computer, check if the LEDs are lit to indicate the current status of the network device. If the LEDs are not glowing/blinking, check that the connector is ok and try to re-plug. Refer to your computer's manual for information about the Ethernet port LED.
- Check the LED on the switch or router. The LEDs should be lit when there is a connection between the computer, the network router or switch and the instrument. If not, try switching it on and off to reset the switch/router.
- If an Ethernet switch is used, its Ethernet port should also show an active Ethernet link. Try connecting with a different cable. If not, there is a problem with the computer connection.
- If you have a button for turning on/off the wireless network antenna on your computer, turn this off.
- Connect the communication cable directly from the computer to the instrument to bypass all of the network wiring and router. Is the PC showing that the link is active? Wait a minute or two and check again.
- If the connection was lost all of a sudden; run a test and analysis function in Windows (see step-by-step description below)
- If the instrument is visible in the Windows Explorer: Send a Break in the terminal emulator, then Switch to Command Mode. A confirmation message should now appear. Try connecting to the instrument as per normal. Check the [DVL Integrator's Guide](#) for more information about the command interface.



Test and Analysis function in Windows:

1. Click "Start"
2. Click "Control Panel"
3. Click "Network and Sharing Center"
4. Click "Change Adapter Settings"
5. Right-click "Local Area Connection". This icon represents your Ethernet connection to the instrument
6. Click "Diagnose." The analysis function in Windows will examine the failed connection and show an explanation of the problem and some advices to fix the problem

Unlike the serial port, once you have verified that the link is active, there is no need to do anything else with configuring the speed or other link characteristics. The next step is to make sure you have an appropriate IP address assigned. For details about the process of assigning IP addresses, refer to the [Appendix](#).

#### **Instrument is connected through serial communication cable**

- Does the instrument have a source of power?
- Wrong serial port. Check that the correct serial port is selected. Go to Start - Control Panel - Systems - Hardware - Device Manager - Ports (look for USB device)
- Wrong baud rate. Open a terminal emulator and try to cycle the power on the serial connection. If gibberish/nonsense or nothing, check the baud rate settings
- There is a problem with the converter. Check that the LED on the converter is lit. If not, confirm that the correct driver is installed.

#### **The blue LED indicator light on the instrument is not lit**

- Is the instrument in Command mode?
- Does the LED blink (short) when applying power?

#### **Cable**

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

## **8.2 Network**

### **Firewall**

Firewalls are usually active by default and could be a possible cause for blocking communication.

### **Routers**



There are some limitations to the discovery protocol. Multicast Ethernet packets are used to implement the protocol and those packets may not be forwarded through routers (depending on the router type and configuration). For that reason, the instrument should be either directly connected or connected through a single Ethernet switch for troubleshooting. Once the IP address is properly configured, it can be used to access the instrument using normal IP communications. Only the discovery protocol uses multicast packets. For more details about the Ethernet communication, refer to the [Appendix](#).

#### **Backup if the web site crashes**

There is a way to reboot the network processor even if the WEB page is not working. Do a Discover from MIDAS or Nortek Discovery, click on the instrument to get up the configuration and then right click in the configuration window. This brings up a menu where you can select to Reboot Network Processor. The support file can also be retrieved this way so we would like them to try to read it before the reboot so we can hopefully find out the cause of this.

#### **IP address**

You have the possibility to enable/disable DHCP and set a static IP address, if necessary. Check out [this appendix](#) for details.

### **8.3 Bottom Track**

In order to detect the bottom the transmitted ping must have return characteristics that provide a sufficiently high enough score to qualify it as a valid bottom detection. Once the bottom detection is made then the velocity along the beam is calculated. This means that any number of beams may have valid estimates of velocity, however in order to report a complete XYZ estimate of velocity, the DVL needs to have a minimum of three valid bottom detections.

The lack of consistent bottom detection may be attributed to a variety of reasons. The following is a list of reasons:

- Acoustic interference from other acoustic instrumentation operating in the same frequency band (25% band centered on DVL transmit frequency). Other acoustic instrumentation may also produce harmonics which interferes with bottom detection. In order to identify acoustic (or electronic sources) of noise, one may consider using the Spectrum Analyzer function of the DVL. This works together with the MIDAS software. Further documentation of this functionality is found in the MIDAS software.
- Highly reverberating environments such as buckets, tanks, and other small enclosures.
- Poor acoustic return from bottom tracking surface such as (a) soft sediment bottoms, (b) seaweed rich bottoms, (c) or extreme bottom slopes.
- Highly scattered transmit pulse for environments that are rich in bubbles: (a) propeller wash, (b) breaking waves may produce bubbles in the first several meters of the water column, (c) schools of fish.
- Extremely close to the bottom.
- Bottom is out of range or configured range of DVL.
- False detections may occur from time to time, particularly at short range when traveling near the surface where there normally is high particle (or bubble) concentrations near the surface (first 10 m or so), and especially when the true bottom is out of range.

One way of avoiding false detects is to configure the blanking distance and/or the maximum range so that it looks for the bottom within a known window. For example, if the vehicle is not going to operate closer than 5 m from the bottom, the blanking distance can be set to e.g. 3 m. This will eliminate all detections within the first 3 meters. The larger the blanking distance, the lower the probability of false detections. Just remember that anything inside the blanking distance is invisible to the DVL.

Highly reverberant environments may also benefit by reducing the transmit power. This is of course done at the expense of the bottom detection at greater ranges.

## 9 Appendices

### 9.1 Glossary

<b>Accuracy</b>	A value giving the degree of closeness of a velocity measurement to the actual velocity. Refer to the data sheet for specific minimum accuracy.
<b>AD2CP</b>	Nortek's broadband signal processing platform.
<b>.ad2cp</b>	Nortek raw binary data file
<b>Amplitude (*)</b>	See signal strength
<b>ASCII output</b>	Data is displayed in ASCII format (text).
<b>Bandwidth</b>	Wider signal bandwidth is used to get more information and improve the velocity precision.
<b>Beam Coordinates</b>	Bottom track: The reported velocities are positive when the motion is towards the transducer. Current profile: The reported velocities are positive when the motion is away from the transducer.
<b>Blanking</b>	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.
<b>Bottom Track</b>	Bottom tracking is a method where the velocity of the bottom is measured. The bottom track algorithm is a "single mode" and functions from the minimum depth to the maximum depth, seamlessly.
<b>Break</b>	A break command is used to change between the various operational modes of the instrument and to interrupt the instrument regardless of which mode it is in. When break is received in command mode, you can see that the LED is switched off for a short time.
<b>Broadband</b>	In this context it means using a more complex transmit pulse to improve the measurement accuracy in each ping.
<b>Cell (*)</b>	One measurement cell represents the average of the return signal for a given period. The cell size and transmit pulse are of equal size.
<b>Command mode</b>	An instrument in command mode is powered up and ready to accept your instructions. If no commands are received for about five minutes, it automatically goes into Power Down Mode, unless Ethernet power is connected. LED is lit constantly when in command mode.
<b>Connector Lubricant</b>	For example 3M Silicone Spray. Do not use grease.
<b>Correlation (*)</b>	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.
<b>Desiccant Bag</b>	Added in the canister to absorb humidity
<b>Firmware</b>	Internal software of the instrument, as opposed to the instrument software running on a PC. Availability of new firmware versions is shown on the instrument web interface.

<b>FOM (Figure of Merit)</b>	Measure of the velocity white noise level (single ping precision).
<b>Internal sampling rate</b>	Rate of sampling for internal sensors. Refer to the specific instrument brochure for details.
<b>LED</b>	Light Emitting Diode.
<b>License</b>	Different capabilities of the instrument are protected under licenses which can be purchased. Contact your sales representative for more information. You will not need a license when updating the firmware version.
<b>MIDAS</b>	Nortek Multi-Instrument Data Acquisition Software
<b>NMEA</b>	Standard data format defined by the National Marine Electronics Association
<b>Noise floor</b>	The amplitude of the internal noise of the instrument. This will limit the minimum detectable signal that can be received.
<b>O-ring lubricant</b>	Lubricate the O-rings with silicone grease. Properly greased O-rings will help maintain sealing integrity and minimize O-ring degradation.
<b>.pd0</b>	Data format defined by RDI, that has been available for a long time. Format is described in RDI Workhorse manual.
<b>Ping</b>	Same as a single transmit pulse.
<b>Precision (*)</b>	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 or (2) reduced velocity range
<b>Pressure Offset</b>	Due to atmospheric pressure variations, the sensor signal may have an offset. Note that the sensor does not output negative values. Set the offset before deployment.
<b>Sidelobe</b>	The acoustic beams focus most of the energy in the center 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 than it does from the water, the small signals that travel straight to the surface can produce sufficient echo to contaminate the signal from the water.
<b>Signal strength</b>	Strength of return signal, presented in dB.
<b>SNR</b>	SNR is the Signal-to-Noise ratio and is a data quality indicator.
<b>Trigger</b>	A signal to wake up/get attention. In addition to the internal there are two external options: RS485 and TTL trigger.
<b>XYZ Coordinates</b>	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.

(\*) Relevant for current profiling only.

## 9.2 Communication and Ethernet

Connections between the instrument and computer can be made in one of two ways.

- Ethernet (via direct connection or router/switch)
- RS232/RS422 through the serial port. Serial communication baud rate: 300-115200, 230400, 460800, 625000, 1250000

### Details about the Ethernet connection

Most instruments are shipped with the Ethernet option. The first time using the instrument, the network address needs to be properly configured for the network. The IP address can be assigned in one of the three ways:

1. Dynamic Host Configuration Protocol (DHCP): A DHCP server in the network is used to assign an IP address to the Ethernet interface.
2. AutoIP: Link-local address assignment.
3. Manually assign IP address (by the user)

As shipped, the instrument uses options 1 and 2. This means that it will try to automatically configure the IP address for the network that the instrument is plugged into.

If a DHCP server is detected it takes approximately 30 seconds to negotiate for and assign an IP address to the Ethernet interface. If you are using a broadband router, it is likely you are using a DHCP Server to assign IP Addresses. Common private network address schemes include 192.168.x.x and 10.0.x.x subnets, with the Subnet mask of 255.255.255.0 or 255.255.0.0

If a DHCP server is not detected (usually because of being directly connected to a computer) and the request for an IP Address is not fulfilled, the instrument will automatically assign itself IP addresses using the AutoIP protocol. DHCP must first time out before the AutoIP protocol starts, so this will result in a delay of approximately 90 seconds before an IP address is finally assigned. A standard AutoIP address sits in the 169.254.x.x range, with the subnet mask being 255.255.0.0.

When using automatic IP address assignment, there is generally no way of knowing which address was assigned to the instrument. To determine the IP address assigned, the Discovery protocol is used to query instruments on the local subnet. The discovery protocol is a Nortek proprietary means for retrieving information from an AD2CP without requiring any knowledge of the IP address assigned.

There are some limitations on the Discovery protocol. It uses a special type of Ethernet packets (known as multicast packets) that may not be forwarded through routers (depending upon the router type and configuration). For that reason, we always recommend that the computer being used for Discovery ONLY be either directly connected to the instrument or connected through an Ethernet switch. Only the Discovery protocol uses multicast packets. Other communications use standard TCP/IP networking which means that the instrument can be communicated with anywhere that IP connectivity is supported once the IP address is known.

For more details about the DHCP or AutoIP there are many articles available in the public domain. These are standard protocols used by most Internet based equipment.

### Routers

The discovery protocol uses multicast packets that may not work through firewalls and routers. The Time-to-Live for the multicast packets is set to 2. This means that at most one router can sit between the acquisition system and instruments. The router must also be configured to support forwarding of multicast packets.

The discovery protocol also supports unicast, so if you know the IP address of the system you can use the Discover > Search for Address and simply type in the IP address or domain name.

**Manually assign IP address**

Networked instruments can also have their IP address manually assigned. This may be useful on networks in which the discovery protocol might not work (e.g. through multiple routers or firewalls).


**Network Configuration**

Click the highlighted instrument in the Instrument Search dialog to get the option of enabling DHCP or set a static IP address or IP address for a local interface (see section [Finding Instrument on PC](#) for description of parameters), or check out the MIDAS software manual.


### 9.3 Cable Connector Pin Configurations

In these diagrams, "wet end" means the connector on the instrument side of the cable, while "dry end" means the connector on the computer side of the cable.


#### 8-pin, Ethernet AD2CP with TTL sync (N2550-051)

Wet end	Pin #	Function	Wire color	Joint	Wire color	Pin #	Dry end
MCIL8F with MCDLS-F (red sleeve)	1	Gnd	Black		Black	Jacket	2-pin jack plug
	2	Pwr +	Red		White	Center	
3	Rx -	White	Green		6	RJ 45 Insulation connector	
4	Rx +	Blue	Green/White		3		
5	Tx -	White	Orange		2		
6	Tx +	Orange	Orange/White		1		
7	Trigger	White	Blue		1	2-pin terminal strip	
8	NC	Green	Black		2		


#### 8-pin, Ethernet AD2CP with RS485 Sync (N2550-052)

Wet end	Pin #	Function	Wire color	Joint	Wire color	Pin #	Dry end
MCIL8F with MCDLS-F (red sleeve)	1	Gnd	Black		Black	Jacket	2-pin jack plug
	2	Pwr +	Red		White	Center	
3	Rx -	White	Green		6	RJ 45 Insulation connector	
4	Rx +	Blue	Green/White		3		
5	Tx -	White	Orange		2		
6	Tx +	Orange	Orange/White		1		
7	RS485 Sync A	White	Blue		1	2-pin terminal strip	
8	RS485 Sync B	Green	Black		2		

**8-pin, RS232 AD2CP with TTL sync (N2550-050)**

Wet end	Pin #	Function	Wire color	Joint	Wire color	Pin #	Dry end
MCIL8F with MCDLS-F (red sleeve)	1	Gnd	Black		Black	Jacket	2-pin jack plug
	2	Pwr +	Red		White	Center	
	3	Tx -	White		Yellow	2	9-pin DSUB female
	4	Tx +	Blue		Purple	7	
	5	Rx -	White		Blue	3	
	6	Rx +	Orange		Brown	8	
					Black	5	
	7	Trigger	White		Blue	1	2-pin terminal strip
	8	NC	Green	Black	2		

**8-pin, RS232 AD2CP with RS485 Sync (N2550-053)**

Wet end	Pin #	Function	Wire color	Joint	Wire color	Pin #	Dry end
MCIL8F with MCDLS-F (red sleeve)	1	Gnd	Black		Black	Jacket	2-pin jack plug
	2	Pwr +	Red		White	Center	
	3	Tx -	White		Yellow	2	9-pin DSUB female
	4	Tx +	Blue		Purple	7	
	5	Rx +	White		Blue	3	
	6	Rx -	Orange		Brown	8	
					Black	5	
	7	RS485 Sync A	White		Blue	1	2-pin terminal strip
	8	RS485 Sync B	Green	Black	2		

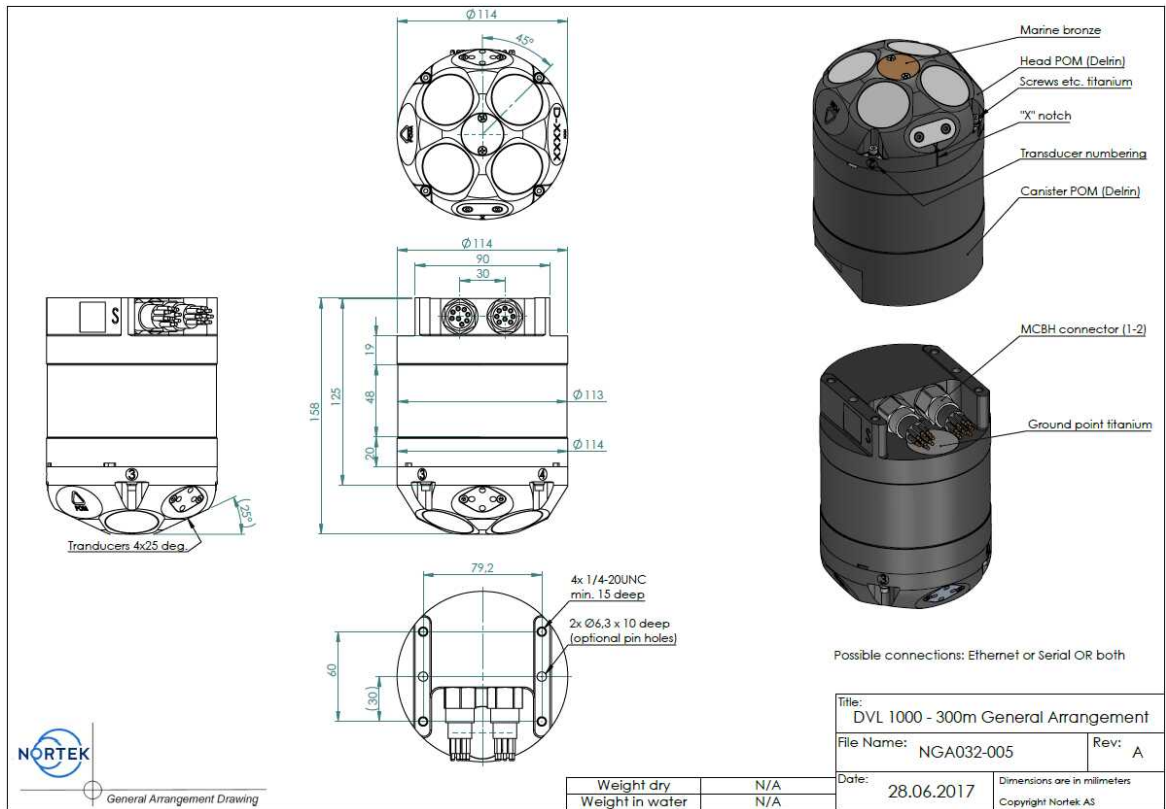
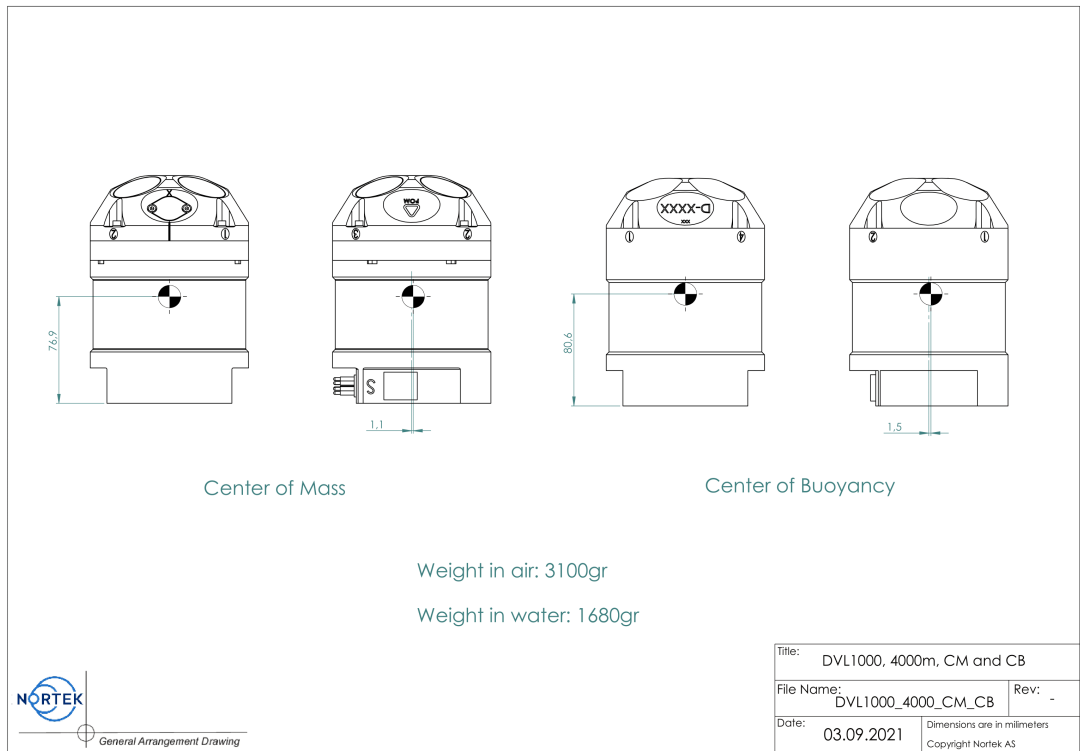


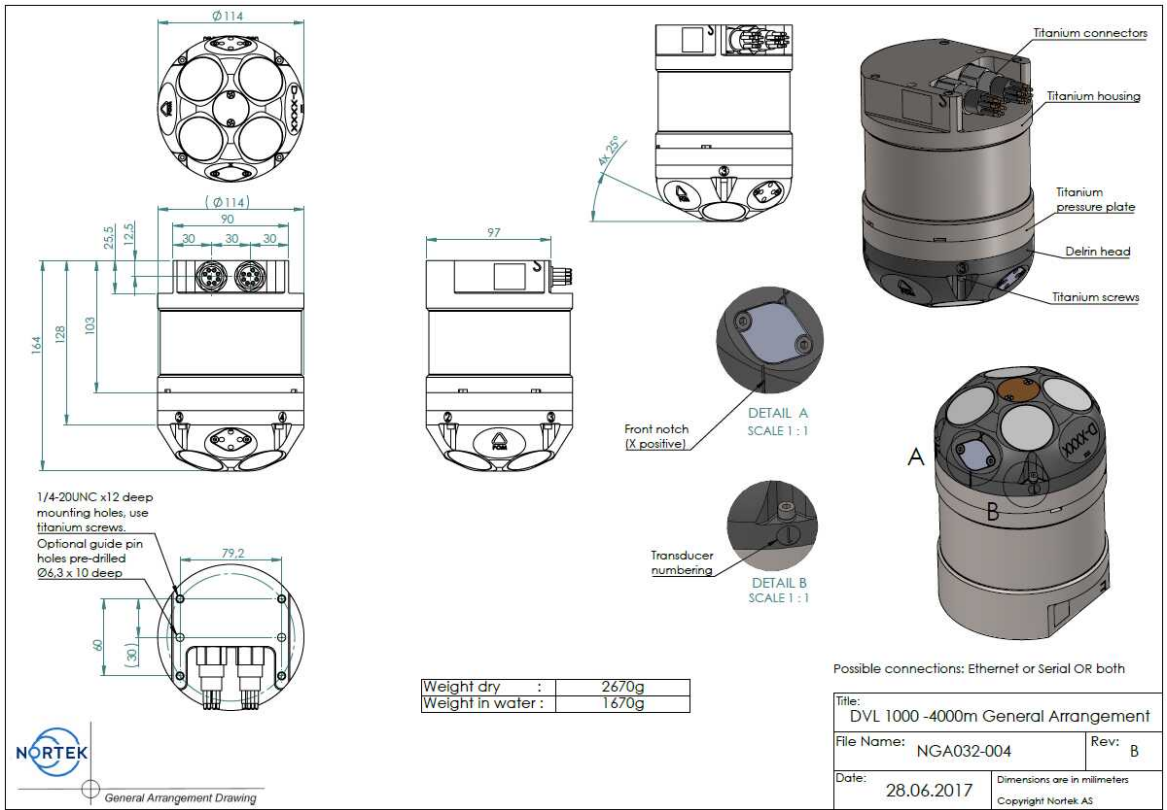
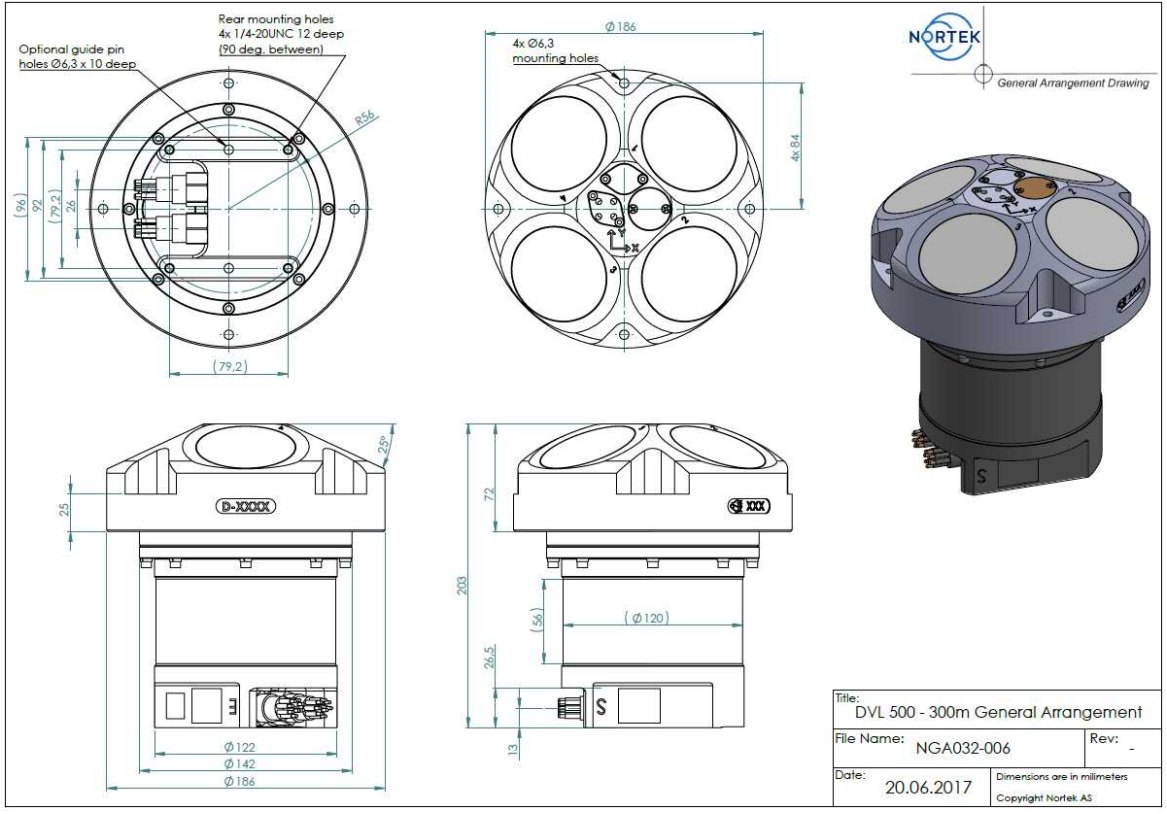
**Internal harness, DVL Serial and Ethernet with SyncIn (TTL trigger) (N2500-001)**

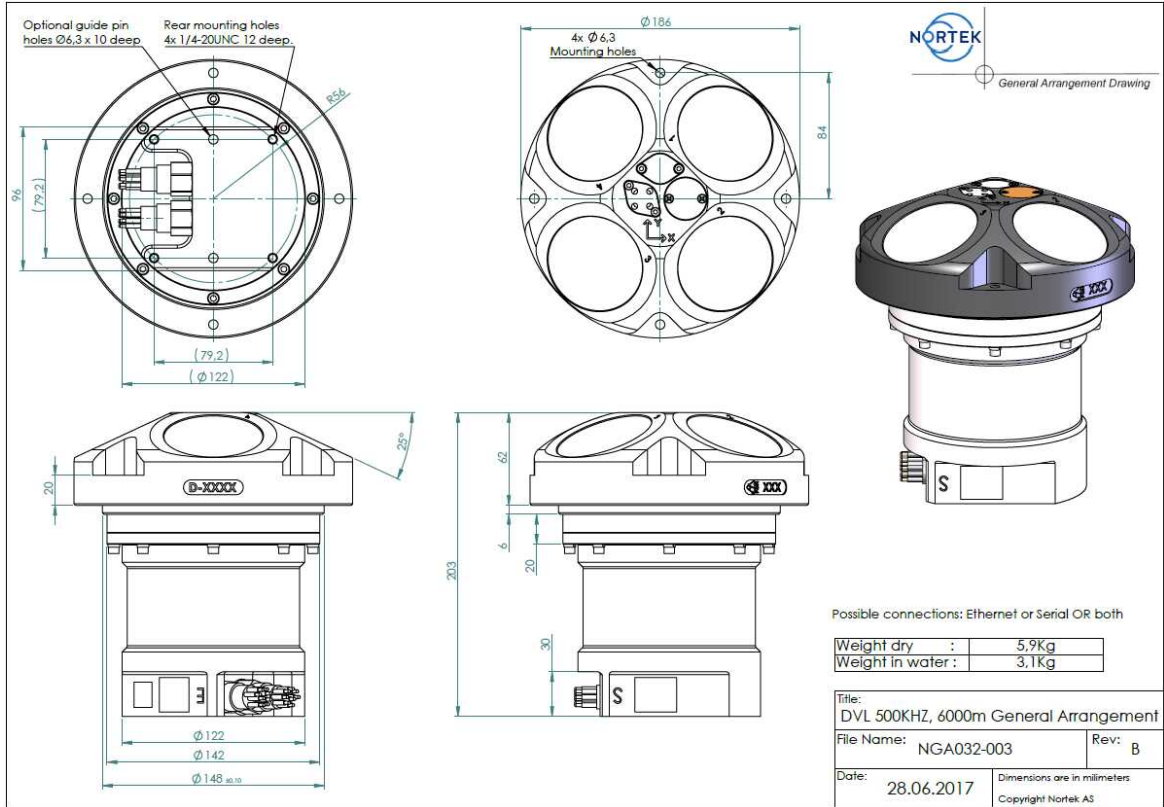
Ext. connector	Pin #	Function	Wire color	Pin # (int.)	Function	Int. connector
Serial	1	Pwr Gnd	Black	3	Pwr Gnd	Molex Sherlock 13-pin
	2	Pwr +	White	2	Pwr +	
	3	RS232 Tx/RS422 Tx-	Red	4	Tx RS232 or Tx 0_Z_DI	
	4	RS422 Tx+	Green	5	Tx 0_Y_RTS	
	5	RS232 Rx/RS422 Rx+	Orange	6	Rx RS232 or Rx 0_A_DO	
	6	RS422 Rx-	Blue	7	Rx 0_B_CTS	
	7	Sync In	Yellow	8	Sync In	
	8	Shield	Red/Black	1	Shield	
Ethernet	1	Gnd	Black	2	Gnd	Molex Sherlock 7-pin
	2	Pwr +	White	3	Pwr +	
	3	Rx-	Red	4	Rx-	
	4	Rx+	Green	5	Rx+	
	5	Tx-	Orange	6	Tx-	
	6	Tx+	Blue	7	Tx+	
	7	Sync In	Yellow	8 (Sync In on 13-pin connector )		
	8	Shield	Red/Black	1	Shield	

Insulated ring to Gnd point on endbell (soldered to Gnd point on PCB)

### 9.4 Mechanical Drawings







## 9.5 Proforma Invoice



NOT A SALE

### Temporary export to Norway for repair

Sender (Exporter)	Receiver
Name:	Name: NortekAS
Address:	Address: Vangkroken 2
City:	City: N-1351 Rud
Country:	Country: Norway
Tel:	Tel: +47 67 17 45 00
E-mail:	E-mail: support@nortekgroup.com
Ref:	Customs Account No.: 322 68 794
	VAT/Company No.: 996 707 415 MVA

About the goods	
Date:	Description of Goods:
Delivery Terms:	No. of Units:
Delivery method:	Weight:
Tracking no:	Origin: NO
Reason for Export:	Total Value:
Return for repair	Nortek RMA No.:
Temporary	

Place:  
Date:  
Exporter's Name: