

VESSEL MOUNTED

CURRENT PROFILER



USER MANUAL

June 2005

VERSION 1.32 AND ONWARDS



VESSEL MOUNTED

CURRENT PROFILER

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and post your message there. The Forums also offer a great opportunity to share your experience using Nortek sensors with other users around the world, and to learn from their experience.

OVERVIEW

What's in this Manual?

Introduction – Vessel Mounted Current Profilers

This part introduces you to the Vessel Mounted Current Profiler (VMCP) concept. In this part you will also find our warranty conditions.

Chapter 1 – Physical Installation

This chapter outlines issues you should consider while you are deciding where to mount the Nortek Vessel Mount Current Profiler (VMCP) on a moving vessel. A must-read before you proceed to mounting the unit onto the ship.

Chapter 2 – Software Installation

The VMCP is controlled from a software program included in the shipment. This chapter covers navigation device interfacing issues.

Chapter 3 – Changing Display Appearance

More software issues, this time describing the options available to tailor the look of the display.

Chapter 4 – Calibration

Most measurements become meaningless unless the measuring chain has been properly calibrated. This chapter describes procedures and options.

Chapter 5 – Routine Operation

When everything has been set up and properly calibrated, time has come to utilize the system. This chapter shows you how.

Chapter 6 – Checking Out Your System

It is a good idea to verify your system's performance from time to time. This chapter describes ways of checking interfaces and other issues. In the unlikely event of malfunction, this will be the right starting point for troubleshooting.

Chapter 7 – Maintenance

To keep your VMCP ship shape, regular maintenance is important. To take advantage of new advances in the controlling software, you may have to upgrade the firmware. This chapter tells you how.

Appendix 1 – Background Information

This part contains background information on how the system actually works.

Appendix 2 – Data Formats

A list of all the data formats used, so that you may export the data acquired to other PC applications to generate reports of your likings.

Appendix 3 – Mechanical Drawings

All mechanical dimensions of the transducers.

Appendix 4 – Returning the Device for Repair

In the unlikely event of a malfunctioning unit you may need to return it to the factory for repair. There is a procedure, which must be followed. You will find it here.

DETAILS

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INTRODUCTION

Vessel Mounted Current Profilers

Welcome to the world of ocean current measurement. The Vessel-Mounted Current Profiler, or VMCP, opens your eyes to the currents underneath your ship. It gives you the big-picture view of what the currents are doing and how they are influencing your offshore operations. At the same time, your navigation system gets top-quality vessel speed log data.

A Vessel Mounted Profiler system includes a Doppler profiler to measure currents relative to the ship, your navigation system, or the sea bed (which enables it to convert these data into earth-referenced currents), and a computer system, which runs SurveyVM™ software and displays the results for you to use.

Nortek's Vessel Mounted Profiler system is unique in its effective use of the high quality navigation systems now common aboard ocean-going ships. SurveyVM™ accepts and carefully processes data from a variety of different navigation systems and it includes the simplest and most effective calibration procedure you can get. Your Vessel Mounted Current Profiler can be ready to operate literally within minutes once it is installed!

Warranty

In order to stay up-to-date and receive news and tips from the factory you should register at our web site. Use the Internet and go to <http://www.nortek-as.com/newsletter.php>. Enter your name, e-mail address and topics of interest.

We also recommend our User Forum where you may post questions and discuss with other people in the oceanographic community. To get to the User Forum

enter <http://www.nortek-as.com> and click on [Forum](#). If you have no internet access or, if you – for any other reason – prefer traditional mail or telefax, you may fill in and return the registration part of the warranty sheet accompanying your Nortek product.

Nortek AS grants a one year limited warranty that extends to all parts and labour and covers any malfunction that is due to poor workmanship or due to errors in the manufacturing process. The warranty does not cover shortcomings that are due to design, nor does it cover any form of consequential damages as a result of errors in the measurements.

In the unlikely event of trouble with your Nortek product, first try to identify the problem by consulting the documentation accompanying your Nortek product. If you need further assistance when trying to identify the problem, please contact your local Nortek representative or the factory. Always include a description of the suspected malfunction as well as any datasets available (whenever applicable).

Please make sure you receive a Return Merchandise Authorization (RMA) *before* any product or module is returned. An RMA can be obtained using our e-mail address: inquiry@nortek.no or our Fax No.: +47 6713 6770. See also *Appendix 4*.

CHAPTER 1

Physical Installation

The following lists outlines issues you should consider while you are deciding where to mount the Nortek Vessel Mount Current Profiler (VMCP) on a moving vessel.

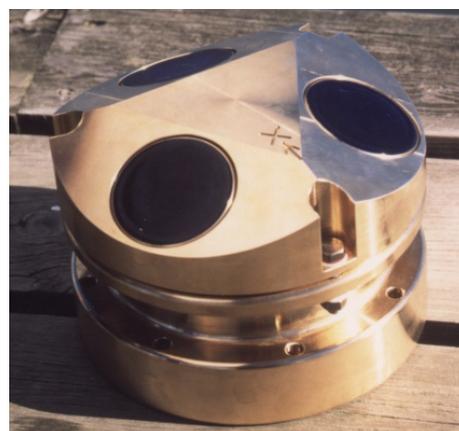
- Try to avoid mounting the VMCP in areas where bubbles from the propeller or thrusters will pass over the VMCP sensor head. The system can tolerate some bubbles in front of the acoustic transducers but when the cloud gets too dense, the acoustic energy will be blocked and the profiling range will be 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 the bubbles are scarce. A second solution is to mount a V-shaped structure in front of the VMCP that will deflect the bubbles. Some ships have thrust tubes (or piston rods) that can hold the VMCP a metre or more below the hull – this is normally sufficient to get the VMCP head below the bubble layer.
- Avoid mounting the VMCP too close to the bow or to the stern. The best areas are usually toward the middle of the ship, at least $\frac{1}{3}$ of the ship's length from the bow. There are two reasons to pick an area in the middle. First, the vertical motion due to pitch and roll is smaller in the middle. Second, the ship-induced flow field is less uniform toward the bow and stern. Non uniform flow reduces the accuracy of velocity data close to the hull and is best minimized.
- The installation angle is not critical because it is corrected in the calibration procedure. However, to ensure that the calibration program works properly we recommend that the x-axis of the instrument is aligned with the hull direc-

tion to within a few degrees. This will also facilitate any debugging that may be necessary at a later date.

- The VMCP's tilt angle should be as small as possible. A small tilt, however, only makes a small difference in horizontal velocity. For example, a 5° tilt gives you an apparent vertical velocity equal to about 9% of the horizontal velocity, but it reduces the horizontal velocity only about 0.5%.

The VMCP is available in 2 frequencies (600 and 1000 kHz), and in two formats. A plastic version with four transducers used for short deployment that can also be used as a stand alone AWAC system, and a bronze system designed for permanent mounting on the vessel hull.

The Vessel Mounted Current Profiler is available in two versions; with plastic housing and bronze housing (far right)



Both formats have mounting holes to the rear of the head. The bronze unit has 8 holes and the plastic unit has 4 holes. The drawings below show the layout and dimensions of the two designs.

Movable Mounts

Movable mounts are used for short term surveys or when the VMCP is moved from ship to ship. Most of these hold the VMCP over the side. As for fixed mounted systems, the mounting arrangement should be electrically isolated from the VMCP sensor. The mount must be rigid to keep the orientation of the VMCP constant relative to the ship during the survey.

Mounting systems that use a separate, towed catamaran or other towed body are not suitable unless the GPS antenna and the heading sensor are also mounted on the towed body, or the bottom track and internal compass are used.

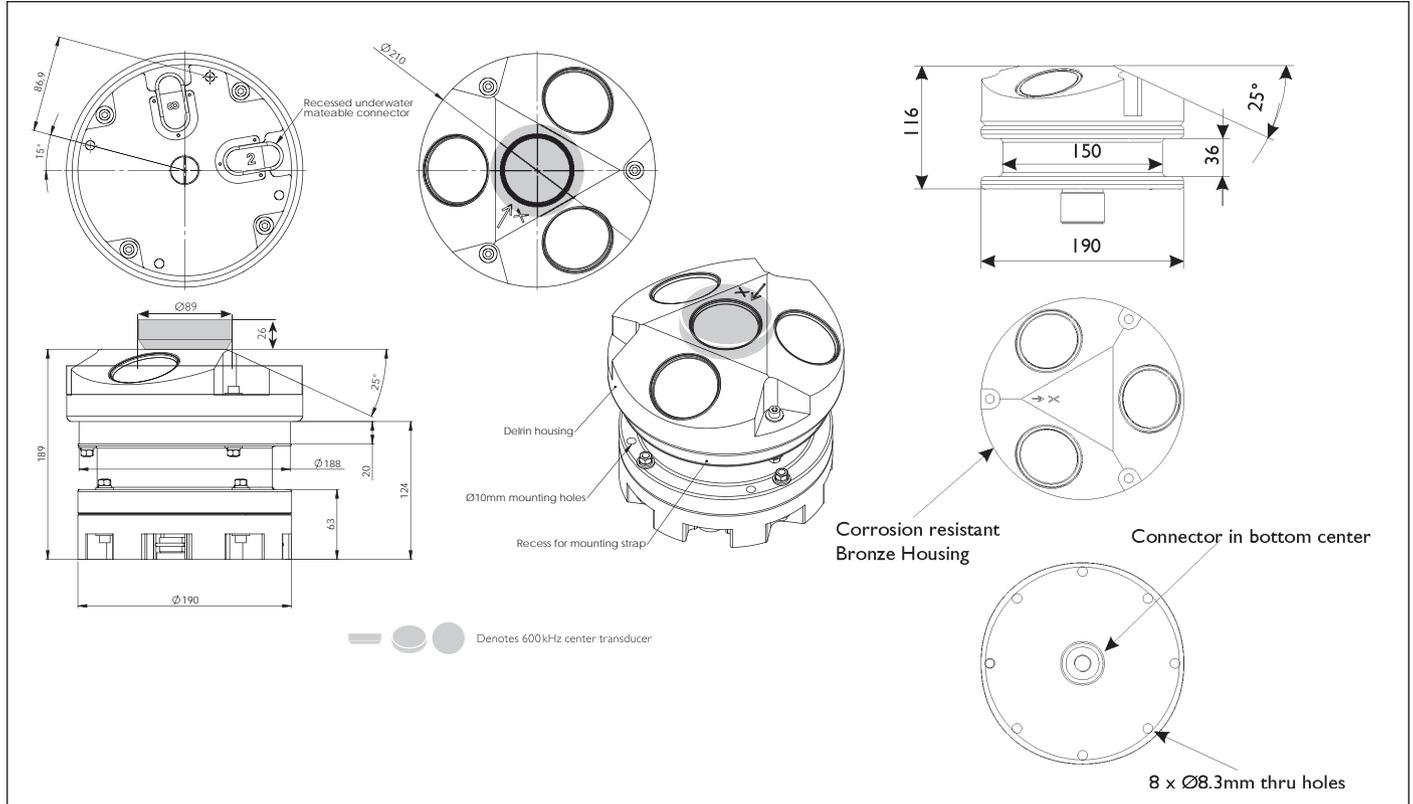
Electrical Isolation

Ensure that the VMCP sensor head is electrically isolated from the ship structure. This is particularly important when the VMCP sensor head is made of metal. Proper isolation will slow corrosion – even if corrosion cannot be completely eliminated. Electrical isolation can also, in some cases, significantly reduce the noise level of the system. Nortek supplies plastic isolation washers with the bronze format, and a plastic isolation plate for mounting at the rear of the instrument.

Cables

The System is supplied with an RS 232 cable for shorter lengths (up to 30 m) or an RS 422 cable for longer lengths. For cables greater than 150 m the system is supplied with a power box mounted near the computer and converter module mounted in or near the unit.

Mechanical dimensions of the Vessel Mounted Current Profilers. Plastic housing below left and and bronze housing below right.



CHAPTER 2

Software Installation

SurveyVMTM is a software program that collects data from the VMCP, heading sensors (gyro), navigation systems (DGPS), and other sensors. You may choose which sensors you want to use, and install just the ones you need. SurveyVMTM runs under Windows NT[®] based operating systems and it performs all the corrections required to obtain earth-referenced current data. We recommend Windows NT[®] for continuous operation, however, the system is also tested under Windows[®] XP and Windows[®] 2000.

To install SurveyVMTM:

- Install SurveyVMTM by running the self-extracting file. It installs by default in the directory **c:\Nortek\Survey**, but you can tell it to install in a different directory. Run the program by clicking on SurveyVMTM.

Serial I/O Interfaces in your PC

A typical system will require serial I/O connection to four or more external devices. A typical example: VMCP, gyro input, DGPS input and serial output. For performance reasons we recommend that computers use an intelligent multi-port board, i.e. with internal CPU and buffering capabilities, for all serial I/O. Contact Nortek for a list of specific boards that we know work with SurveyVMTM.

You can assign your serial ports any way you wish. Here is a typical assignment sequence:

- COM1 – standard port 1 (not used)
- COM2 – standard port 2 (not used)

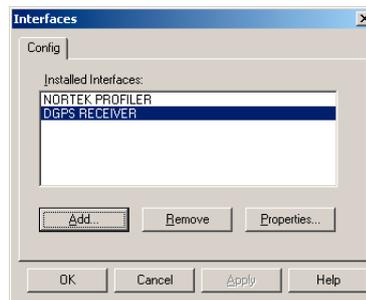
- COM3 – multiboard port 1 – VMCP
- COM4 – multiboard port 2 – DGPS/nav system
- COM5 – multiboard port 3 – Gyro
- COM6 – multiboard port 4 – serial out

Nortek has tested a number of USB based com port multiplexers. These normally work satisfactorily, however in some instances particularly with Windows® XP we have found that large or fast data quantities can cause problems, particularly Gyro systems, which generate data at 10–20Hz.

Installing Navigation Device Interfaces

On entering the **Communications** menu on the toolbar, the **Interfaces** option enables a window giving options to add remove or change auxiliary devices.

The **Interfaces** options menu lets you add, remove, and configure the interfaces.



To enable a new device:

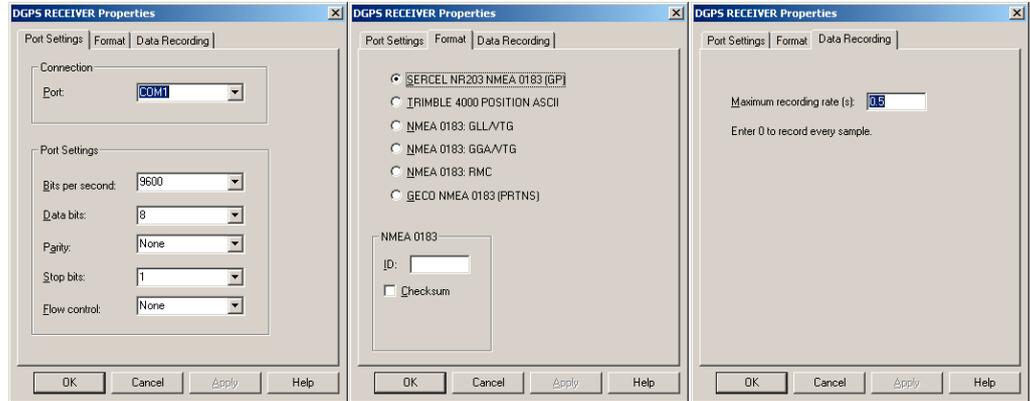
- 1 Click **Add**, and then the device type required e.g. **DGPS RECEIVER**, to enable a new device.
- 2 Select **Properties** when this device is highlighted to bring up the **Properties** menu for that particular device.

The Properties menu contains three panes:

- Setup information for the communications port (**Port Settings** tab),
- A choice of formats for the selected type of device (**Format** tab). You can have SurveyVM™ verify checksums of NMEA strings by checking the **Checksum** box. An optional 2-character NMEA identifier may be entered for systems that do not use the standard identifier, entering the two letters of the format will result in the software only accepting that format.
- Recording rate setting (**Data recording** tab). The default maximum recording rate, 0.5s, is appropriate for most circumstances. This value defines how often data will be recorded onto hard disk when recording. Increasing this time will lead to less data being stored, which may result in poor correction performance in replay mode.

Tip: To install additional interfaces, e.g. gyro, follow the same procedure for each interface.

The Properties menu for the interfaces contains three tabbed panes; **Port Setting** (left), **Format** (middle), and **Data Recording** (right). See text for details.



To test navigation interfaces, refer to *Chapter 6 – Testing navigation Interfaces*.

In addition to auxiliary inputs, the system can be made to output a number of formats to other navigation or data logging systems (e.g. spectra). These include Nortek proprietary formats and NMEA standard formats for vessel speed through water, speed over ground, and current. These formats are documented in full in *Data Formats* which can be found in the *Appendices*.

Installing the VMCP Interface

To install and configure the VMCP interface:

- 1 Click **Communication > Interfaces...** in the SurveyVM™ software program. Normally you will see **Nortek VMCP** in the **Interfaces** window. If you do not, then click **Add > Nortek Profiler**.
- 2 Configure the VMCP interface by clicking on **Nortek VMCP > Properties**. Set the interface to use the COM port you will connect to the VMCP, and set the communications parameters. Standard parameters are 9 600 baud, no parity, 8 bits, 1 stop bit and no flow control. The normal data recording rate is 0.5 s – there is rarely reason to change this value. The software versions below 1.31 require the user to set the head baud rate using the Nortek AWAC software. In this version the baud rate of the VMCP can be adjusted using the change baud rate function in the **Settings** menu.
- 3 Click on **VM setup** on the menu bar and enter the correct frequency for the system.

To test the system:

- Press **Start**. The system will start after a couple of seconds.

Using VMCP Without External Heading Sensor

On very small vessels there is often no reliable electronic heading device. In this case the internal compass of the VMCP can be utilized (Plastic Version only). If no other heading device is installed or detected, the system will automatically use the internal device. It is important to note that this compass is electromagnetic and will be influenced by any iron in the vicinity. This method will therefore only work with wooden, plastic, or aluminium vessels.

The Nortek compass includes a liquid based attitude sensor. It is important that this is correct to give a correct heading. Too much vibration in the system will result in erroneous data. The system will assume the attitude data is wrong when the tilt rises above 10°. At this point the tilt display on screen will display red and the system will assume a tilt of 0°.

Using the VMCP without DGPS

Due to the bottom track facility within the VMCP, it is now possible to measure currents without DGPS correction. If **Bottom track correction** is selected, any GPS input is used solely to mark the position of the measurements on the stick plot, or in the export files and outputs. If no GPS is interfaced, the system will operate in a *dead reckoning* mode. It will automatically switch to bottom tracking correction and will plot the vessels track based on the bottom track velocities, relative to the starting point, this track will be depicted as a dashed red line on the stick plot.

If the bottom track momentarily fails in this mode, the system will depict the current sticks with a dotted green line instead of solid green. If the bottom track fails for any length of time (defined by the number of slips in the **Correction** menu) the dead reckoning track will stop and place a pink spot where the data stopped.

In low cost surveys it is possible to interface a handheld GPS to give just position for the stick plot. However, bottom track correction should always be used under these conditions.

Dead reckoning: Calculation of one's position on the basis of distance run on various headings since the last precisely observed position.

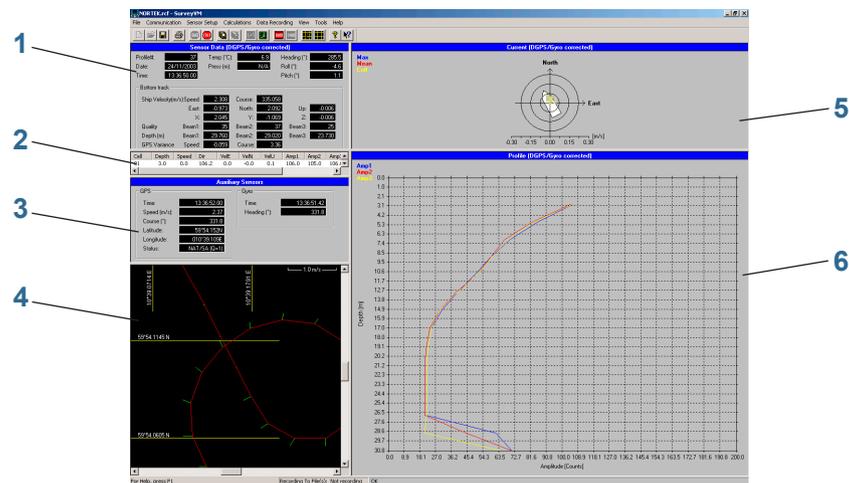
CHAPTER 3

Changing Display Appearance

The display consists of a group of panels, which you can resize with your mouse:

- 1 Contains VMCP data.
- 2 Contains a tabular listing of the profile data.
- 3 Contains data from your navigation system (**Auxiliary Sensors**).
- 4 Contains the **Stick Plot**, a navigation grid upon which Survey displays the ship track and current sticks representing the current speed and direction.
- 5 Contains the **Current** plots.
- 6 Contains the **Profile** plots.

The SurveyVM main display is divided into six panels each containing different information – see text overleaf for details.



Sensor Data (DGPS/Gyro corrected)			
Profile#: 37	Temp (°C): 6.3	Heading (°): 285.5	
Date: 24/11/2003	Press (m): N/A	Roll (°): 4.6	
Time: 13:35:50.00		Pitch (°): 1.1	
Bottom track			
Ship Velocity(m/s) Speed: 2.309	Course: 335.058		
East: -0.973	North: 2.092	Up: -0.006	
X: 2.045	Y: -1.063	Z: -0.006	
Quality: Beam1: 35	Beam2: 37	Beam3: 25	
Depth (m): Beam1: 29.780	Beam2: 29.020	Beam3: 23.720	
GPS Variance: Speed: -0.059	Course: 3.35		

Panel 1 – VMCP Data shows data from the VMCP head. If installed, this shows the data from the internal sensors of the instrument, and below it shows the bottom track parameters. These include:

- **Ship velocity/direction.** The ship’s speed and course (corrected with the gyro/compass).
- **The velocity components** of the vessel relative to the bottom in earth coordinates (East, North, Up) corrected with the Gyro/compass and relative components XYZ.
- **The quality** of the three bottom track estimates (should be above 20 under normal circumstances).
- **The projected depth** on the three beams. The beams are separated by an azimuth angle of 120° and are tilted 25° from the vertical. They will effectively display the depths at three independent points (corrected to the vertical).
- **GPS variance.** Both bottom track and DGPS measure speed over ground and course over ground. The difference between these is displayed here. This serves as a check for the user to see if the system is calibrated properly. If the vessel is sailing in a straight line these values should be near zero.
- **Info.** These values are binary numbers which report the setup and any errors in the system.

Tip: If the system is uncalibrated, an estimate of the heading offset can be taken from the course variance.

Cell	Depth	Speed	Dir	VelE	VelN	VelU	Amp1	Amp2	Amp3
01	3.0	0.2	322.4	-0.1	0.1	0.1	110.0	102.0	109.1
02	5.0	0.1	341.1	-0.0	0.1	0.1	69.0	86.0	83.0
03	7.0	0.1	351.5	-0.0	0.1	-0.0	69.0	67.0	70.0
04	9.0	0.0	265.4	-0.0	-0.0	-0.0	63.0	61.0	61.0
05	10.9	0.0	166.4	0.0	-0.0	0.0	50.0	48.0	53.0
06	12.9	0.3	353.0	-0.0	0.3	-0.1	38.0	37.0	36.0
07	14.9	0.1	294.7	-0.1	0.0	-0.0	29.0	26.0	30.0
08	16.9	1.0	279.9	-1.0	0.2	-0.1	25.0	23.0	26.0
09	18.9	1.0	270.2	-1.0	0.0	-0.1	24.0	23.0	24.0
10	20.9	1.8	267.7	-1.8	-0.1	-0.0	23.0	22.0	24.0
11	22.9	1.3	271.8	-1.3	0.0	0.0	23.0	21.0	23.0
12	24.9	1.6	292.3	-1.5	0.6	0.0	22.0	21.0	24.0
13	26.4	1.5	267.1	-1.4	0.4	-0.1	21.0	21.0	21.0

Panel 2 – Current table shows the cell information in tabular form. The table has the following columns:

Cell: This is the cell number.

Depth: This is the depth from the surface taking into account the mounting depth and blanking distance.

Speed: The current speed of each cell (including averaging), using the selected correction form.

Direction: The direction of the current in each cell using the chosen correction.

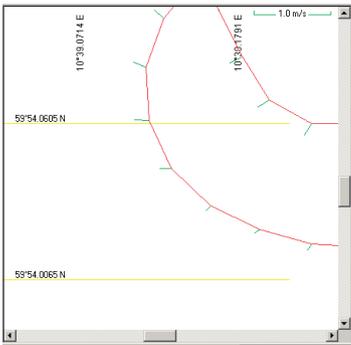
Velocity: These three component velocities for each cell follow the profile display i.e. if ENU is selected they will display VelE, VelN, VelU.

Amplitudes: These three amplitudes show the return strength of the signal and are in effect a low definition echosounder.

Std: Not used.

Auxiliary Sensors	
GPS	Gyro
Time: 13:36:52.00	Time: 13:36:51.42
Speed (m/s): 2.37	Heading (°): 331.8
Course (°): 331.8	
Latitude: 53°54.152N	
Longitude: 010°33.105E	
Status: NAT/SA (0-1)	

Panel 3 – Auxiliary inputs shows the auxiliary input values. These appear when the input is installed. If installed correctly, the values will change whenever a new signal is received. If the values do not change, this is because the wrong format has been selected or because no data is present.

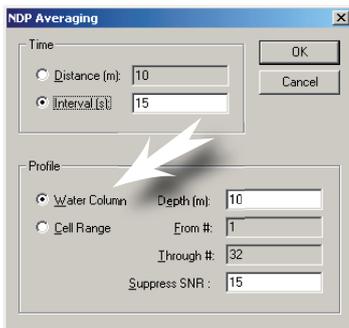


The Stick plot

Panel 4 – Stick Plot is a navigation grid upon which the vessels track is plotted in red.

To select the current to be shown as “stick” (i.e. as vector):

- 1 Click on **Calculations > Averaging** to produce the **VMCP Averaging** menu.
- The selection made in the **Profile** section (the lower part of the menu) defines the “stick” or vector placed on the grid.
- 2 You may choose either **Water Column** in metres (from the head) or **Cell Range** by selecting which cells to view. If the amplitude falls to a value near the noise floor of the system then the software can automatically remove the cells within that noise by entering the noise value of the system (in counts) in the **Suppress SNR** box.

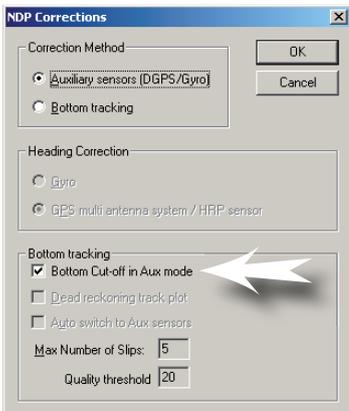


The VMCP Averaging menu

The system will automatically cut off any data below the seabed when the bottom track data is valid and selected. However, if **Auxilliary correction** is selected, you must do this manually.

To remove data from below the seabed in Auxiliary mode:

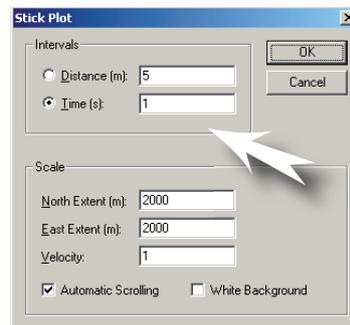
- 1 Click on **Calculations > Corrections** to produce the **VMCP Corrections** menu.
- 2 Checking the **Cut off bottom in Aux mode** allows the data below the bottom to be cut off.



The VMCP Corrections menu

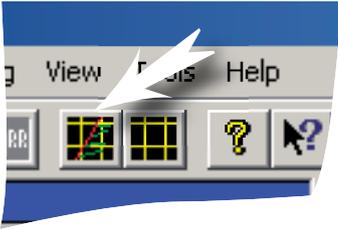
To resize the stick plot:

- 1 Click on **View > Stick plot** to produce the **Stick plot** menu:



Note: If the averaging is longer than this value, the averaging period will define the separation between sticks.

The **Intervals** section in this window allows the user to repress the stick display until it reaches a programmed distance or time. When this distance or time is reached the latest averaged value will be displayed.



The **Find sticks** icon

In addition, this menu provides you with the following options:

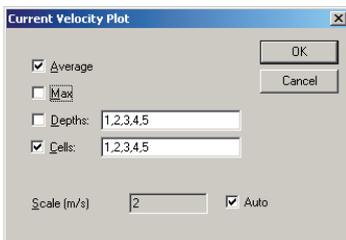
- The **Scale** section of the menu allows you to increase the size of the plot and change the scale of the sticks.
- When **Automatic Scrolling** is enabled the stick plot will automatically keep the present position of the vessel within the screen. If disabled and the vessel is lost you may use the **Find sticks** icon to move the map to the present position.
- The **White Background** switch allows you to change the background colour, a function useful for printing screen grabs.
- The **Corrections** window also allows you to plot a *dead reckoning track*, which calculates a track starting from the start point in the stick plot and plotting the calculated track from the bottom track velocities. This is another way to verify the calibration of the system as this track should be identical to the GPS track. If no GPS is present, the dead reckoning track will take the place of the GPS track and will become a dashed line. If the bottom track momentarily fails in this mode, the system will depict the current sticks with a dotted green line instead of a solid green. If the bottom track fails for any length of time (defined by the number of slips in the correction menu), the dead reckoning track will stop and place a pink spot where the data stopped.



The **Clear sticks** icon

To clear the sticks when the screen gets cluttered:

- The stick plot can contain up to 4000 sticks, after which the first stick gets removed. If the screen gets cluttered you may remove the sticks by pressing the **Clear sticks** icon. You will be prompted to confirm your intentions as the sticks cannot be recalled unless in replay mode.



The **Current Velocity Plot** menu

Panel 5 – Current Plot. This image depicts the currents relative to the vessel. The compass rose points North and the vessel rotates according to the heading input.

To set up which currents to display:

- Click on **View > Current velocity plot** to produce the setup menu.

The following options are provided:

- **The profile average** as shown in the stick plot and defined in the averaging window of the **Calculations** menu, this will be indicated as a red vector.
- **The Cell with highest current**, displayed as a blue vector.
- **Cells nearest a depth**, displayed yellow, and selected by entering the number of the cells separated by a comma, or a group of cells separated by a dash.

Tip: The Current Plot display is particularly useful for defining points in the profile where currents change in direction (*shears*). In these cases it is important that the profile average does not include the shear, as this will result in a false average and the stick plot will show vectors in the wrong directions.

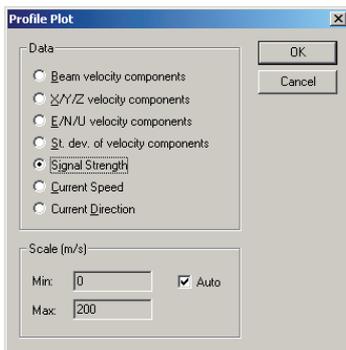
- **Individual cells**, each is shown by a yellow vector.
- **Auto.** The Velocity scale can be set to automatically use the scale that suits the highest value or it can be fixed.

Panel 6 – Profile Plot parameters. This image presents a profile graph depicting the currents or amplitudes through the water column.

To set up the data to be displayed:

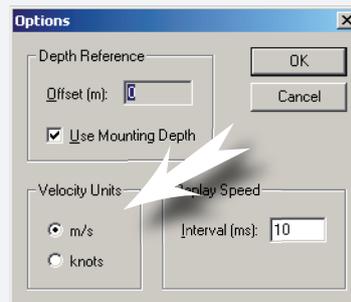
- Click **View > Profile Plot** to produce the **Profile Plot** setup menu.

The titles are self explanatory, apart from perhaps the **Signal strength** plot, which shows the signal amplitude data from all the cells chosen. The other plots however, will be cropped in depth if the bottom is detected or if the signal strength is below the defined cutoff point.

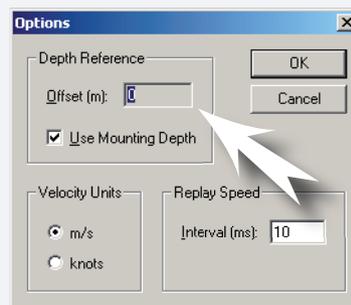


The Profile Plot setup menu

In need of changing from m/s to knots or vice versa? The system can be made to show currents in either m/s or knots. To change the units, click **View > Options...**



In need of seeing depths relative to an underwater object (such as towfish or streamers)? Define an offset by clicking **View > Options...**



CHAPTER 4

Calibration

The purpose of a calibration run is to measure the following two parameters:

- VMCP installation angle
- VMCP accuracy correction

The installation angle represents the total angular offsets required to correct from VMCP coordinates to earth coordinates. The main contributions are VMCP mounting angle offset, offset in gyro or heading sensor, and unaccounted magnetic deviation.

The VMCP accuracy correction is the difference between the average speed measured by the VMCP and by the GPS system. It is given as a fractional error in the VMCP data and includes the errors in the VMCP transducer orientation and in the speed of sound entered by the operator in the software.

Calibration Area

To run a calibration, the effect of the local currents must be eliminated. We do this by running the ship in opposite directions along the same track. You must make the two runs quickly to minimize changes in the flow from one run to the next. Better yet, make your runs in an area with weak currents.

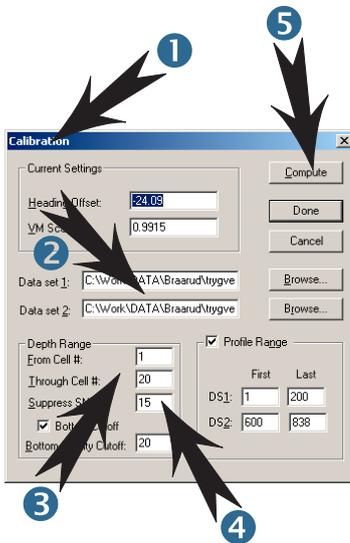
Find an area with low currents and decide on a straight track that will take at least 2–3 minutes to run. In areas with strong currents the calibration tracks should be into or with the currents to minimize the effect of *crabbing*, i.e. large differences between track course and ship heading.

Give the heading sensor or gyro and the DGPS system time to stabilize by letting the ship go for 30 seconds on a steady course before reaching the starting point. Keep the ship on a steady track during data collection. The ship speed should be comparable or slightly exceeding the speed you will use in an actual survey. Start data collection at the beginning of your course and stop data collection at the end. The procedure is not extremely sensitive to the start and stop time of the data collection.

Again, let ship heading stabilize before you rerun the in the opposite direction. Run the ship at the same speed you used in the first run and record data the same way.

To calibrate, do as follows:

- 1 Click **Tools** > **Calibrate** to produce the **Calibration** menu.
- 2 Load the two data files you just collected.
- 3 Select the current depth range you are interested in.
- 4 Set **Suppress SNR** to 0 dB.
- 5 Click **Compute** and note the results a few seconds later.



The **Calibration** menu and the calibration procedure – see text for details.

Note particularly the VM scaling! It should be between 0.9 and 1.1; it should normally be close to 1.0. Be sure to save this calibration result with your configuration files (see *Configuration Files* in *Chapter 5 – Routine Operation*). The resulting calibration parameters will then be used automatically for all subsequent data collection surveys. If you record data, keep track of the calibration parameters you use because the parameters are not stored with the data files. The best way to do this is to record new configuration files every time you change configuration or recalibrate, and to use the same name for both data and configuration files.

Particular care should be taken to ensure the erroneous readings are not included in the calibration data set. If the calibration is performed in shallow water, the bottom track facility can be utilized to remove any cells below the sea bed by clicking the bottom cutoff switch. The user can also choose which cells to use in the calibration such that any shears can be removed. If the VM scaling is outside of 2%, ie 0.98 or 1.02, reducing the number of cells can often give a better result. In general the best result is the correct one.

Tip! The profile number is the value shown in the VMCP data window with no averaging.

If you wish you can sail the two calibration lines within the same file. To split the file into two lines the user selects the same file for both data sets and then selects the profile range option and defines each line.

Recalibration

It is hard to say exactly how often the calibration routine should be repeated because this will depend on the stability of the navigation equipment as well as the local conditions. Nortek therefore recommends that you perform the calibration routine more frequently in the beginning until you become confident in the stability of the results. However, there are some times when you should always calibrate:

- Every time the VMCP is installed or reinstalled.
- Every time the navigation equipment has been changed, serviced, or upgraded.

In addition, it is prudent to repeat the calibration whenever the equipment has been sitting idle for a while or if the operator is unsure of when the last calibration was performed.

The calibration should be stable over time (within 0.5% in the VMCP correction and 0.5° in the angular correction) if the user is providing the correct salinity. If it is not stable, it could be a sign that there is a systematic error in the procedure, the gyro is unstable, the temperature sensor in the VMCP is malfunctioning or the VMCP mount is not fixed.

Bottom Track Calibration

If good calibration data is not available, or DGPS is not available bottom tracking allows manual calibration to be implemented. This is performed realtime by sailing the vessel in a known heading and using the *dead reckoning* function to plot the track. The offset in direction between the bottom track course value and the know course is the offset parameter needed. If a GPS is installed the dead reckoning track should correspond with the GPS track once the system is calibrated.

Note: If this method is used, it is important that a line is not used that includes bottom track failures. It is also critical that the bottom is within range all the time.

Scaling factor is most relevant for the auxiliary mode correction and should be performed using the standard calibration procedure.

Data can, if necessary, be reprocessed later using a calibration taken at a later stage.

CHAPTER 5

Routine Operation

Configuration Files

Configuration files contain the information you need to use Survey for routine operation. Whenever you change settings or recalibrate the system, be sure to save the configuration file. If you are recording data, save new configuration files whenever you make changes. Your life will be easier if you use the same name for the configuration files and data files.

To save a configuration file:

- Click **File** > **Save** and enter a name for your file.

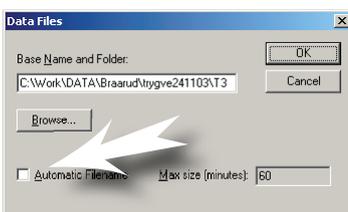
Data Recording

It is a good idea always to record data. Depending on the profiling parameters and the VMCP internal averaging interval, the amount of data will be around 10–20 MB per day. Modern hard disks can easily record this amount of data. If you have problems later on, your recorded data will be an invaluable aid to troubleshooting.

To record data:

- Click **Data Recording** > **Data Files** and enter a name for your data files.

The data file type is automatically added (i.e. **.adp** for VMCP data, **.GPS** for GPS data, etc.). It is also a good idea to use automatic data file naming. If you select 1440 minutes per file, then you will get a new file every day with the date added to the name.



The **Data Recording** menu.

If you check the **Automatic File-name** (indicated by the arrow) and select 1440 minutes per file you will get a new file every day with the date added to the file name.

If you do not save a configuration file with the same name as your recorded data, you should keep track of how you set up the system, including your calibration parameters, in a notebook.

Data Playback and Export

An acquired dataset can be played back showing your measurement like a movie.

To play back a data set:

- 1 Open the configuration file you used when you recorded the data file. If you do not have one, you will have to recreate one:
 - Use **File > Open** to read in the configuration file.
- 2 Load the recorded VMCP data file by clicking **File > Data Replay** and selecting the data you want to see. Survey will automatically find associated navigation files to read.
- 3 When you click the **START** icon, the data will replay as if you were aboard the ship. To adjust the speed of the replay go to the options window of the view menu and insert the time between profiles. Inserting 1000ms will play the data at real speed.
- 4 To get back to online mode (so that the VMCP hardware is used), click **File > Data replay** and click **Cancel**. The SurveyVM™ title will display which mode it is in.

To export acquired data:

You can export data into several formats, including ASCII text, a specialized data format called **MOSS** or averaged, corrected velocity data in the VMCP binary data format. Programs such as **Explore** can display VMCP binary data.

To produce the Data Export menu:

- Click **Tools > Data Export**.

Main menu features are explained in side bar.



The **START** icon is used to start a playback.

Note: You may need to remove (deactivate) one or more of your installed interfaces (e.g. Serial Output) to make this replay feature work properly, if you are on a different computer than the one used for data collection.

The Data Export Control menu

The screenshot shows the 'Data Export' dialog box with the following settings and callouts:

- Raw file name:** Points to the 'Data set' field containing the path 'Y:\DATA\Vessel\Braarud\tygve06-02-03\'. A 'Browse...' button is next to it.
- Export format:** Points to the 'Export files' section where 'ASCII format' is selected with a checked checkbox. Other options include 'Corrected NDP Binary', 'Averaged NDP Binary', 'Depth Averaged ASCII', 'Per Depth Averaged ASCII', and 'Adjust GPS Time'. A 'Separator' dropdown is set to a comma (',').
- If ASCII is to be used as export format, you must define a delimiter (separator):** Points to the 'Separator' dropdown.
- New file name:** Points to the 'Save As:' field, which contains the same path as the 'Data set' field. A 'Browse...' button is next to it.
- If Corrected NDP Binary is to be used as export format, you must select a Correction method:** Points to the 'Correction method' section. Under 'Vessel speed correction', 'Auto (BT then DGPS)' is selected. Under 'Compass correction', 'Normal (ENU)' is selected. A 'Quality threshold' field is set to '20'.
- Compass correction is either earth coordinates (East-North-Up) or none (i.e. relative to vessel):** Points to the 'Compass correction' section.
- Include Time averaging:** Points to the 'Time Averaging' section where 'Interval (s)' is set to '5'. 'Distance (m)' is set to '10'. 'Export', 'Done', and 'Cancel' buttons are visible.
- Include Profile averaging:** Points to the 'Profile Averaging' section where 'Water Column' is selected. 'Depth (m)' is '10', 'Offset (m)' is '0', 'From #' is '1', 'Through #' is '32', and 'Suppress SNR' is '15'. 'Cell Range' and 'Profile Range' are unselected.
- Calibration settings for the file:** Points to the 'Calibration' section where 'Heading Offset' is '1.5' and 'VM Scaling' is '0.995'.
- Select which profiles to use (interval definition):** Points to the 'Profile Range' section with 'First' set to '1' and 'Last' set to '49'.

Cut off limit in bottom tracking or auto correction mode. In Auto mode the system will fail up to a "slips" number of times before switching to Aux sensors. Slips is set up in Calculation Corrections.

Automatic Startup

To make SurveyVM™ start automatically, do the following:

- 1 Place a copy of the configuration file you plan to use into the SurveyVM™ directory.
- 2 Use the right mouse button to drag the Survey icon to the Windows NT Start-up folder, and select **Create Shortcut Here** when you let go of the mouse button.
- 3 Right click the shortcut icon you just created and select **Properties**.
- 4 On the **Target** line, place the cursor at the end of the line and add the text

```
xxx.rcf
```

 where `xxx.rcf` is the name of your configuration file.
- 5 To make the system start when the software is opened, insert `-s` in the target line.

Hardware Setup

The software settings described in *Chapter 3* are all only valid in the software. This means that they can be changed and reprocessed in postprocessing. The most important settings to get right are those that are sent to the instrument itself. These values cannot be changed in retrospect.

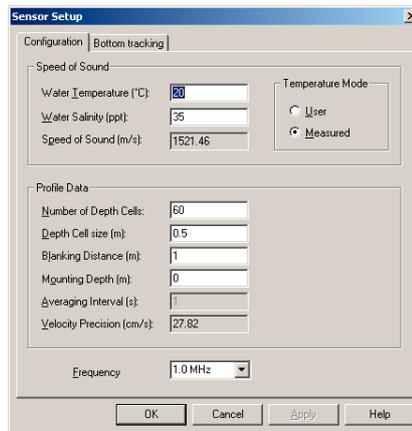
All of these values are found in the **Sensor Setup** menu, which consists of two tabbed panes – viz. **Configuration** and **Bottom tracking**.

The configuration pane sets up the following:

- **Speed of sound.** This is calculated from the temperature of the water at the head and the salinity of the water. The VMCP contains a temperature sensor which reads every second. The Water salinity is measured or estimated by you. As a guideline the open ocean tends to have a salinity value of approximately 35 ppt, bracken water may be in the region of 20 ppt, and fresh water is approx. 0–5 ppt.

If you know that there is a difference between the temperature measured at the head and the temperature lower in the water you may set the temperature to a specific value.

The **Sensor Setup Configuration** menu.
See text for menu details.



To set the temperature to a specific value:

- 1 Click **Sensor Setup** and make sure the **Configuration** tab is in front.
- 2 Key in the temperature in the **Water Temperature** field.
- 3 Select **User** as **Temperature Mode**.

If you know the speed of sound, you may decide to adjust the salinity and user temperature to achieve the correct speed of sound.

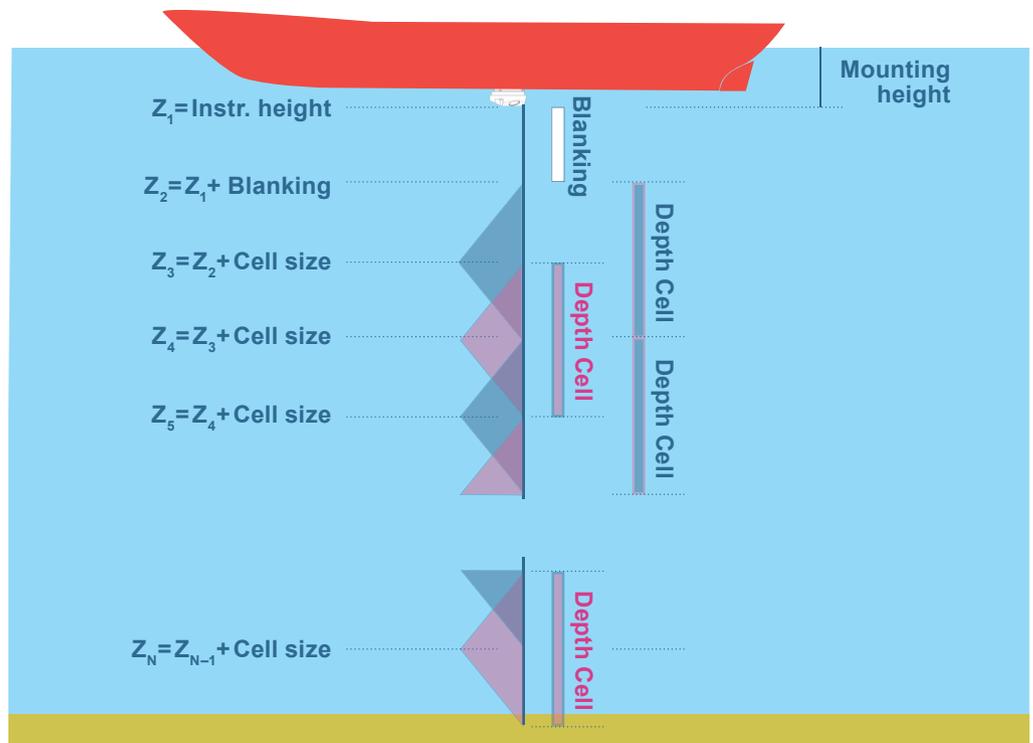
Profile Data, We recommend that you use discretion with these parameters. There is little point in measuring currents below the sea bed or further than the range of the instrument. The product **Number of cells × cell size** gives

the measurement range, after blanking. In the above diagram the range is $60 \times 0.5\text{m} = 30\text{m}$.

The user can choose up to 127 cells. Blanking distance is the period of time set by the user between the end of the transmission pulse and the start of the received signal return. Blanking is required to allow the transducers to return to their full receiving potential.

Mounting depth. This is the depth from the water surface to the front face of the head. This value adjusts the depth values on the screen to make them true depth rather than relative to the head.

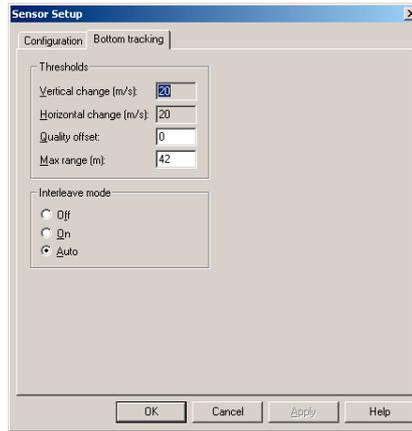
An illustration of some of the terminology used. The product of the **No. of Cells** and the **Cell Size** gives the measurement range, after blanking.



The Bottom tracking pane allows the user to set some parameters to optimize the bottom tracking part of the system:

- **Quality offset** is a figure which sets the quality value where the head stops sending bottom track data and indicates it is not valid. This parameter can be set to zero as the software also has a feature in the corrections window of calculations, that can be changed in post processing. This value cannot be changed in post processing.

The **Sensor Setup** for **Bottom tracking** menu. See text for menu details.



- **Max range.** If the greatest depth is known, this value can be set to a little more than that depth. The system will only look for the bottom out to the set depth. If this value is less, then the system may be able to schedule another ping in the time window, which in turn will improve the data quality.
- **Interleave mode.** Bottom tracking requires a reasonably large cell size. If you specify a cell size smaller than the size demanded by the system, this will cause the system to operate with two cell sizes – one as specified by the user and the other specified for bottom tracking. You will not see the difference other than the quality of the data being slightly reduced due to fewer pings. Raising the averaging time will compensate for this. If you decide not to use bottom track, there is no point in having this interleave mode in action and the user can switch the mode off. In automatic mode the interleave will be activated at cell sizes less than 0.5 m for the 1MHz system and at cell sizes less than 1 m with the 600 kHz system. To indicate that interleave is active, the status data bit 5 will become 1.

Correction

The VMCP measures the velocity of the vessel and the water combined. If Raw data is selected instead of corrected, the current sticks will reflect the velocity of the vessel through the water rather than the water velocity. In some circumstances this information is useful. The Serial output NMEA format VDVHW gives the vessels speed through the water, often used as a navigational aid. However most users are most interested in seeing the true water velocities below the vessel. To get these a correction must be applied to remove the motion of the vessel.

The motion of the vessel can be detected in one of two ways;

- **Auxiliary sensory** using the DGPS system and gyro/compass. In this case the quality of the GPS/gyro plays a significant role in the correction and therefore the data quality. Data produced in this mode is usually satisfactory when the

vessel sails in reasonably stable courses.

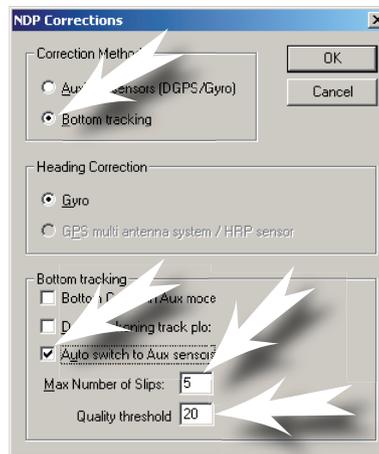
- **Bottom track.** Using the bottom track correction, the correction is applied within the same acoustic ping. This simplifies the correction process and eliminates any errors due to time differences between the external sensors and the VMCP sampling. This shows itself as better information when the vessel changes course.

In general, bottom tracking should be better than the auxiliary method, however if the bottom quality falls due to an acoustically absorbent bottom or the depth becoming greater than the range of the instrument, the system can be made to automatically switch to the auxiliary sensors.

To set the system to automatically switch to auxiliary sensors when bottom tracking fails:

- 1 Click on **Calculations > Corrections.**
- 2 Activate **Bottom tracking.**
- 3 Activate **Auto switch to Aux sensors.**
- 4 Key in the **Max Number of Slips** (the number of times the bottom tracking may fail) you will tolerate before the system should switch to the other correction method. When the system switches to **Auxiliary corrections**, the sticks become yellow.

The **VM Corrections** menu (**Calculations > Corrections**) allows you to set up the system to automatically switch to other correction methods when bottom tracking fails.



A bottom track failure is defined by the quality value of any beam falling below the quality threshold value (default value is 20).

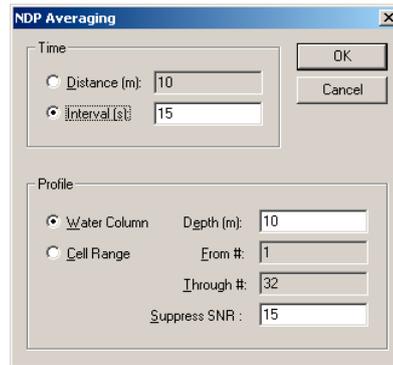
- 5 Adjust this value if you see that the local conditions are such that good data is available with a lower quality.

If you have both a multi-antennae heading system (Seatex200) and a gyro installed, you can choose which system to use in the heading correction frame. Modern GPS-GYRO systems use standard NMEA HDT formats which the system interprets as a gyro.

Averaging

Data samples are sent from the sensor head to the computer every second. This is not adjustable, and needs to come as often as possible as correction takes place in the computer, not in the head.

The **VM Averaging** menu (**Calculations > Averaging**) allows you to set up the system to average the acquired data to reduce the noise in the measurement.



However, it is necessary to apply time averaging to the samples to remove noise elements from the individual samples. The recommended time is 20s, but with larger cell sizes it is possible to considerably reduce this time. Very low current speeds may require larger averaging periods than higher current speeds. Too low averaging often results in current direction being unstable.

The display will update once every averaging period. Averaging can be adjusted in the Averaging window of the Calculations menu and can be set either to a time interval or a travel distance.

Averaging over the depth profile is described in *Chapter 3*.

When You Put the Transducer In and Out of the Water

When you pull the transducer out of the water, then put it back in, you will sometimes change the transducer mounting angle offset. Transducers mounted on some circular pistons are subject to large changes in the offset angle. Even rigid mounts can change the angle a small amount. When you do this, pay close attention to the calibration heading offset. It may be necessary to recalibrate every time you put the transducer back into the water, depending on the type of mount you use.

CHAPTER 6

Checking Out Your System

Verifying the VMCP interface

To check the system is correctly connected and operational click the start button. If you receive an error message, check the configuration is correct and try again. If error messages still appear the following fix the problem.

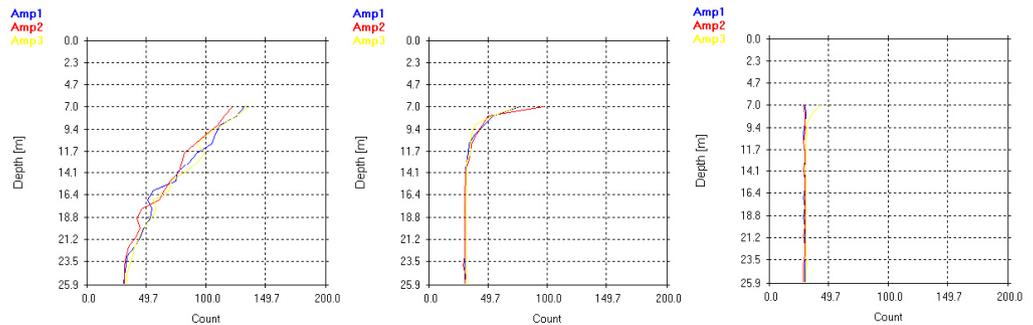
Specifically, we recommend that you check the following:

- Check that the VMCP serial cable is connected properly to the computer.
- Check that the VMCP interface is configured to use the correct COM port and that the communications parameters are set properly for the VMCP (i.e. 9600 baud, no parity, 8 bits, 1 stop bit, no flow control).
- Check the serial interfaces by sending data from one COM port to another. Connect two COM ports with a serial cable consisting of a standard cable (straight-through wiring, pins on one end, sockets on the other), a gender changer and a null-modem adaptor (the null modem adaptor crosses signal wires 2 and 3). Run two instances of HyperTerminal (the terminal program that comes with Windows), and set each for the appropriate COM ports and the same communications parameters. What you type in one window should then show up in the other. Alternatively, short pins 2 and 3 on a serial cable plugged into a COM port and run a single instance of HyperTerminal. Ensure that HyperTerminal is not set to echo characters locally. Then you will see characters echoed back to you when the cable is connected and you will not when it is removed.
- To check the VMCP, click on **Settings > Terminal emulator** and click **Break**. On successful communication a welcome message with the firmware version will appear on the screen.

- If you suspect a noisy environment is causing data errors, you could consider replacing the serial cable with a higher quality cable (i.e. shielded) or you could lower the baud rate. To change the baud rate settings in the VMCP, select **Settings > Change baudrate**.

Verifying the VMCP is in the water

Signal strength for a 1.5 MHz. A) Left: normal, B) Middle: VMCP is still inside the thrust tube, but in the water, C) VMCP is inside the thrust tube and above the water line.



In installations in which the VMCP can be lowered or raised, you can verify the VMCP is in the water by checking the signal strength. Click **View > Profile Plot** and select **Signal Strength**. Your signal strength should look like the left panel in the above Fig. If you are in shallow water, you may see a peak associated with the bottom echo.

Testing Navigation Interfaces

You can test individual navigation interfaces by removing all other interfaces from Survey. Click **Communication > Interfaces...**. One at a time, click on each interface except the one you want to test, and click the **Remove** button. Be sure to remove the VMCP interface too. Set your navigation device to send out its data and click the Survey **START** button. The data from your navigation device should soon appear, decoded, in the **Auxiliary Sensors** pane.

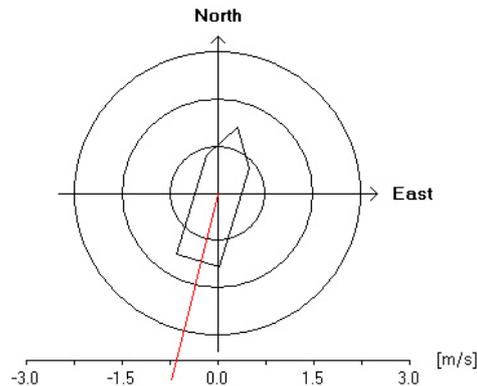
If you have a text file with navigation data, you can test the interface without having access to the device itself. Configure **HyperTerminal** to use a delay between lines that is the same as your navigation device (i.e. 1000 ms for a 1-s interval). Then send the navigation data as a text file. You may do this with a cable consisting of a standard cable (straight-through wiring, pins on one end, sockets on the other), a gender changer and a null-modem adaptor.

You can use the same procedure outlined in *Verifying the VMCP Interface* to monitor the Serial Output COM port (*Set Hyperterminal for the VMCP COM port...*).

Calibration Sanity Check

The VMCP scaling corrects for sound speed errors and hull-induced flow effects. Because both of these are normally small, the correction should be between 0.9 and 1.1 – ideally between 0.98 and 1.02.

Example of a “RAW” current display, i.e. when the heading offset includes correction only for installation offsets, but not compass offsets.



You can detect small errors in your calibration parameters by inspecting the stick plots:

- If you see a consistent current to the right or left of the ship track, suspect a small error in the heading offset. If you see a current that tends to follow the direction (or opposite the direction) of the ship, suspect an error in the VMCP scaling.
- If you have a large error in either factor, you will see a large error in the readings that should be quickly apparent. For example, if your display shows strong currents across the ship track, but the ship’s compass lines up with the course track, suspect a large error in your calibration, or that profile averaging includes the bottom.

In installations in which the navigation system provides compass readings already corrected to true north, your heading offset angle should reflect primarily the transducer mounting angle offset. You can quickly check this offset in the **Current** display. When you click the **RAW** button, the next **Current** display will show you the uncorrected current. This current should point opposite the direction of the ship (see the above Fig.).

The Bottom track can be used as a second sanity check. By turning on the Dead reckoning option in the Correction menu, a track will be plotted next to the GPS track. The two tracks will, over time, drift from each other, but if the Bottom track is of good quality the two should follow each other. Adjusting the offset will move this track port or starboard.

CHAPTER 7

Maintenance

Note: To clean the VMCP, use a high-pressure hose or a hard brush. The transducers will tolerate being painted with a non-copper based antifouling paint.

Mechanical Maintenance

The VMCP sensor head should be periodically cleaned to remove marine growth, which could otherwise block the acoustic pulses.

It is possible to download new firmware and software from the Nortek website <http://www.nortek-as.com>. This will include all the latest improvements to the hardware and functionality of the system. To check which version of firmware you have click **Settings** > **Terminal** emulator and click the **Break** button. We strongly advise upgrading as often as possible, as this system is still under heavy development and is constantly improving.

Upgrading the Firmware

By the term *firmware* we are referring to the internal software of the VMCP transducer system, as opposed to the software running on a PC and described in this manual.

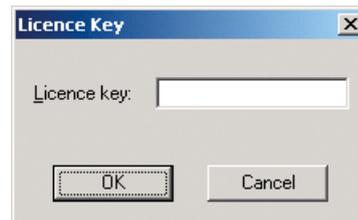
When you purchase a brand new VMCP from the factory, the transducer has a firmware version matching the PC software. Hence no firmware upgrade will be needed before you start using the VMCP.

However, new functionality (and in rare cases bugfixes) is likely to be offered in the future, requiring that the firmware is upgraded. Announcement of new firmware is posted on our web site at <http://www.nortek-as.com/support.php>. You will need to register to get access, but access is otherwise free of charge.

To do a firmware upgrade:

- 1 Go to <http://www.nortek-as.com/support.php>, register if this is the first time, otherwise log into the **User Room**, click on **Software&Firmware** and download the new firmware file.
- 2 Connect the unit to your computer and start the SurveyVM™ software.
- 3 Click on **Settings > Firmware Upgrade**, navigate to the downloaded firmware file and select it.
- 4 You will now be prompted to key in a license key:

The License Key dialogue box will appear when attempting to upgrade the firmware.



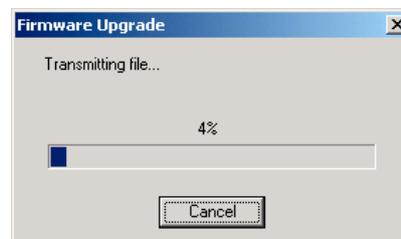
Note! The license key is based on a specific transducer serial number. Hence it applies to one specific VMCP only. It cannot be used to upgrade the firmware of a VMCP with a different serial number.

The license key can be found on the software CD that accompanied your AWAC. If you cannot locate it, contact Nortek AS for a new license key.

Bugfix-releases are free of charge and can be installed using the accompanying license key. However, upgrades including new functionality are, in general, not free of charge. The license key that accompanied your VMCP will therefore not work with such new versions. Contact Nortek AS if you would like to upgrade to new functionality when available.

- 5 Enter the license key and press OK to start downloading the file into the instrument.

This will produce the following box:



To ensure that the firmware does not become corrupted because the download transmission failed during the download process, the VMCP runs a check on the received file before it is allowed to replace the existing firmware.

Once verified as valid, the following dialogue box will appear ...



... just to warn you that any data stored internally on the VMCP will be erased to avoid inconsistencies. In other words, transfer data that you would like to retain to your PC before you upgrade the firmware.

Support

If this manual doesn't answer your questions satisfactorily, the Nortek website has a Vesselmount discussion group for general inquiries, otherwise send an e-mail to inquiry@nortek.no.

APPENDIX 1

Background Information

How It Works

Current sensors mounted on a ship measure the velocity relative to the ship. *Vessel Mounted Current Profilers* are current profilers that are mounted on a vessel that has a net average motion. In contrast to a stationary current profiler, such a system will measure the sum of the vessel velocity (\mathbf{U}_v) and the currents ($\mathbf{U}_c(\mathbf{z})$):

$$\mathbf{U}_{\text{VMCP}}(\mathbf{z}) = \mathbf{U}_c(\mathbf{z}) + \mathbf{U}_v$$

where bold face indicates vector quantities.

To calculate the currents, it is necessary to subtract the boat velocity from the measured water velocity. This process takes place in the program called **SurveyVM™** and requires information from the ship heading (gyro) and navigation system (GPS).

The program also includes an alternative option which utilizes a bottom tracking algorithm to estimate the boat velocity. In the bottom track algorithm, the position of the bottom is first identified by analyzing the acoustic scattering strength and the Doppler shift then calculated from the area around the bottom. This approach works well if the bottom is acoustically distinct from the water. It does not work well if the bottom is not in sight (deep water) or if the bottom is acoustically indistinct from the water. This is especially the case for areas with high levels of suspended sediments, such as flooding rivers, high velocity areas with fine sediments, and around ongoing dredge operations.

Ship Generated Flow Fields

All ships induce flow around their hulls. The magnitude of this field is a function of the ship size and 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 boat than it is directly below the hull. The magnitude of the flow field can be analyzed by looking for persistent vertical gradients in the velocity data.

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 part of true current regime but an artifact of the ship induced flow field.

When the VMCP is mounted close to the bow or to the stern, the VMCP will show a net vertical velocity close to the hull. The vertical velocity measured by a tilted VMCP is typically a constant fraction of the horizontal velocity; gradients in the vertical velocity are usually the result of ship-induced flow.

Ship induced motion is usually a bigger problem as the ship grows larger, the relative water depth becomes smaller, and the ship becomes more bulky (less “classic” hull structure). Ship-induced flow is usually not a significant problem on smaller vessels or for VMCPs mounted over the side.

Time Settings and Time Tags

SurveyVM™ attempts to get time from the GPS data. It uses this time to set the clocks in both the PC and the VMCP. Some navigation interfaces do not provide the GPS time. In this case, **SurveyVM™** uses the PC time to set the VMCP time.

When recording, the software time-tags and records all raw data coming in over every serial port that has been installed in the interface menu. Note that settings in the **VMCP Averaging** and **VMCP Corrections** dialogues apply to the display views and serial data output only. The recorded data files always contain raw (uncorrected) data to ensure maximum reprocessing possibilities.

APPENDIX 2

Data Formats

The system can output data in either binary or ASCII format. Both binary and ASCII formats are available for output over the serial ports. VMCP data written to disk is always stored in binary format. Data written to disk for auxiliary sensors is in ASCII format.

The **SurveyVM™** software and the VMCP instrument itself use identical data file and serial output formats for VMCP data. The difference in content is that the VMCP outputs raw current velocity data while the **SurveyVM™** software outputs velocity data corrected for vessel motion and with some additional vessel related data included.

Note that when interfaced to a computer running the **SurveyVM™** software no data request commands are required by the external device that receives VMCP data. The software outputs ASCII or binary VMCP profiles automatically when collected. The output rate is determined by the VMCP averaging interval. Also, note that the output over the serial port contains profile records only (i.e. profile header and profile data). The configuration records are not output over the serial port.

The available data output formats are described in detail below.

ASCII Format

The ASCII data output format contains data from one VMCP profile, including both header information and profile data. The information contained in the header (first four lines) is broken down by line below.

Header line 1:

- Field 1:** data type (internal use)
- Field 2:** system serial number (“4025”)
- Field 3:** profile number
- Field 4:** year
- Field 5:** month
- Field 6:** day
- Field 7:** hour
- Field 8:** minute
- Field 9:** second
- Field 10:** number of beams
- Field 11:** System type 3=600kHz, 4=1MHz
- Field 12:** temperature mode (0=user, 1=measured)
- Field 13:** orientation (0=down, 1=up, 2=side)
- Field 14:** coordinate system (0=beam, 1=XYZ, 2=ENU)

Header line 2:

- Field 1:** number of cells
- Field 2:** cells size (in cm)
- Field 3:** blanking distance (in cm)
- Field 4:** averaging interval (in seconds)
- Field 5:** number of pings in this profile

Header line 3:

- Field 1:** mean heading (in 0.1°),
- Field 2:** mean pitch (in 0.1°),
- Field 3:** mean roll (in 0.1°),
- Field 4:** mean temperature (in 0.01°C),
- Field 5:** mean pressure (in 0.01 dBar),
- Field 6:** std heading (in 0.1°),
- Field 7:** std pitch (in 0.1°),
- Field 8:** std roll (in 0.1°),
- Field 9:** std temperature (in 0.01°),
- Field 10:** std pressure (in 0.01 dBar),
- Field 11:** sound speed (in 0.1 m/s)

Header line 4:

- Field 1:** GPS coordinate system (0=geog; 1=map),
- Field 2:** GPS latitude (in 0.0000001°) or northing (in 0.01 m)
- Field 3:** GPS longitude (in 0.0000001°) or easting (in 0.01 m)
- Field 4:** vessel north speed (in 0.01 m/s)
- Field 5:** vessel east speed (in 0.01 m/s)

- Field 6:** Raw velocity (in 0.01 m/s)
- Field 7:** Raw Direction (in 0.1°),
- Field 8:** Correction mode (0=DGPS; 1=Bottomtrack)
- Fields 9–12:** system variables

The profile data is presented in a tabular format (starting with line 5). The table has a total of 10 columns, and 1 row for each depth cell.

- Column 1:** depth cell number
- Column 2:** corrected velocity data (Veast) in mm/s
- Column 3:** corrected velocity data (Vnorth) in mm/s
- Column 4:** corrected velocity data (Vup) in mm/s
- Column 5:** standard deviation data (SD beam 1) in mm/s
- Column 6:** standard deviation data (SD beam 2) in mm/s
- Column 7:** standard deviation data (SD beam 3) in mm/s
- Column 8:** amplitude (signal strength) data (beam 1) in counts (1 count = 0.43 dB)
- Column 9:** amplitude (signal strength) data (beam 2) in counts (1 count = 0.43 dB)
- Column 10:** amplitude (signal strength) data (beam 3) in counts (1 count = 0.43 dB)

ASCII control characters may optionally be inserted at the start (STX) and end (ETX) of each VMCP profile output. Each line is terminated with Carriage return (CR) and New line (LF) characters.

```
STX = ASCII  2
ETX = ASCII  3
CR  = ASCII 13
LF  = ASCII 10
```

```

<STX>
  16      N4532      110 1998  2 16 13 41 23 3 0 0 1 2<CR><LF>
    50    50    50    5      8<CR><LF>
  1949    0    0    539 3305    0    0    0    0    0 14658<CR><LF>
0 529669251 47824623 395 121 22 24 24 0 163 233 120<CR><LF>
  341 1239 -26 140 101 126 59 34 62 2 0<CR><LF>
1 102 37 -40 50 41 39 154 158 149<CR><LF>
2 34 24 25 37 55 41 150 152 147<CR><LF>
3 -4 14 24 45 45 42 135 137 132<CR><LF>
4 -30 7 50 41 58 41 129 123 120<CR><LF>
5 64 -1 12 47 38 44 117 117 111<CR><LF>
6 23 -61 5 43 60 42 112 107 106<CR><LF>
7 -30 28 -37 34 55 44 102 97 101<CR><LF>
8 -36 45 -56 41 44 46 94 90 88<CR><LF>
9 -7 25 -32 41 43 32 88 81 84<CR><LF>
10 47 -1 21 55 51 43 79 74 79<CR><LF>
<ETX>

```

Example

Extended ASCII format

Header lines 1–3 are as for ASCII output.

Header line 4:

- Field 1:** GPS coordinate system (0=geog; 1=map),
- Field 2:** GPS latitude (in 0.0000001°) or northing (in 0.01 m)
- Field 3:** GPS longitude (in 0.0000001°) or easting (in 0.01 m)
- Field 4:** vessel north speed (in 0.01 m/s)
- Field 5:** vessel east speed (in 0.01 m/s)
- Field 6:** vessel water speed (in 0.01 m/s)

- Field 7:** vessel water speed direction (in 0.1°)
- Field 8:** water speed coordinate system (1=XYZ, 2=ENU)
- Field 9:** correction mode (0=DGPS, 1=bottomtrack)
- Fields 10–14:** system variables

Header Line 5

- Field 1:** BT Velocity X/E(in 0.01 m/s)
- Field 2:** BT Velocity Y/N(in 0.01 m/s)
- Field 3:** BT Velocity Z/U(in 0.01 m/s)
- Field 4:** Range Beam1(cm)
- Field 5:** Range Beam2(cm)
- Field 6:** Range Beam3(cm)
- Field 7:** Quality Beam1
- Field 8:** Quality Beam2
- Field 9:** Quality Beam3
- Field 10:** Status1
- Field 11:** Status 2

Status 1

- Bit 0** Output Format Type (1=NDP Format)
- Bit 1** Pulse Length Filter (Checks the return pulse is not too long)
- Bit 2** Quality Filter (1=on)
- Bit 3** Velocity (Horizontal Filter) Works by not letting the system detect too fast x/y velocities
- Bit 4** Velocity (Vertical Filter) attempts to prevent the system detecting false layers
- Bit 5** Interleave mode
- Bits 6–7** Unused

Status 2

If any of the following are 1 the data is invalid the error byte shows this:

- Bit 0** Pulse Length Error
- Bit 1** Quality Error
- Bit 2** Velocity (Horizontal)
- Bit 3** Velocity (Vertical)
- Bits 4–7** Unused

The profile tabular section (starting with line 6) includes both raw (speed through water) and corrected current velocities.

- Col. 1** depth cell number
- Col. 2** raw velocity data (Vx) in mm/s
- Col. 3** raw velocity data (Vy) in mm/s
- Col. 4** raw velocity data (Vz) in mm/s

- Col. 5:** raw velocity data (Veast) in mm/s
- Col. 6:** raw velocity data (Vnorth) in mm/s
- Col. 7:** raw velocity data (Vup) in mm/s
- Col. 8:** corrected velocity data (Vx) in mm/s
- Col. 9:** corrected velocity data (Vy) in mm/s
- Col. 10:** corrected velocity data (Vz) in mm/s
- Col. 11:** corrected velocity data (Veast) in mm/s
- Col. 12:** corrected velocity data (Vnorth) in mm/s
- Col. 13:** corrected velocity data (Vup) in mm/s
- Col. 14:** amplitude (signal strength) data (beam 1) in counts
(1 count = 0.43 dB)
- Col. 15:** amplitude (signal strength) data (beam 2) in counts
(1 count = 0.43 dB)
- Col. 16:** amplitude (signal strength) data (beam 3) in counts
(1 count = 0.43 dB)

Export format

When exported, ASCII data will be placed in a text file in the following format:

```
%Date,Time,Latitude,Longitude,East,North,VesSpd,VesCrs,Vesdg,VE-001,VN-001,VU-001,
Vel001,Dir001,VE-002, ... ,VE-009,VN-009,VU-009, Vel009,Dir009,BtX,BtY,BtZ,BtE,
BtN,BtU,Dist1,Dist2,Dist3,Q1,Q2,Q3,St1, St2
```

```
01/01/1995,00:00:08.10,-23.565883,-39.626228,-4036038.2,-2618641.0,2.61,2.9,
11.3,0.00,0.00,0.00,0.00,0.0, ... ,0.00,0.00,0.00,0.00,0.0,0.00,0.00,30.58,0.00,
0.00,30.58,271.94,43.42,0.17,165,235,0,91,0
```

(Some data have been removed for clarity)

Binary format

Some users may wish to view/integrate the raw or corrected binary format. This is as follows:

```
typedef struct {
  unsigned char SyncChar; // 0xA5
  unsigned char DataType; // 0x10
  unsigned short Nbytes; // In profile header

  char SerialNumber[10];
  unsigned long ProfileNumber; // From start of data collection
  AdpDateTime ProfileTime; // Of middle of avg interval

  char Nbeams; // 2/3
```

char VertBeam; // 0-NO; 1-YES BT only 2-190 2-600 3-1000
char SensorOrientation; // 0-down; 1-up; 2-side
char TempMode; // 0-User value 1- Measured
char CoordSystem; // 0-Beam; 1-XYZ; 2-ENU
unsigned short Ncells; // # of depth cells in profile
unsigned short CellSize; // in cm
unsigned short BlankDistance; // in cm
unsigned short AvgInterval; // in s

unsigned short Npings; // Averaged in profile
short MeanHeading; // in 0.1 deg
short MeanPitch; // in 0.1 deg
short MeanRoll; // in 0.1 deg
short MeanTemp; // in 0.01 deg
long MeanPress; // in 0.01 db
unsigned char StdHeading; // in 0.1 deg
unsigned char StdPitch; // in 0.1 deg
unsigned char StdRoll; // in 0.1 deg
unsigned char StdTemp; // in 0.1 deg
unsigned char StdPress; // in 0.1 db
unsigned short SoundSpeed; // in 0.1 m/s

unsigned char Status[20]; // System variables (TroubleShooting)
// Status[0] Bottom Velocity X Lo (mm/s)
// Status[1] Bottom Velocity X Hi (mm/s)
// Status[2] Bottom Velocity Y Lo (mm/s)
// Status[3] Bottom Velocity Y Hi (mm/s)
// Status[4] Bottom Velocity Z Lo (mm/s)
// Status[5] Bottom Velocity Z Hi (mm/s)
// Status[6] Beam Range 1 Lo (cm)
// Status[7] Beam Range 1 Hi (cm)
// Status[8] Beam Range 2 Lo (cm)
// Status[9] Beam Range 2 Hi (cm)
// Status[10] Beam Range 3 Lo (cm)
// Status[11] Beam Range 3 Hi (cm)
// Status[12] Quality 1 (range 0-255)
// Status[13] Quality 2
// Status[14] Quality 3
// Status[15] Programmed Status
// Status[16] Filter/Error Status
// Status[17] Not Used
// Status[18] Not Used
// Status[19] Not Used

```
} u;
} AdpProfileHdr;
```

hi/lo refers to hi byte, lo byte (int16)

Status Byte

Bit Filter

0 Output Format Type (1=NDP Format)

1 Pulse Length Filter (Checks the return pulse is not too long)

2 Quality Filter (1=on)

3 Velocity (Horizontal Filter) Works by not letting the system detect too fast x/y velocities

4 Velocity (Vertical Filter) attempts to prevent the system detecting false layers

5 Interleave mode

6 Unused

7 Unused

and the error byte shows this:

Bit Filter

0 Pulse Length Error

1 Quality Error

2 Velocity (Horizontal)

3 Velocity (Vertical)

4 Unused

5 Unused

6 Unused

7 Unused

followed by the data for the cells

```
////////////////////////////////////
// ADP profile data, total size = 4*nCells*nBeams
```

```
typedef struct {
short Vel[ADP_MAX_CELLS][ADP_MAX_BEAMS]; // in 1 mm/s
unsigned char Std[ADP_MAX_CELLS][ADP_MAX_BEAMS]; // in 1 mm/s
unsigned char Amp[ADP_MAX_CELLS][ADP_MAX_BEAMS];
} AdpProfile;
```

NMEA formats

VHW. The NMEA format uses the VHW – water speed and heading – message string defined in the NMEA 0183 specification.

Format:

\$VDVHW,Heading,T,,,SpeedKnots,N,SpeedKPH,K*Checksum<CR><LF>

Heading	Heading relative to north (from gyro)
SpeedKnots	speed through the water along ship in knots
SpeedKPH	speed through the water along ship in km/h

VTG. The NMEA format also uses the VTG – Ground speed and heading – message string defined in the NMEA 0183 specification to transmit the bottom track data. Both messages are activated by selecting serial string in the communication / interfaces section.

Format:

\$VDVTG,GroundCourse,T,,,M,SpeedKnots,N,SpeedKPH,K,a<CR><LF>

Ground Course	Course over ground relative to North
SpeedKnots	speed over the ground in knots
SpeedKPH	speed over the ground in km/h

To activate this message a format with VTG must be selected in the DGPS setup. Both messages are activated by selecting serial string in the communication / interfaces section.

VDR. The NMEA format also uses the VDR – Set and Drift – message string defined in the NMEA 0183 specification to transmit the corrected current speed and direction. This value is the same value that is sent to the Stick plot, i.e. averaged over time and profile.

Format:

\$VDVDR,DirectionTrue,T,,,M,Current SpeedKnots,N,a<CR><LF>

VDVDR	
DirectionTrue	True Current direction in degrees
SpeedKnots	Current Speed in Knots

Note! The vector in NMEA format point towards the current, unlike the SurveyVM™ software which points away from the current.

Note! Nortek has not applied for NOLAS approval and the software & equipment described in this manual should therefore **not** be used for navigation.

Extra Features – Command Line Switches

The below features can be activated by applying the appropriate switch in the properties box. Do as follows:

- 1 Place a copy of the configuration file you plan to use into the SurveyVM™ directory.
- 2 Use the right mouse button to drag the Survey icon to the Windows NT Startup folder, and select **Create Shortcut Here** when you let go of the mouse button.
- 3 Right click the shortcut icon you just created and select **Properties**.
- 4 On the **Target** line, place the cursor at the end of the line and add the following:
 - s Startup, the unit will start up when activated
 - b Anchor, the GPS speed is ignored (the vessel is anchored or moored and is not moving).
 - c No sound speed correction, does not correct for the sound speed for depth values.

<filename\$path>.rcf is setup file to be loaded when software is started.

Example: To utilise all of the above features and assuming that the config file has the name and path as shown below, the target line will look like this:

```
-s -c -b c:\My preferences\config1.rcf
```

Tutorials

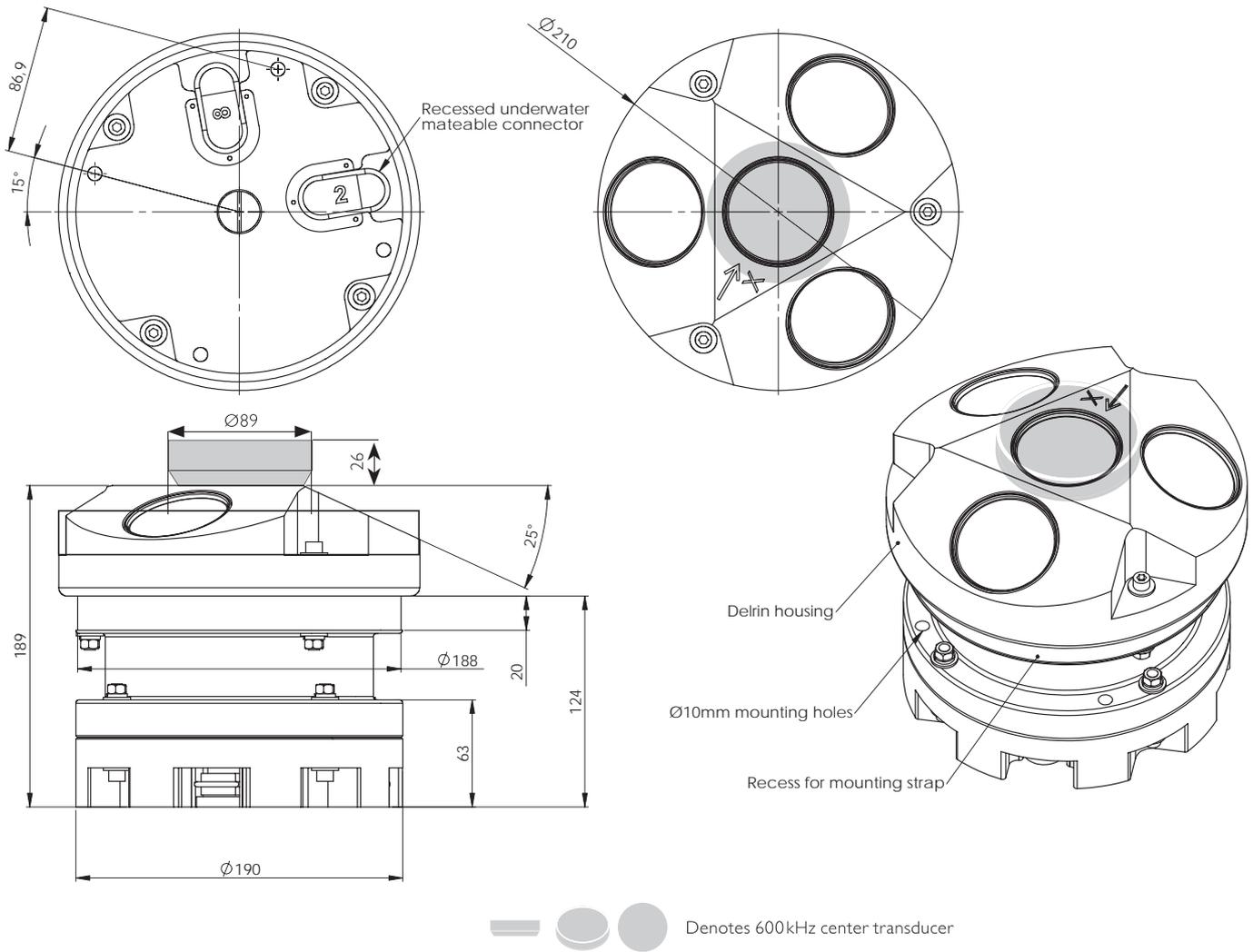
A full course and tutorial can be downloaded from

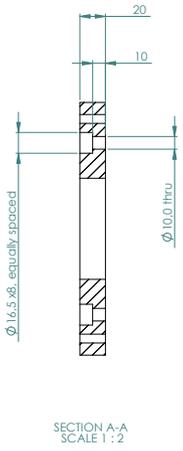
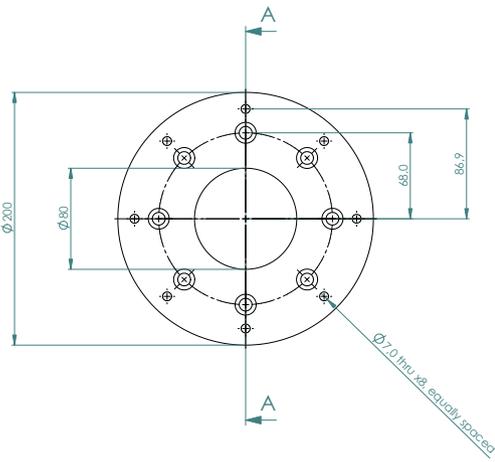
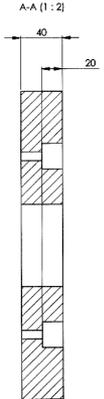
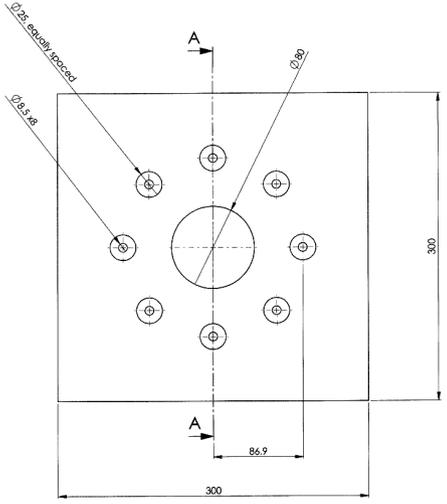
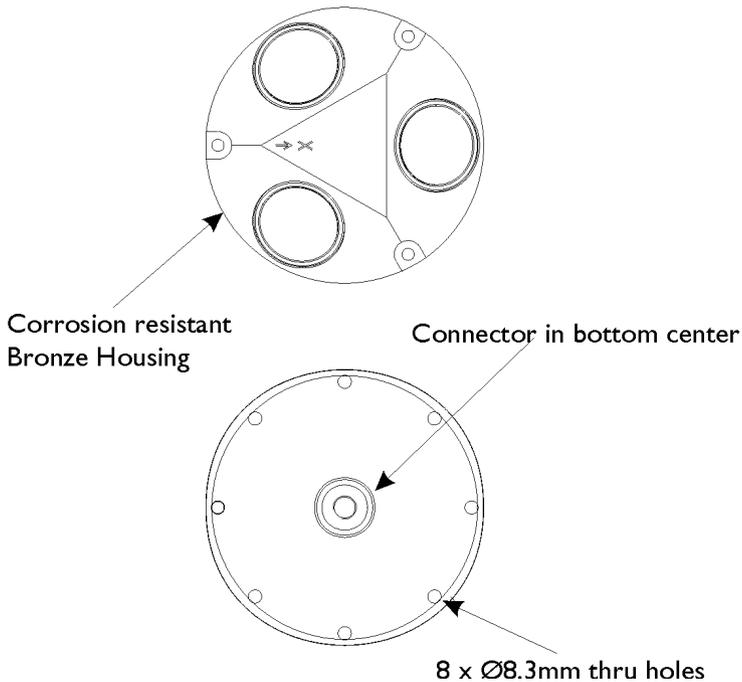
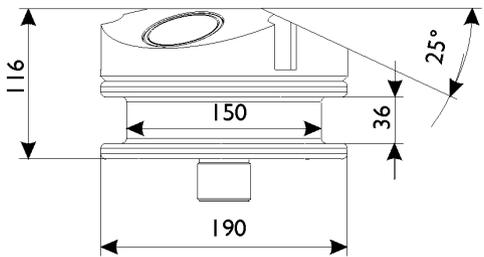
<http://www.nortek.no/support>. You need to register to gain access to the **Manuals and Course materials** section.

APPENDIX 3

Mechanical Drawings

Mechanical dimensions on the transducers used can be found overleaf.





APPENDIX 4

Returning Products for Repair

Before any product is returned for repair you must have obtained a Return Merchandise Authorization (RMA) in writing from Nortek AS.

Copy the Proforma Invoice template overleaf, or make your own, but be sure to include all the information requested in the Proforma invoice.

Also, be sure to include a copy of all shipping and export documents inside the freight box.

Important! Freight insurance on repairs is *not* covered by Nortek AS. You must make sure your goods are properly insured before shipment. Nortek AS is by no means liable if the instrument is damaged or disappear while being shipped to Nortek AS for repair. Likewise, Nortek AS is not liable for consequential damages as a result of instruments becoming damaged or disappearing while being shipped to Nortek AS for repair.

Nortek AS will insure the instrument upon returning the goods to you and invoice you for this, along with the repair- and freight costs.

If the instrument is under warranty repair, the transport and freight insurance from Nortek AS to you will be covered by Nortek AS.

Proforma Invoice



SENDER (Exporter)	
Name:	<input type="text"/>
Address:	<input type="text"/>
City:	<input type="text"/>
Country:	<input type="text"/>
Tel.:	<input type="text"/>
Fax:	<input type="text"/>
Ref.:	<input type="text"/>

RECEIVER	
Name:	Nortek AS
Address:	Vangkroken 2
City:	NO-1351 Rud
Country:	Norway
Tel.:	+4767174500
Fax:	+4767136770
E-mail:	inquiry@nortek.no
Contact:	Jonas Røstad

About the Goods	
Date: <input type="text"/>	No. of Units: <input type="text"/> Weight: <input type="text"/>
Delivery Terms: <input type="text"/>	Customs Account No.: 28605-56
Description of Goods: <input type="text"/>	Origin: NO Value: <input type="text"/>
	Total Value: <input type="text"/>
	Nortek RMA No: <input type="text"/>
Reason for Export: <input type="text"/>	

Date: _____	_____
	Exporter's signature

