

# VECTRINO

VELOCIMETER







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# Chapter 1

## Introduction

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Thank you for purchasing Nortek's Vectrino velocimeter! Your Vectrino has been designed to provide you with many years of safe, reliable service.

The Vectrino is a high-resolution acoustic velocimeter used to measure turbulence and 3D water velocity in a wide variety of applications from the laboratory to the ocean. The basic measurement technology is coherent Doppler processing, which is characterized by accurate data and no appreciable zero offset.

### Getting Started

This guide in combination with the Quick Start guide which is part of the Help function in your Vectrino software, will help you getting started with your Vectrino. As initial preparation for using your new Vectrino velocimeter, we recommend the following steps:

- 1 Verify that you have received all parts (see next page).
- 2 Install the Vectrino software on a computer (see chapter 5, Software).
- 3 Perform a functional test of your new Vectrino (see chapter 7, Test and Verification).
- 4 Mount the Vectrino in accordance with the guidelines (see chapter 6, Mounting Guidelines).

## Contents of Your Shipment

When you receive your Vectrino, the shipping box should contain the following components:



- 1 Transportation and storage case
- 2 Vectrino velocimeter
- 3 External power/signal cable
- 4 Tool kit, Nortek
- 5 USB to serial converter
- 6 Seeding material (bottle of 250 ml)
- 7 AC/DC voltage transformer, 24 V DC
- 8 International kit with AC plugs
- 9 USB memory stick with Vectrino software
- 10 This guide
- 11 Final test check list
- 12 Packing list
- 13 Warranty card

**Note:** If any part of the delivery should be missing, please contact Nortek immediately

# Chapter 2

## Product Specification

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### Mechanical

Vetrino cylinder:	70 mm
Vetrino height:	388 mm
Transport weight:	8 kg
Dimensions	
Transport box:	88 x 27 x 12 cm
Transport and storage box:	88 x 34 x 12 cm
Weight in air:	1.2 kg

### Sampling Volume

Distance from probe:	0.05 m (nominal)
Diameter:	6 mm
Height (user selectable):	3–15 mm

### Echo Intensity

Acoustic frequency:	10 MHz
Resolution:	Linear scale
Dynamic range:	25dB

## Sensors

Temperature:	Thermistor embedded in probe
Range:	-4 °C to +40 °C
Accuracy/Resolution:	1 °C / 0.1 °C
Time response:	5 min.

## Data Communication

I/O:	RS 232. The software supports most commercially available USB-RS 232 converters.
Baud rate:	300–115 200 (user setting)
Max. cable length:	50 m
User control:	Vectrino standard or Vectrino <sup>+</sup> software
Analog outputs:	4 channels standard, one for each velocity component. Output range is 0–5 V, and scaling is user selectable.
Synchronization:	Multiple Vectrinos can be synchronized. Each can operate as either master or slave.

## Multi Unit Operation

Software:	PolySync software (requires license)
I/O:	RS 232–USB support for devices with 1, 2, 4, and 8 serial ports.

## Software (“Vectrino”)

Operating system:	Windows 2000®, or newer
Features :	Instrument configuration Data collection Data storage Probe test modes

## Power

DC Input:	15–48 VDC
Peak current:	2.5 A at 15 VDC (user selectable)
Max. consumption at 200 Hz:	1.5 W

## Connectors

Bulkhead:	Splash-proof connector or MCBH-12-FS waterproof connector
Cable:	Splash-proof or PMCIL-12-MP waterproof

## Materials

Standard model Delrin<sup>®</sup> housing. Stainless steel (316) probe and screws.

## Environmental

Operating temperature:	–4 °C to +40 °C
Storage temperature:	–15 °C to 60 °C
Shock and vibration:	IEC 721–3–2

## Options

Your Vectrino can be shipped with the following components to suit your requirements. For further information, contact Nortek.

- Standard or Vectrino<sup>+</sup> firmware (upgrading to Vectrino<sup>+</sup> is also available as retrofit)
- 4-beam down-looking probe or side-looking probe. Fixed stem or flexible cable
- 12-pin splash-proof connector or Impulse 12-pin underwater connector
- 10, 20, 30 or 50 m cable with your choice of splash-proof or Impulse underwater connector
- Combined transportation and storage cage



# Chapter 3

## Technical Description

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### System Components

#### Probe

The probe is made of titanium and consists of four receive transducers and a transmit transducer. It is mounted either on a fixed stem connected to the main housing through the probe end bell, or on a cable connected to the main housing through the same probe end bell.

#### Transducers

Each of the four receive transducers is mounted inside a *receiver arm*. The transmit transducer is in the centre of the probe. The transducers are covered with hard epoxy.

#### Electronics Modules

The electronics module is located inside the pressure case and consists of a single board with the power transmitter, analog and digital signal processing, power conditioning, and interface circuits.

#### Temperature sensor

The temperature sensor (thermistor) is located inside the probe head.



The two available connectors

## Power and Communication Cable

The power and communication cable is connected to the end bell connector. The cable supplies external DC power (15–48 V) and provides two-way serial communication with an external computer. It also provides four analog outputs (0-5 V DC) for input to an AD converter.

The cable also provides synchronization options when the Vectrino is used as master or slave to synchronize measurements with other Vectrinos and/or other instruments.

**Cable Wiring.** By default, the Vectrino is shipped with a 12-pin connector and cable. The connector type is either a splash-proof connector or an MCBH-12-FS waterproof connector. The Vectrino power lines are diode protected, hence, you do not have to worry about wiring the Vectrino power backwards. If you do, it will not damage your instrument. The pin-out is shown in the side bar.

Pin No.		Function
1	A	Analog out 1
2	B	Analog out 2
3	C	Analog out 3
4	D	Analog out 4
5	E	Gnd (analog)
6	F	Sync-
7	G	Sync+
8	H	Gnd (digital)
9	J	Tx
10	K	Rx
11	L	Gnd (power -)
12	M	Power + (15–48V)

The pin-outs for the connectors.

# Chapter 4

## Functional Description

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This section briefly describes some of the underlying principles that control the operation and application of the Vectrino velocimeter.

**The Vectrino has two modes of operation:**

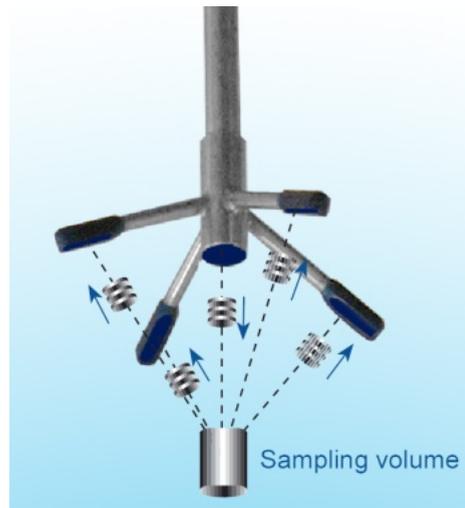
- **Command mode.** In command mode the Vectrino is ready to accept your instructions.
- **Data Acquisition Mode.** The Vectrino enters data acquisition mode when you click any of the **Start** commands (e.g. **Start Data Collection**) in the Vectrino software. The Vectrino collects data without interruption.

### Doppler Theory

Sound does not reflect from water, but from particles suspended in the water. These particles are typically suspended sediment or seeding particles, and move with the same average speed as the water. The velocity that is measured is consequently the velocity of the water.

The Vectrino uses the Doppler effect to measure current velocity. The Doppler effect is the change in pitch that is heard when either the source of a sound or the listener is in motion. When you hear a vehicle with a siren, the pitch is higher when the vehicle is heading towards you, and lower when it is going away. The change in pitch tells you how fast the vehicle is moving.

The Vectrino transmits short pairs of sound pulses, listens to their echoes, and, ultimately, measures the change in pitch or frequency of the returned sound.



**The Vectrino velocimeter operating principle:** A pulse is transmitted from the centre transducer, and the Doppler shift introduced by the reflections from particles suspended in the water, is picked up by the four receivers.

## Data Handling

The Vectrino software saves data in binary files, which are easily converted to ASCII format files, using the conversion module in the software.

- The \*.hdr file is a self-documented table. Please note that this file contains a detailed data format description of all files that are generated.
- The \*.dat file contains velocity data at the full sample rate.

ASCII files are easily imported into most spreadsheets and data analysis programs. For turbulent data analysis, Nortek recommends the use of a specially developed program, ExploreV. You can learn more about this program on our web pages: Go to [www.nortek-as.com](http://www.nortek-as.com), and click your way to **Products** > **Software products** > **ExploreV**.

# Chapter 5

## Software

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This chapter provides you with basic information about the software, installation of the software and its configuration. For further information, about the software, its configuration and use, please see the Help function in the Vectrino software.

### Vectrino software options

The Vectrino software program has been designed to set up and read data acquired by the Vectrino, and is available in two flavors: Vectrino and Vectrino<sup>+</sup>. The latter provides a wider range for some of the settings than the standard version does.

The Vectrino<sup>+</sup> firmware allows data collection rates up to 200Hz, significantly higher than the standard Vectrino firmware which has a performance similar to that of the standard NDV/ADV®, with a maximum output rate of 25Hz.

With Vectrino<sup>+</sup> a parallel receiver will provide you with four times as many samples. The Vectrino<sup>+</sup> also has a separate echo sounder mode for distance measurements.

The standard Vectrino application is shipped with the instrument. For more information about the optional software packages and system integration options, contact your local Nortek representative or Nortek AS. (See our contact information in Chapter 11, Further Information and Help.)

For information about soft- and firmware updates, please visit the support pages on our website regularly.

## Installation

Follow these steps to install the software on a computer running Windows:

Insert the memory stick and run the Setup.exe file.

Follow the on-screen instructions. Accept the default settings.

If prompted to restart your computer, do so to finalize the installation.

## Configurations

Using the enclosed cables, connect the Vectrino instrument to the power and the USB port on your computer, and start the Vectrino software.

To configure the settings of your Vectrino, you can either

select **Data collection** > **Load From Instrument** to read back the current settings from the instrument

or

select **Data collection** > **Edit Configuration** to load the settings from the configuration file.

The **Configuration dialog box** where you can adjust the settings will open.

# Chapter 6

## Mounting Guidelines

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Follow these guidelines when you mount your Vectrino.

### What to consider

- Make sure that there are no obstructions between the sensor and the focal point (sampling volume) located about 5 cm from the transducers.
- Consider the effects of large objects on the flow itself. A rough rule of thumb is that objects disturb the flow as far as 10 diameters away from the object. Flow disturbance is greatest directly downstream in the wake behind the object.
- All acoustic transducers must be submerged during data collection. Operating your Vectrino when the transducers are out of water will not cause any damage, but your data will be meaningless. For side-looking probes, it is possible to collect 2D-data with only the lower receiver arms submerged.
- The best quality is achieved if the main flow direction is perpendicular to the transmit axis. Flow directly into the transmit axis should be avoided.
- Make sure your mounting structure is stable. Small vibrations in the mount can generate large accelerations in the data.

**Note:** When mounting your Vectrino, use the recessions to strap it to the structure. Never use the probe stem as mounting point.



# Chapter 7

## Test and Verification

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Verify that your equipment is working as expected.

### Communication

Check that you have installed the software correctly according to the procedure in chapter 5, Software, and then follow this procedure to test the communication:

- 1 Using the enclosed cables, plug in the AC adapter, and connect the Vectrino cable and USB converter to the USB port on your computer.
- 2 Start the Vectrino software.
- 3 Select **Communication** > **Serial Port**, and specify which port number to use.
- 4 Accept the default baud rate settings (19200 baud), which is also the default baud rate for the instrument.
- 5 Click the toolbar button **Connect**. The Vectrino instrument should reply to the break with an identification string.

### Upgrade baud rate

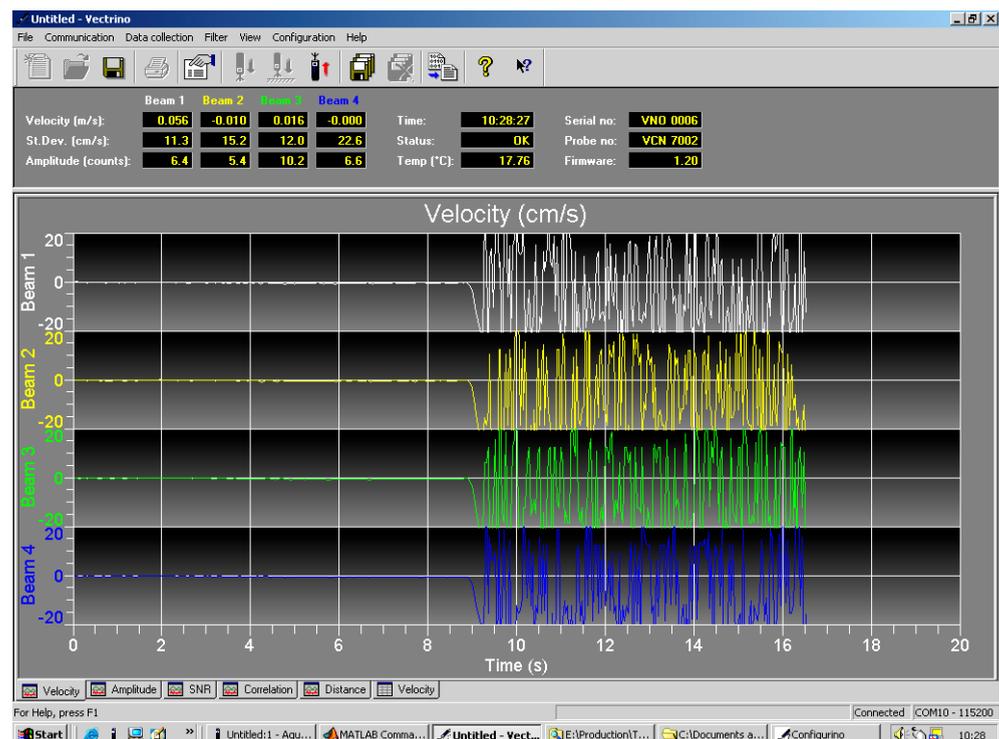
The baud rate settings for transfer of head file and firmware upgrades may differ from those for transmission of deployment setups and for online data collection. The reason is that the former assumes that high transmission rates can be used without problems, i.e. that the cable connecting the computer to the instrument is short.

For the Vectrino a setting of 19200 baud is sensible although a lower setting may be required when using wireless connections. For 200 Hz data collection, a 57.6 kB setting may be required.

You can change the setting if you upgrade in-situ using long cables. The Vectrino verifies the received head file and firmware upgrade files before they are allowed to replace the existing head and firmware files, hence, using the wrong transmission speed will not cause trouble.

## Transducers

- 1 Fill a bucket with water and a little dirt (as sound-scattering material).
- 2 Click **Data collection > Start Data Collection**. While the transducers are in the air, the velocity measurement will look like random noise.
- 3 Immerse the transducers in the water, and observe the velocity, the standard deviation, and the amplitude in counts. Note the change in the graphical view of the velocity when the probe is lowered into the water. In the air the graphs are noisy; in water they should be smooth.



The velocity in water (left part of the graph) and in air (right part of the graph).

**Noisy velocity graphs:** If the velocity graphs remain noisy when the probe is immersed in water, try varying the position of the probe, or add some seeding like dirt or small particles to the water.

## Probe Check

Designed to act as a measurement quality assurance tool, the **Probe Check** function in the Vectrino software lets you inspect the region where the Vectrino makes its measurements by showing how the signal varies with range. You can use it to diagnose and correct problems and to optimize data collection.

**To start the probe check:**

- 1 Make sure the probe is submerged in water.
- 2 Click **Data collection > Start Probe Check.**

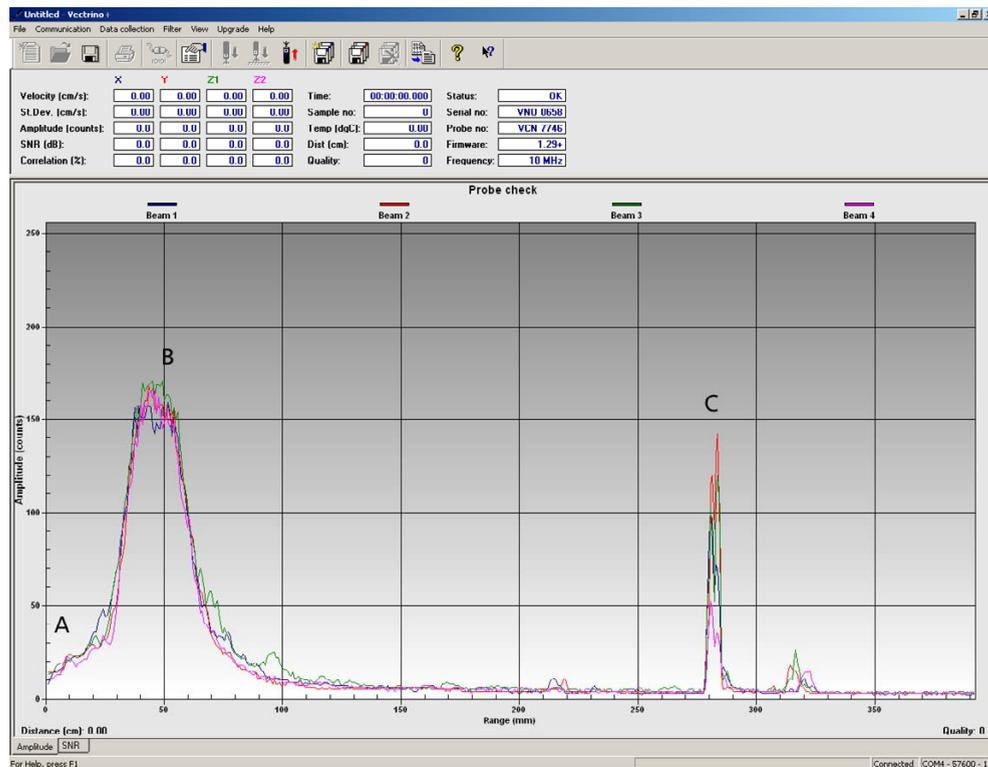
The four colored graphs correspond to each of the four receive beams. Graphs are scaled in distance in millimeters from the transmit transducer, parallel to the transmit beam.

**Signal-to-noise ratio:**

The signal-to-noise ratio (SNR) is defined as follows:

$$SNR = 20\log_{10}\left(\frac{Amplitude_{signal}}{Amplitude_{noise}}\right)$$

Strictly speaking, some noise will always be present, so  $Amplitude_{signal}$  should read  $Amplitude_{signal+noise}$ . However, for SNR values in the magnitude applicable to typical Vectrino situations, the difference is negligible.



**The letters correspond to the following:**

- A** The transmit pulse
- B** The receive volume
- C** The bottom echo

The actual sensing volume is a relatively narrow region within the broad peak indicated by **B**.



# Chapter 8

## Synchronizing Multiple Instruments

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Your Vectrino can serve as master for other Vectrinos, or its sampling can be controlled by other sensors. This comes in handy when you need to use several Vectrinos for a single set of measurements.

**The RS485 standard:** RS485 is a balanced, half duplex transmission standard which allows for communication over long distances in noisy environments.

If you connect a controller to the Vectrino, you can set up a fairly sophisticated system in which the controller can power the Vectrino and provide it with sync pulses to control the sampling accurately. The controller can serve as a storage device.

**Note:** On some older instruments the sync lines are labeled *Sync in* and *Sync out*. These should be treated as *Sync-* (Sync In) and *Sync+* (Sync Out).

Your Vectrino can be synchronized with other instruments via a pair of sync lines. To avoid noise problems and to make cabling easier, the two sync lines are RS485 which is balanced and bi-directional.

The sync lines are labeled *Sync-* and *Sync+*.

### Synchronizing Multiple Vectrinos

- 1 Connect all the *Sync+* lines together and all the *Sync-* lines together. All instruments should share a common ground.
- 2 Select one instrument as the master and the rest as slaves (Input sync) in the software.
- 3 Start data collection in all slaves before starting the master. The slaves will then wait for the first sync pulse from the master before sampling commences.

If you use **Sample on sync**, all instruments should be configured with the same sampling rate.

## Synchronizing From a TTL Source

TTL signal levels can be mixed with the RS485 levels of the Vectrino:

Connect your sync pulse to **Sync+** and connect **Sync-** to a constant voltage, 1.5 volts for instance. This provides a defined transition when the TTL signal changes, which is not the case if you ground **Sync-**.

**RS485 levels:** These levels define the signal the Vectrino reads for Input Sync:

High level:  $\text{Sync+} > \text{Sync-}$  by 200 mV

Low level:  $\text{Sync+} < \text{Sync-}$  by 200 mV

**Noise problems:** If you encounter noise problems, try terminating the **Sync+** line at the TTL input by connecting a 120 ohm resistor in series with a 1nF capacitor between the **Sync+** line and ground. The best solution for external sync is using RS485 as the input/output device.

**Note:** This implies that a Vectrino can operate as a master for a Vector, but the opposite is not possible.

When Vectrino functions as master, the **Sync+** line can be connected to the TTL input and the two systems must be connected so they share common ground.

## How Synchronization Works

*Output Sync* (operating as the master) transmits a pulse on RS485 with a duration of  $40 \mu\text{s}$ . **SyncOut** for Vectrino transmits the pulse by the end of the sampling interval and a single pulse at the beginning of the first sampling interval to start off everything. For other sensors, **SyncOut** transmits a pulse at the middle of the sampling interval.

*Input Sync* triggers on any edge, rising or falling, on RS485. After each trig the input is discarded for the next  $64 \mu\text{s}$ .

# Chapter 9

## Maintenance

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Before you assemble a system that involves custom cables, power supplies or the like, first assemble and test the Vectrino using just the cables and power supply that came with the system. This is the easiest way to get the system up and working. If you encounter problems, you can always return to this setup to confirm that they are not caused by a faulty instrument.

### Preventive Maintenance

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

Clean your Vectrino Velocimeter regularly. Use a mild detergent, and pay special attention to the transducers.

### Corrective Maintenance

Only qualified personnel are allowed to perform corrective maintenance activities. Please refer to the separate service manual or contact Nortek for further assistance.



# Chapter 10

## Upgrading

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### Upgrading Software

**Note:** If you enter the download section without logging in, you will be prompted to log in when you attempt to download a file. If you are not a registered user, simply follow the link to the registration form.

You will find the latest release of the software for your Vectrino at [www.nortek-as.com/support](http://www.nortek-as.com/support). To download the software, log in, and choose **Software Download** in the menu on the left. Then locate the file for your Vectrino in the list, and click to download it.

To upgrade the software, follow the procedure for software installation (see Chapter 5).

### Upgrading Firmware

Firmware refers to the internal software of the instrument, as opposed to the instrument software running on a computer and described in this manual.

When you purchase a brand new instrument from the factory, it contains the latest firmware version, and there is no need to upgrade the firmware.

However, new functionality (and in rare cases bug fixes) is likely to be offered in the future, requiring an upgrade of the firmware. New firmware is posted on our web site at [www.nortek-as.com/support](http://www.nortek-as.com/support). When you upgrade your firmware, make sure you also have the latest version of the software as new versions are often released at the same time.

### To do a firmware upgrade:

**Note:** If you have not registered with us already, you will need to do this first. Click the link **New User** on the right, and fill in the registration form to register.

- 1 Log in at [www.nortek-as.com/support](http://www.nortek-as.com/support).
- 2 Choose **Software Download** in the menu on the left, and download the new firmware file to your computer.
- 3 Click on **Configuration > Firmware Upgrade** in the Vectrino software, browse to the downloaded firmware file and select it.

If you upgrade to the Vectrino<sup>+</sup> firmware, you will now be prompted to enter a license key:

The **License Key** dialogue box will appear when you attempt to upgrade the firmware.



The license key can be found on the memory stick that accompanied your Vectrino<sup>+</sup>. If you cannot locate it, please contact Nortek AS for a new license key.

- 4 If prompted, enter the license key and click OK. If you have the standard Vectrino, simply click OK to start downloading the file to the instrument. This will produce the following box:



To ensure that the Vectrino firmware is not corrupted if the download transmission fails during the download process, the Vectrino runs a check on the received file before it is allowed to replace the existing firmware.

If the firmware file is not accepted, repeat the upgrade process until the firmware file is successfully downloaded.

# Chapter 11

## Further Information and Help

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### Visit [www.nortek-as.com](http://www.nortek-as.com)

At our website, [www.nortek-as.com](http://www.nortek-as.com), you will find technical support, user manuals, and the latest soft- and firmware updates for the Vectrino and our other products, as well as more general information, technical notes and user experience regarding data analyses and related matters.

Our aim is that our users should be able to find any information they may need regarding our instruments and the use of them online. If you are unable to find the information you are looking for, we encourage you to use our forum.

### Nortek's Forum

Nortek's forum on the web is where users from all over the world meet to discuss and share their experience with Nortek's instruments.

If you have comments, questions, application tips, suggestions for improvements, or simply want to learn from others or share your own experience with other users all over the world, we encourage you to register and post to our forum.

## Contact Information

If you need more information, support or other assistance, you are always welcome to contact us by e-mail, phone, or fax.

**E-mail:**            [inquiry@nortek.no](mailto:inquiry@nortek.no)  
**Phone:**            +47 67 17 45 00  
**Fax:**                +47 67 13 67 70

You can also write us at:

**Nortek AS**  
**Vangkroken 2**  
**NO-1351 RUD, Norway**

# Chapter 12

## Returning Your Vectrino for Repair

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### Returning your Vectrino

Before you return a product for repair you must have obtained a Return Merchandise Authorization (RMA) in writing from Nortek AS. You can send your RMA request by e-mail to [inquiry@nortek.no](mailto:inquiry@nortek.no) or by fax to +47 67 13 67 70.

Your shipment must be accompanied by a proforma invoice. You can either copy the proforma invoice on the next page, or make your own, but make sure you include the same information.

Remember to include a copy of all shipping and export documents in the freight box.

### Insurance

We recommend that you fully insure your return shipment in case it is lost or damaged, as Nortek AS does not cover freight insurance on repairs.

Nortek AS is not responsible for instruments damaged or lost in transit. Nor shall we be held responsible for consequential damage as a result of instruments being damaged or lost in transit.

Nortek AS will insure the instrument upon returning the goods to you. We will bill you for the insurance along with the costs for repair and freight.

**For warranty repairs, the transport and freight insurance from Nortek AS to you will be covered by Nortek AS.**

## Customs regulations

The regulations and requirements covering the export and re-import of items sent for repair varies from country to country. In the past, some of our customers have experienced problems because they have failed to provide the proper documentation. If these matters are not managed correctly, you may be charged import duties and taxes for a second time when your instrument is returned to you.

At Nortek we must meet our own country's regulations when instruments are repaired and subsequently returned. This, however, may not be sufficient for your country.

To avoid problems, we strongly recommend that you, as part of your own procedures for handling returns, always check with your customs authorities as to what information, documents etc. they need from you and from us. Then let us know what you need from us by e-mail, fax or mail. We will do our very best to help you.

***NOT A SALE – TEMPORARY EXPORT TO  
NORWAY FOR REPAIR ONLY***

## PROFORMA INVOICE

SENDER (Exporter)	RECEIVER
Name:	Name: NORTEK AS
Address:	Address: Vangkroken 2
City:	City: NO-1351 RUD
Country:	Country: NORWAY
Tel.:	Tel.: +47 67 17 45 00
E-mail:	Fax: +47 67 13 67 70
Fax:	E-mail: <a href="mailto:inquiry@nortek.no">inquiry@nortek.no</a>
Contact:	Contact: Jonas Røstad

### ABOUT THE GOODS

Date:

No. of Units:

Tracking no.:

Weight:

Value:

NORTEK RMA No.:

Reason for Export:

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Exporter's signature

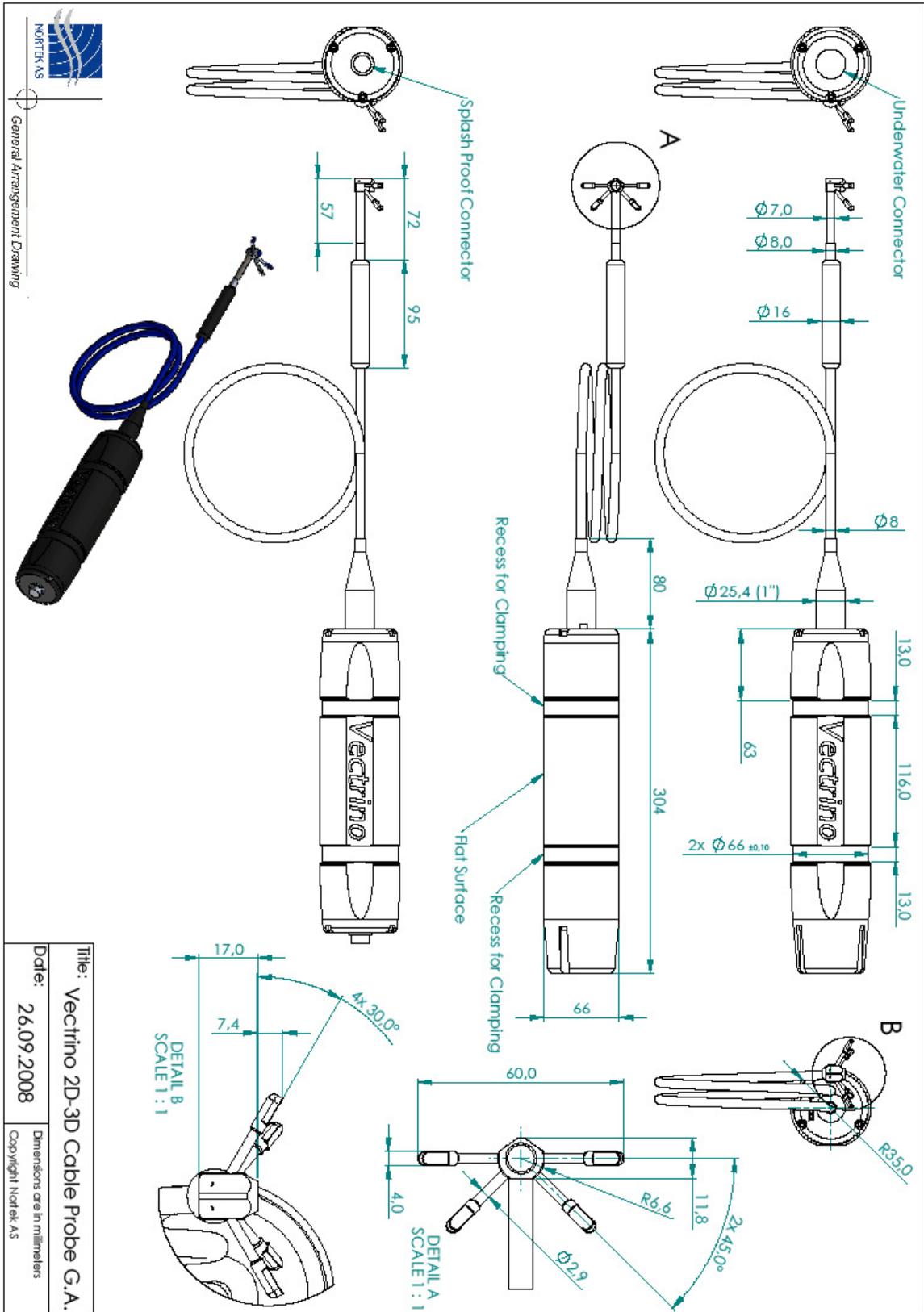


# **APPENDIX**

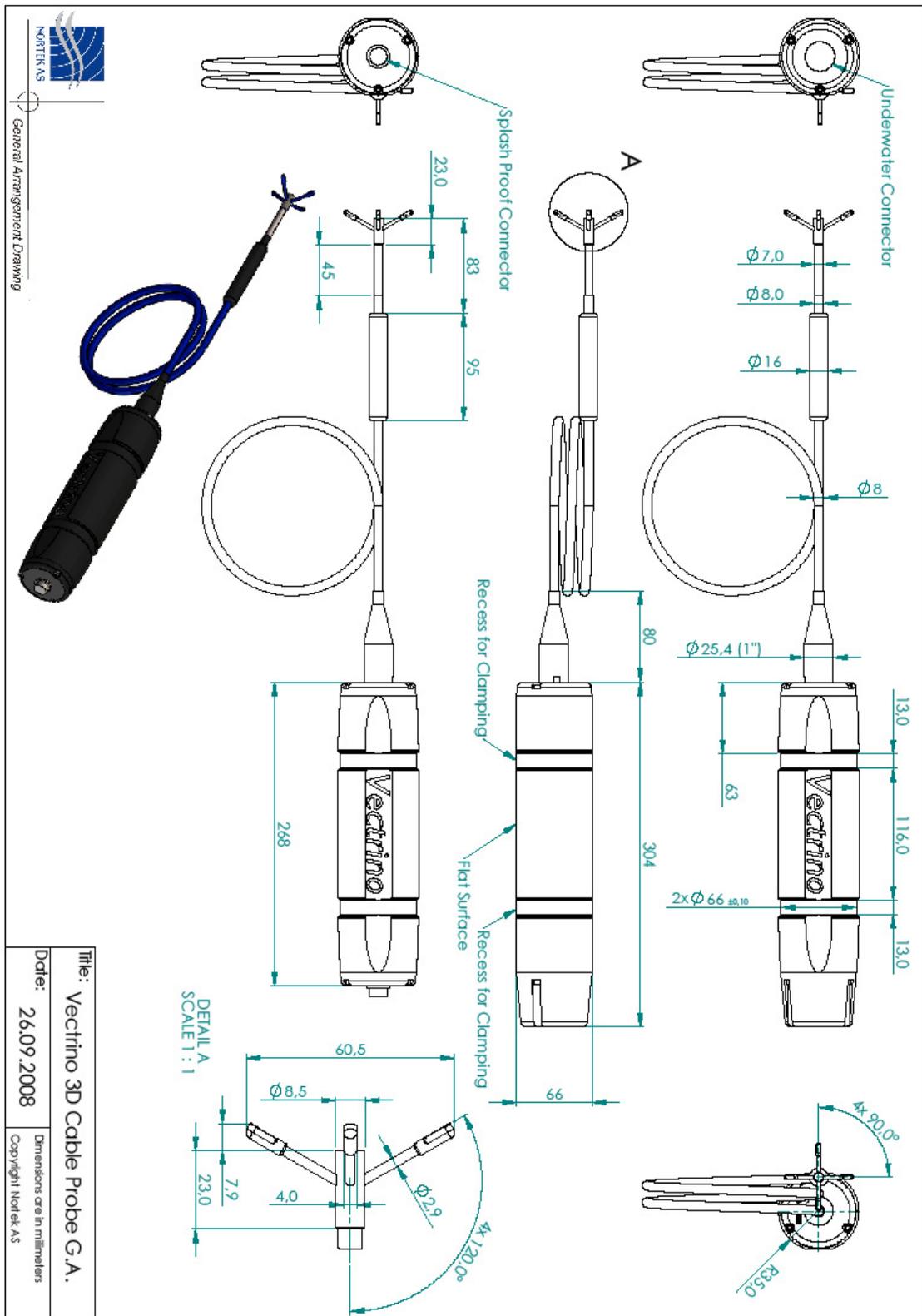
## **Drawings and Dimensions**

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On the following pages you will find drawings with dimensions for your Vectrino.

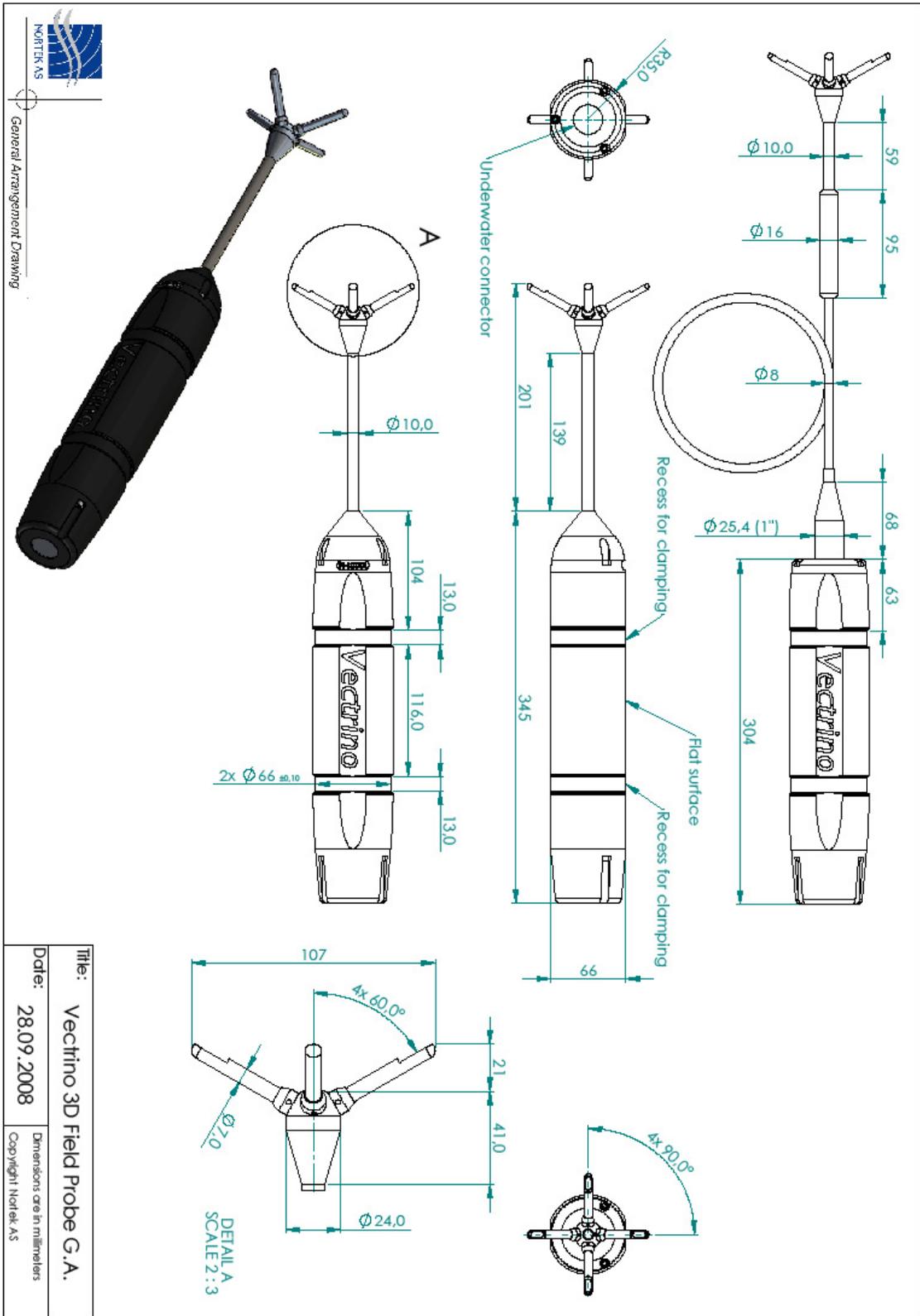


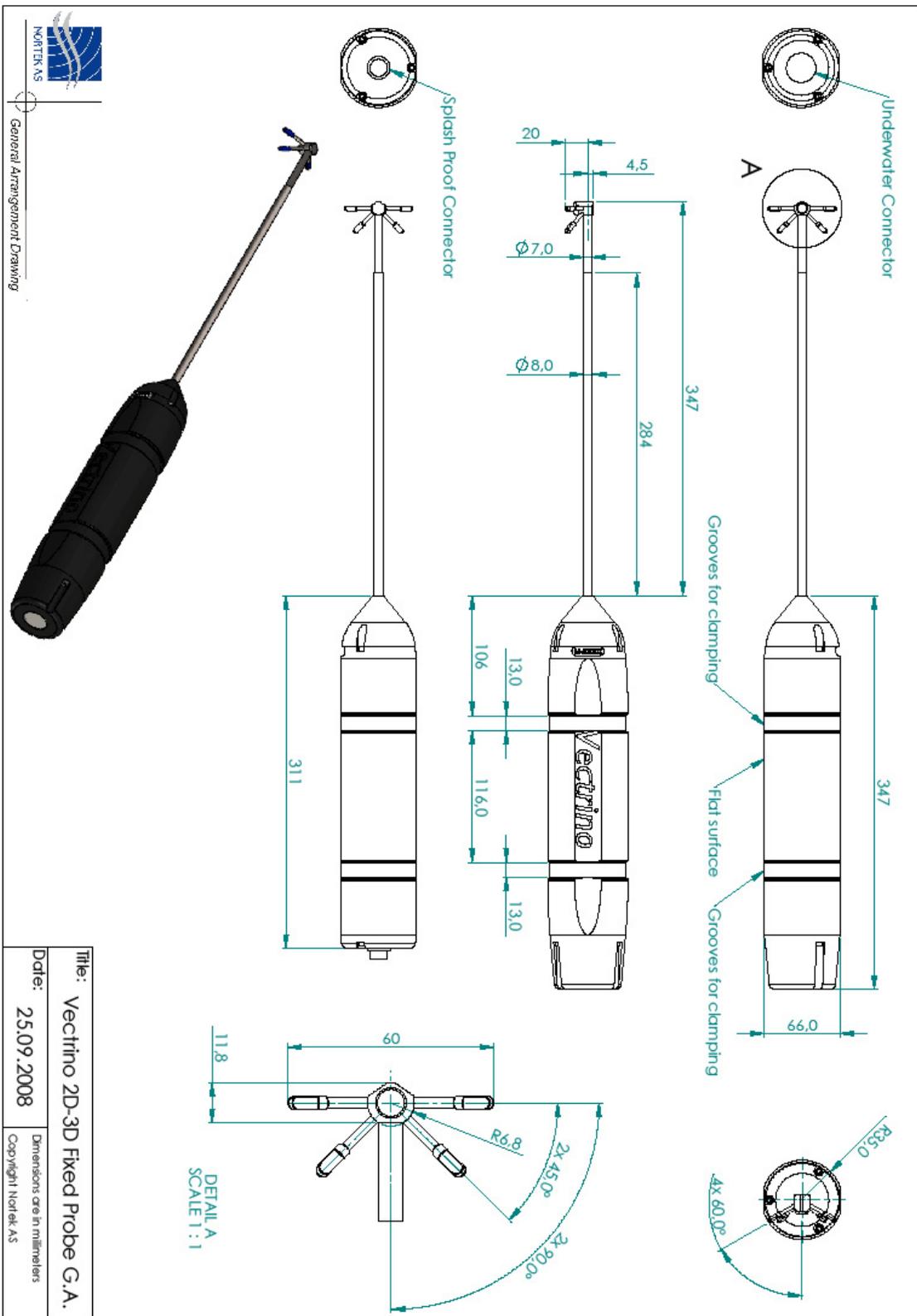
Title:	Vectrino 2D-3D Cable Probe G.A.
Date:	26.09.2008
Dimensions are in millimeters	Copyright Nortek AS



General Arrangement Drawing

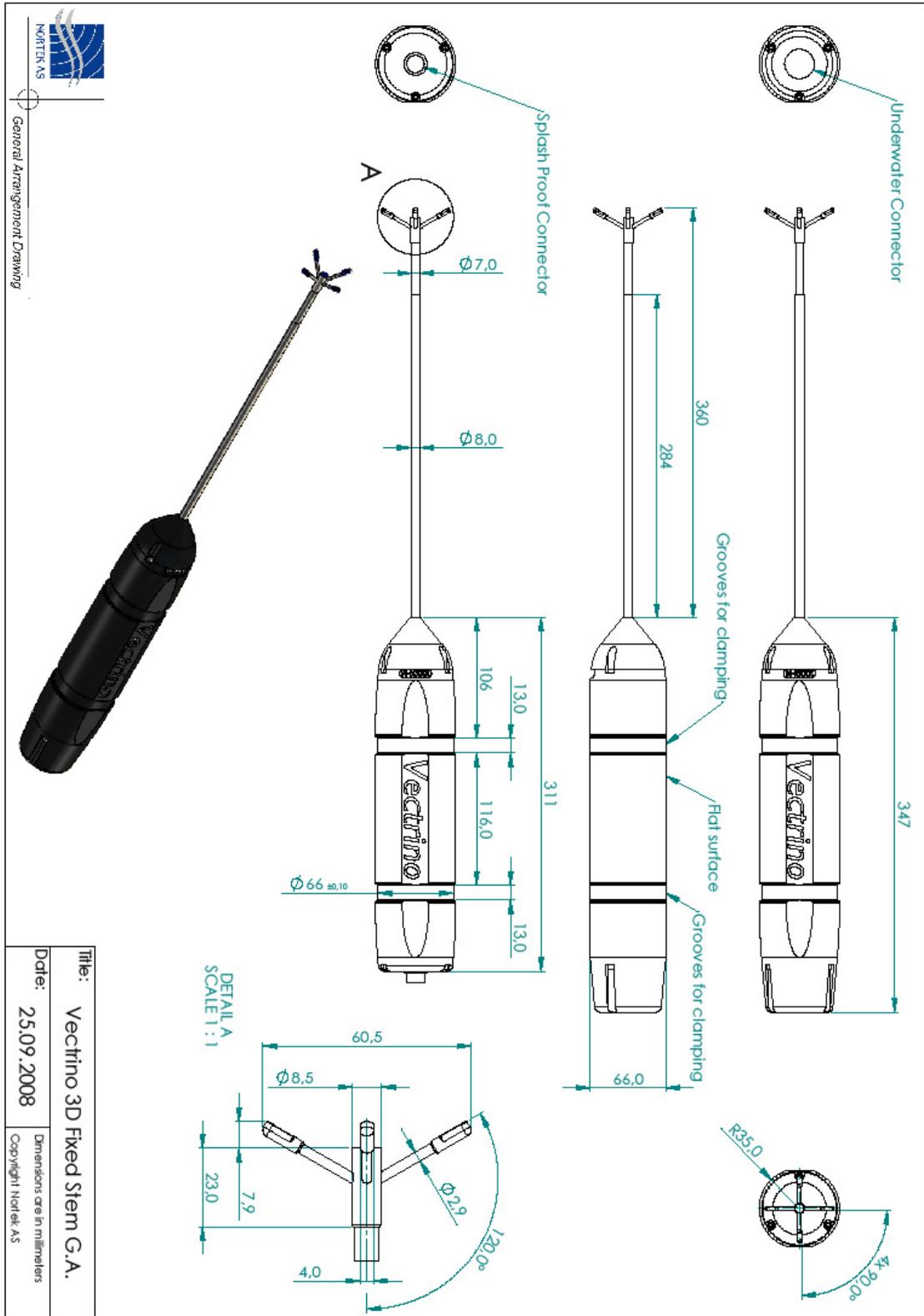
Title:	Vectrino 3D Cable Probe G.A.
Date:	26.09.2008
Dimensions are in millimetres	Copyright Nortek AS





General Arrangement Drawing

Title:	Vectrino 2D-3D Fixed Probe G.A.
Date:	25.09.2008
Dimensions are in millimeters	Copyright Nortek AS



Title:	Vectrino 3D Fixed Stem G.A.
Date:	25.09.2008
Dimensions are in millimetres	Copyright NORTEK AS