RDCP 600

A medium range, 600kHz self-recording Doppler Current Profiler.

Features

- *Comprehensive configuration schemes:*
  - *Multiple columns*
  - *Surface referred columns*
- *Embedded, Windows CE based, configuration tools*
- *Advanced vector based tilt compensation with beam adjustment*
- *Data storage capacity of 1GByte or real-time output on PDC4, RS-232 or RS-485*
- *Comprehensive Windows based post-processing software with 3-dimensional graphs for instant data analysis*
- *300 and 2000m depth capability*
- *Oxygen, Conductivity, Turbidity*

Handheld technology made available to the marine scientists

Aanderaa Instruments is known in the market for building reliable, easy to use instrumentation. It was therefore a challenge to design the new and very comprehensive profiler with such a wide application area and flexibility while still offering an easy to use embedded configuration facility. Customer feedback tells us that we have managed just that.

However, the advanced processing system is not only used for easy handling. It also includes state-of-the-art signal processing and data processing software. The current speed algorithms includes means for measuring closer to the surface or bottom using techniques such as surface referencing, vector based beam compensation and cell overlapping.

The highly advanced, multi-threaded data acquisition system enables the RDCP 600 to be a true multi-parameter platform, measuring additional parameters such as tide level, wave height, conductivity, turbidity and oxygen content.

The RDCP 600 also comes with a rich, Windows based post-processing system, the RDCP Studio, that yields almost immediate visualization of measured data using advanced 3D graphics and a comprehensive suite of presentations. RDCP Studio also includes data export facilities for external data analysis.

Application Areas

The RDCP 600 may be used in a wide range of applications. It may be moored at the bottom in a fixed frame, in an inline mooring string looking upwards or downwards, or it may be installed on a buoy system or at a quay looking downwards.

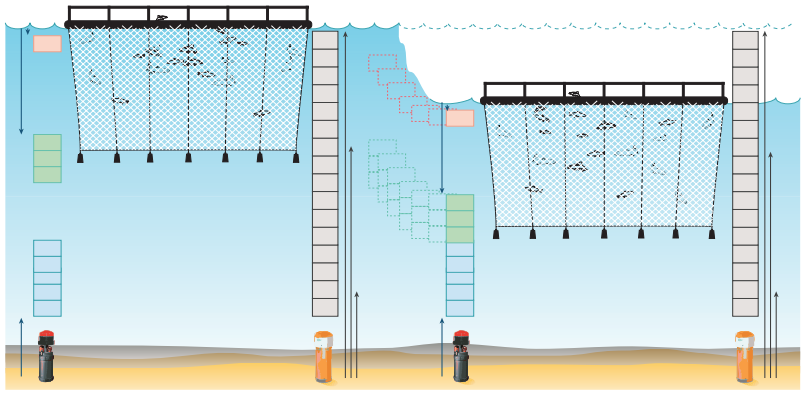
Key application areas are:

- ***Climatic Research*** using in-line mooring installations down to 2000m depth.
- ***Ports and Harbors*** for vessel traffic management and sea condition warning.
- ***Fish Farming*** for monitoring flow conditions, spill transport and water quality.
- ***Pollution Control*** for monitoring flow conditions, sediment transport and water quality.

The RDCP is a 600kHz self-recording profiler, which measures current conditions at a medium range (depending on the scattering conditions in each deployment). The RDCP is also a multi parameter platform; refer page 4 for standard and optional features. The standard RDCP 600 can be deployed down to 300m depth.

Multiple Columns with Surface referred Cells and Overlap:

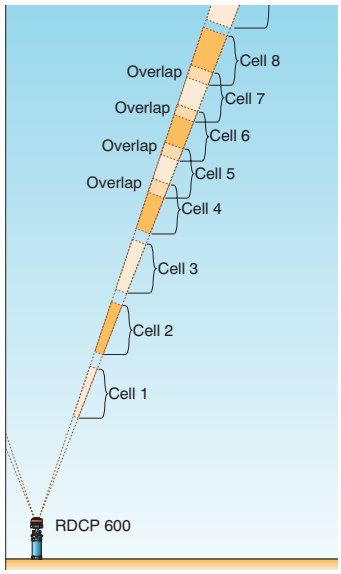
The RDCP 600 may be configured to deal with several columns (profiles) simultaneously for optimum flexibility. Each column may be set-up with individual cell size and cell overlap, and may further be defined as being either instrument referred or surface referred. When a column is instrument referred, the distance from the instrument to the start of the column is kept constant; a setting which is usually used in deep waters where the surface is distant or when bottom currents are to be monitored.



RDCP *other profiler* *RDCP* *other profiler*

Surface referred columns are defined as having constant distant from the surface to the column. In order to achieve this, the RDCP 600 uses the high accuracy pressure sensor (which must be installed on the RDCP) to calculate the distance to the surface. It then uses this information to move the column up and down to hold the distance to the surface constant. Surface referred columns are especially powerful when you are measuring currents close to the surface or want to monitor current speeds at a certain depth.

Cell overlap is a feature that allows the extension of one cell to overlap its neighboring cells (refer illustration to the right). This feature improves the vertical resolution without sacrificing data quality. Another advantage is the possibility to fine tune the upper or lower cell position so that measurement may be performed as close to the surface or bottom as possible without facing problems with side lobe contamination. Cell overlap may range from 0% (no overlap) to 90% (adjacent cells overlap 90%).



Downwards or upward looking RDCP:

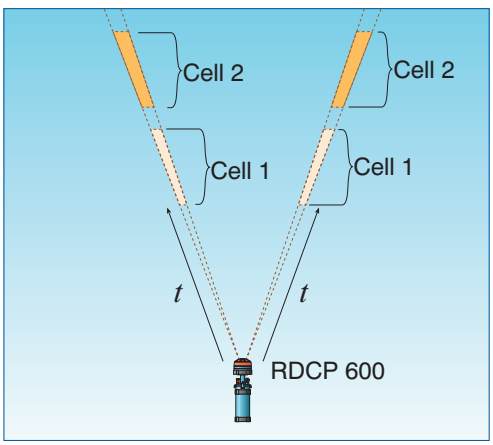
The internal compass enables a downwards looking deployment as well as an upward looking.

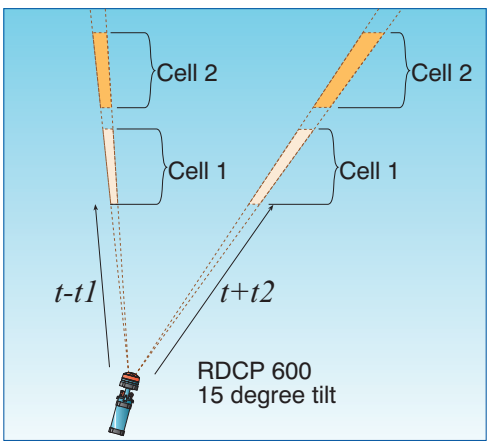
Vector Based Tilt Compensation with Beam Adjustment:

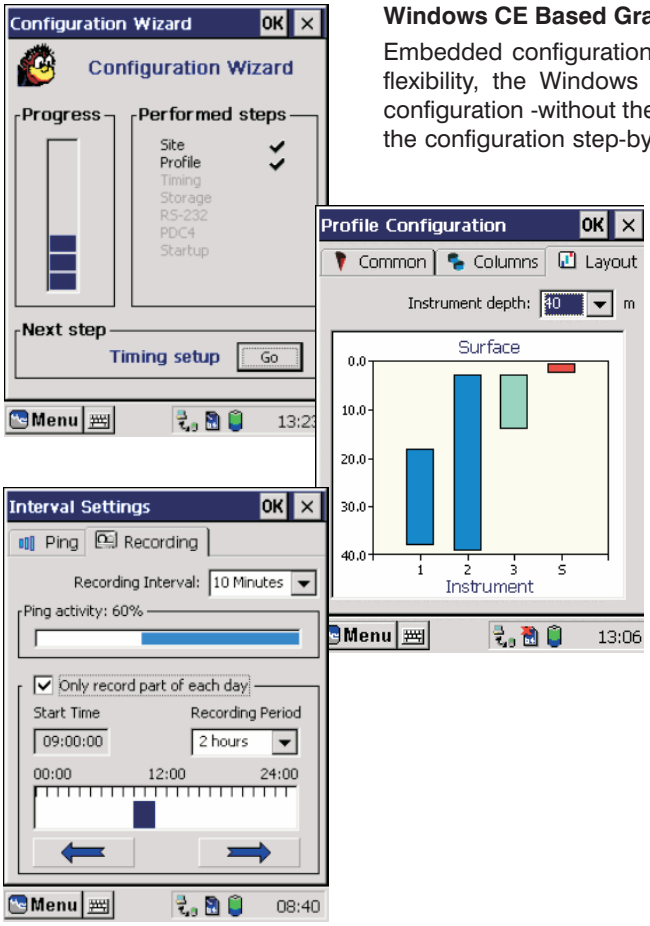
The RDCP 600 employs an advanced tilt compensation algorithm to achieve true horizontal current measurements even when the instrument is tilted. Heading, pitch and roll are embedded into a three-dimensional rotation matrix system that calculates the true horizontal distance to a specific cell for each beam.

When the instrument tilts, the cells in the beam that have a shorter distance to the surface are moved closer to the instrument, and for the ones that have a longer distance the opposite occur. The advantage of this technology is not only that the true horizontal layer is monitored, it also prevents an increase in the side lobe caused illegible zone close to the surface when the instrument is tilted.

The tilt compensation algorithm is updated for each ping and works with tilts up to 20°.







Windows CE Based Graphical User Interface:

Embedded configuration is another major feature with the RDCP 600. Without sacrificing flexibility, the Windows CE based GUI allows you to easily set-up the most complex configuration -without the need of an external computer. A built-in wizard takes you through the configuration step-by-step. As you proceed, the instrument monitors the decisions you have already made and prevents you from making selections that are illegible based on those.

After completing the profile configuration, your latest settings are visualized in the layout window.

The user may set the RDCP to record data evenly during the day or only in a certain period of the day to drain less battery.

The RDCP software estimates the power consumption for the last stored configuration, and displays the average consumption in a summary window along with the configuration settings.

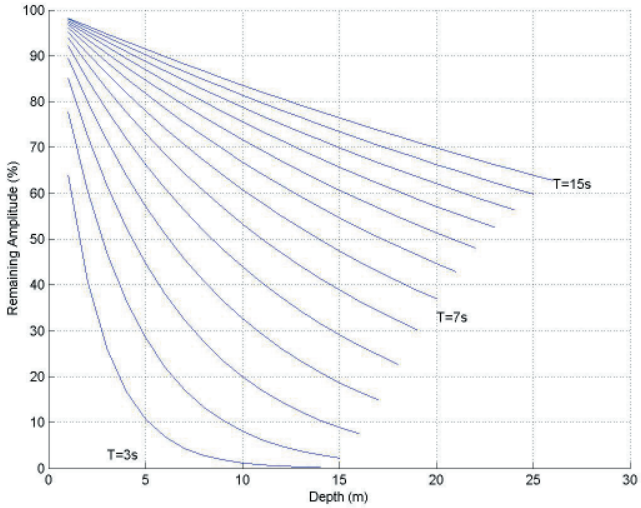
Fast data retrieval:

It takes a few seconds to download data from the instrument to our RDCP Studio Software for analysis and viewing of stored parameters. RDCP Studio is a modern windows based post-processing system that is included in the RDCP 600 package. Refer page 6 for more information about RDCP Studio.

WAVE

The wave motion at the sea surface causes a dynamic pressure that can be measured by use of a pressure sensor. The magnitude of the observed dynamic pressure depends on the surface wave period (T) and the sensor deployment depth (refer graph to the right).

The RDCP 600 calculates wave parameters based on pressure measurements made by a high accuracy pressure sensor sampled at a 2 Hz rate.



Wave parameters:

- Specific Wave Height
- Maximum Wave Height
- Peak Period
- Mean Period
- Mean Zero Crossing Period
- Energy Wave Period
- Wave Steepness
- Irregularity of Sea-State
- AR Wave Period
- Wave Spectrum
- Time Series

With wave parameters available together with other sub-sea parameters, you have a small, robust system for measurements of the Sea-State when using our RDCP 600.

Graphs of the wave parameters are available in the RDCP Studio (ref page 6).

From RDCP Studio, graphs are easily copied into a document for publication or research purposes. Ascii data can also be exported into other software for analysis.

Standard Features:

- 300m depth capability
- Current profile data
  - Horizontal speed & direction
  - Vertical speed
  - Individual beam speeds
  - Signal strength
  - Single ping standard deviation
- Instrument referred multiple columns
- Real-time output on PDC4 and RS-232
- Heading, pitch and roll measurements
- Temperature measurements
- RDCP Studio post-processing suite

Optional Features:

- 2000m depth capability
- Up to four sensor or interface features comprising
  - RS-485 real-time output
  - Conductivity sensor 3619 or 3919
  - Oxygen sensor 3830
  - Turbidity sensor 3612
- Tide and depth measurements using
  - 60m range quartz based pressure sensor
  - 340m range quartz based pressure sensor
- Surface referred columns
  - Down to 60m installation depths using 60m range quartz based pressure sensor
  - Down to 100m installation depths using 340m range quartz based pressure sensor
- Wave height and period measurements
  - Down to 15m installation depths using 60m range quartz based pressure sensor

Standard Accessories:

- 64MByte MMC card for data storage
- MMC card reader for USB port
- Stylus
- Alkaline battery 15Ah for training
- AC 12V power supply for in-house configuration and training
- Shipping container

Optional Accessories:

- 30 Ah non-magnetic lithium battery for deployments using low power setting
- 35 Ah non-magnetic lithium battery for deployments using low or high power setting
- Inline mooring frame
- Extra protecting rod for inline mooring frame
- Bottom mount mooring frame with tilt stabilization
- MMC cards (32, 64, 128, 256MBytes)
- Test cable
- Maintenance kit
- Deck unit (for PDC4 output)
- Cable for power supply and real-time output in fixed installations
- Floats and accessories for mooring systems
- RS-485 to RS-232 converter for PC COM port
- ActiveX based interface software component for RS-232 real-time output may be used together with software based on Visual C++, Visual Basic or compatible compilers

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USAGE CONSIDERATIONS

Surface Referred Columns

In order to utilize the surface referred columns feature, the tide measurement option must be installed. Two depth ranges are available:

- The 60m range allows for both tide measurements and surface referred columns down to installation depths of 60m.
- The 340m range allows for tide measurements down to 340m and surface referred columns down to 100m.

The surface referred columns technique relies on being able to measure current speeds all the way up to the surface. This means that the maximum installation depth when using this feature also depends on the scatter conditions in the installation environment.

Surface referred columns are not available when the instrument is mounted in a downward looking installation as the surface then will be out of reach for the instrument.

Measurement Range

The measurement range depends on scatter conditions and power setting. Scatter conditions will typically vary from place to place and time to time. At high scatter levels, such as often found in harbor waters and similar with a high degree of erosion content, the measurement can exceed 80m when high power level is used.

At low scatter levels, such as found in clean waters at deep depths or in the Arctic, the measurement range would be limited to approximately 40m or even less if the water has extremely low scattering conditions.

Maximum Number of Columns and Cells

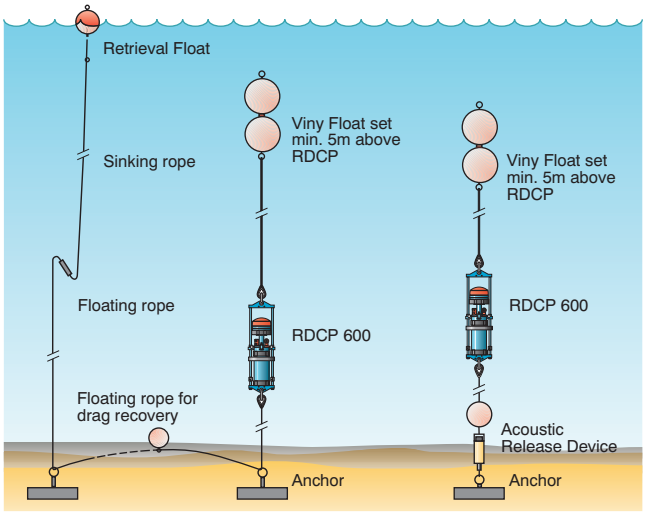
The RDCP 600 has a few, memory based, limitations that influences the maximum number of columns and cells that may be used in a deployment:

- Maximum range (software limitation) is 100m
- Maximum number of cells in a column is 100
- Maximum total number of cells for all columns combined is 150

Usually one would not use 100 cells in one column alone, and the maximum number of columns that could be used therefore usually varies between 3 and 6.

Tide Measurements

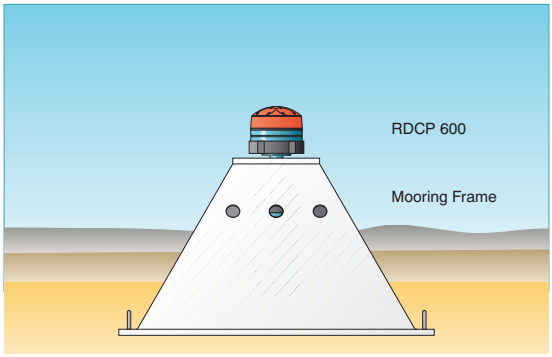
Tide measurements are either done with a 60m or a 340m meter pressure gauge. When one of these is installed, the maximum depth capability is limited to the specification of this sensor unless a pressure blocking cap is installed and the pressure measurement is omitted.



The RDCP can be deployed using

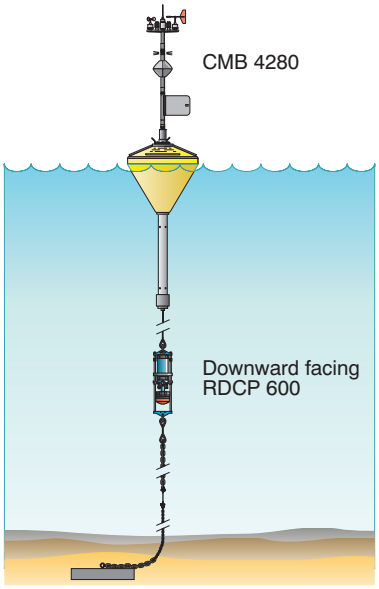
- An In-Line string mooring
- A Fixed Bottom Frame mooring
- A Data Buoy
- An existing fixed installation, like e.g. a quay

In-Line mooring
The In-Line frame may be pre-installed in the mooring string, allowing the instrument to be inserted into the frame just-in-time by means of two hand-operated screws. The In-Line frame together with the fully electronic compass and tilt sensor, allows for upwards as well as downwards looking deployments, and hence surface referred columns. A separate special battery container may be used to prolong the deployment time.



Fixed Bottom Frame mooring
The fixed bottom frame mooring is typically used in fixed deployments like i.e. for harbour surveillance systems. The bottom mounted frame supports extended battery capacity in form of an external battery package or external power by means of a cable to the shore. The RDCP must be upwards looking, which allows surface referred columns and measurements of wave parameters when conditions on page 4 and 5 are fulfilled. Data may be output in real-time as RS-485, RS-232 or PDC4 packages. *Due to slow data rate on the PDC4 output, only a limited set of parameters may be sent in real-time.*

Data Buoy
The RDCP may also be used in a downwards facing application from a data buoy in shallow water. Contact our engineering department for advice on installation and communication devices.



Other fixed installations, like e.g. from a quay
When installed in a quay, the RDCP must be used as downwards facing. Be aware of installation parts that may obscure the measurements, like e.g. ropes and poles.

USAGE CONSIDERATIONS

Wave Measurements
In order to perform wave measurements, the 60m quartz based pressure sensor must be installed. Wave measurements relies on fluctuations in pressure caused by the waves. These fluctuations are heavily attenuated with distance. The high frequency components are attenuated more than the low frequency components.

This means that the installation depth influences the wave measurement result. We do not recommend that wave measurements are performed if the installation depth is more than 15m. Since the attenuation also is frequency dependent, the smallest wave period measured will also depend on the installation depth (refer graph on page 3 in this document). At 6m installation depth, the minimum wave period measured is approximately 3 seconds.

Power Consumption
Power consumption is highly dependent on configuration. It is influenced by power level, ping count, profile length and recording interval. Power consumption will also increase with the number and type of optional sensor installed.

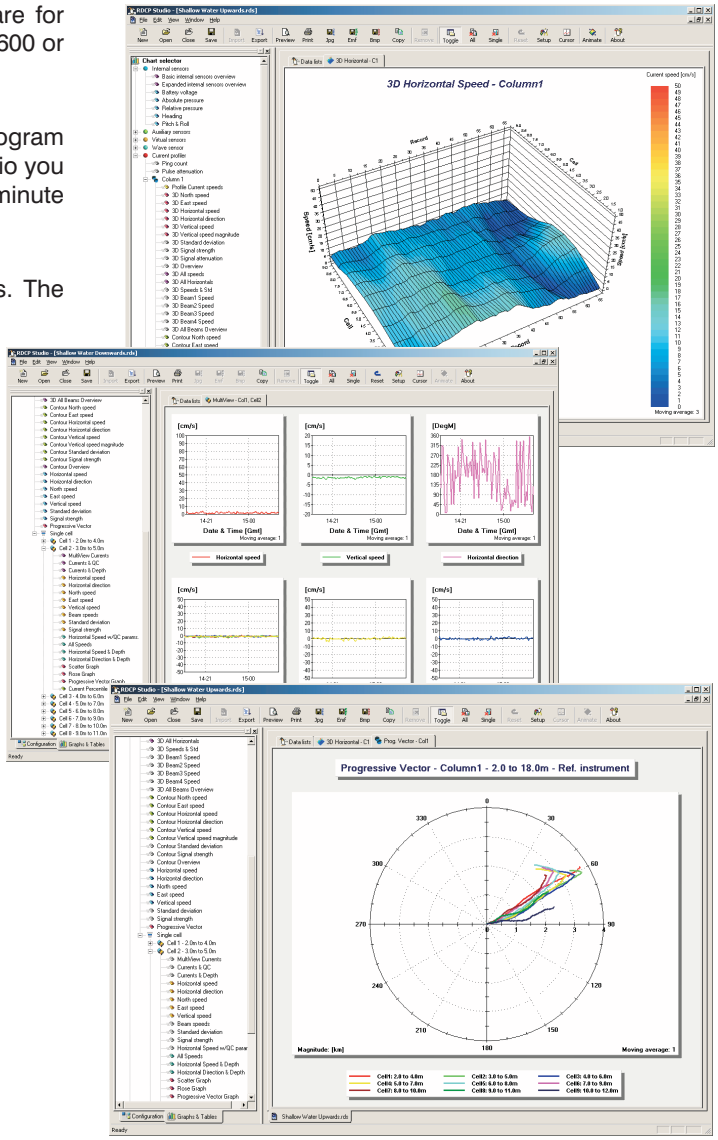
An estimate of the average power drain is provided by the embedded configuration program. A special spread sheet for calculating power consumption is also available at our web site. External battery containers may be used to extend battery capacity.

When using external power supply please also take into account the instrument's peak current drain that take place during pinging.

RDCP Studio is a Windows based post-processing software for RDCP 600. It reads data files either produced by the RDCP 600 or the native data files produced by the RDCP Studio itself.

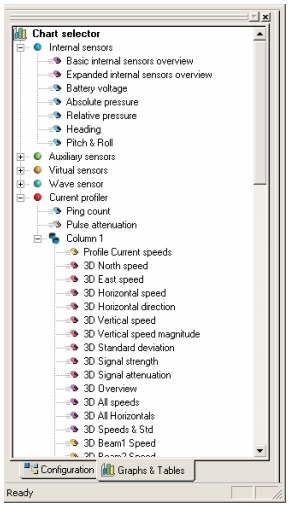
Data stored on MMC cards are quickly imported into the program using an USB based MMC card reader. With the RDCP Studio you usually have an overview of the data collected within one minute after you have plugged the MMC card into the reader.

Data may be analyzed cell-by-cell or as combined profiles. The large suite of presentation forms includes 2D and 3D contour graphs, 2D line graphs and polar presentations. The program also incorporates a set of multi-graph views where several presentations are combined into one view for easy comparison of different measurement parameters.



With RDCP Studio you can:

- Import deployment data collected by the RDCP 600 on either on MMC or CF card.
- Display configuration setting used in the deployment.
- List and edit listed data.
- Export data to ASCII text files.
- Display 2D and 3D presentations of single cells or complete profiles.
- Customize 2D and 3D graphs to enhance or focus important sections of the deployment session.
- Print or export graphs in different formats.
- Copy graphs to the clipboard for inclusion into other programs such as Word, Excel or similar.
- Save edited sessions.



The different graphs and presentations are conveniently accessed using the graph selector tool in the program's control section area.

The tree shaped list organizes all available graphs for each group of data, and a specific graph is opened by means of double clicking.

Several overview graphs are available for easy comparison of events happening at the same time, and a cursor system may be used to read specific numbers at any portion of the graph.

Graphs may be rotated, parts of the data set may be excluded from the analysis, and you may introduce a vector based moving average for all data collected. A 'Full Screen' feature shows the currently selected graph using all available pixels on your monitor for maximum resolution.

RDCP Studio includes all graphs required by the Scottish Environmental Protection Agency (SEPA) for fish farming water flow monitoring.

HARDWARE AND SOFTWARE REQUIREMENTS

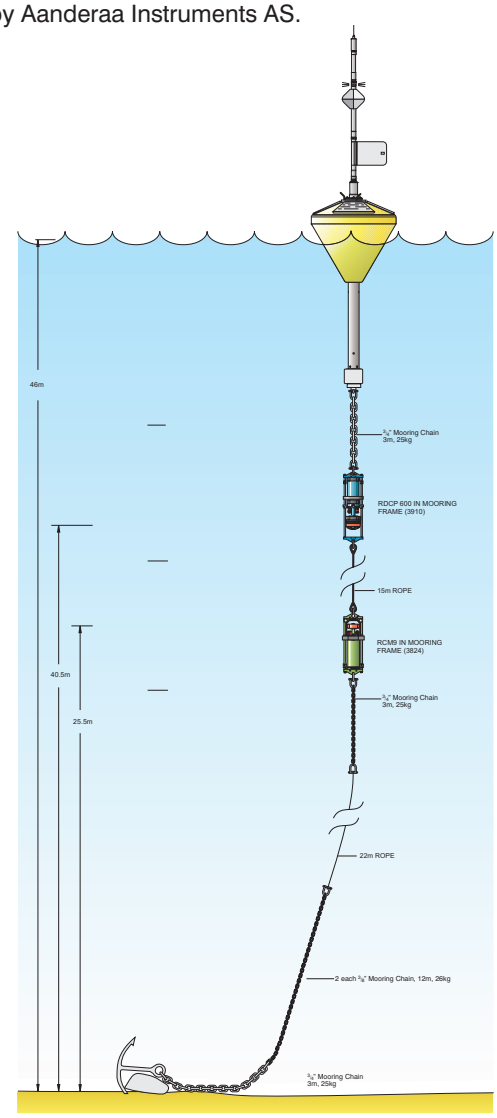
RDCP Studio may be used together with Windows 2000 or Windows XP based computers.

We recommend to use computers with average or above processing power and 512MB of memory or more installed.

The minimum recommended screen size is 1200 x 1024 pixels.

A field test of the RDCP 600 moored in a Data Buoy 4280 was performed in April 2004 just outside Bergen (Norway). For comparison, an RCM 9 was mounted below the RDCP. The test was performed by Aanderaa Instruments AS.

The RCMs have been on the marked for a long time, and have proven reliable and robust. The RDCP 600 is developed based on the same acoustic technique, hence a comparison between the RCMs and the RDCP 600 indicates the instruments reliability as well. Refer Data Sheet D 331 for RCM 11 measurements in deep water (4000m).

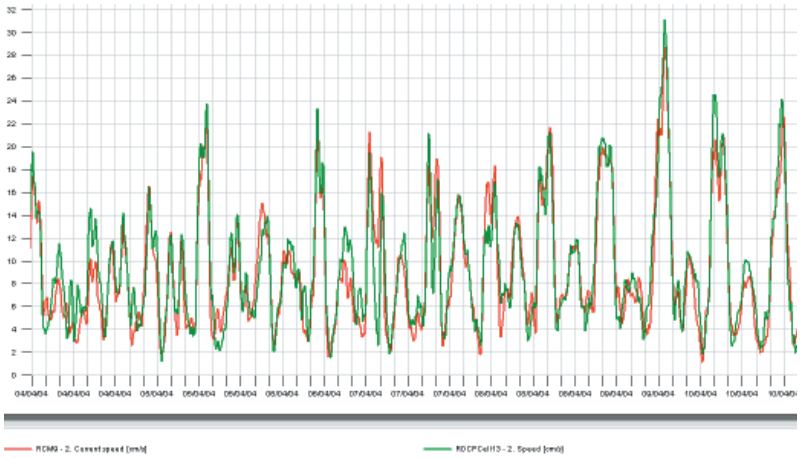


Description of the Buoy Deployment

The RDCP 600 was deployed 5m below the surface, facing downwards, and the RCM 9 was deployed 20m below the surface. The distance from the seabed to the surface was 46 meters. The deployment time was 14 days. An illustration of the buoy deployment is given to the right.

RDCP 600: Burst mode, 2m cell size, 2m pulse length, 50% cell overlap, 300 ping, 10 minutes recording interval. The deployment depth was 6m below the surface. The Instrument was facing downwards.

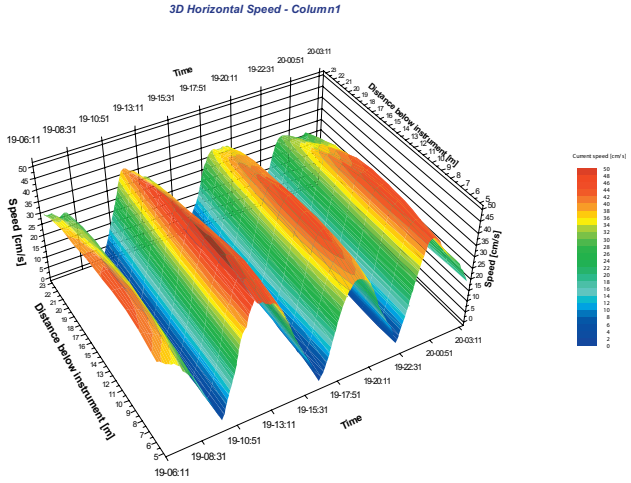
RCM 9: Burst mode, 10 minutes recording interval. The deployment depth was 21m below the surface.



Comparison of data from RCM 9 and RDCP 600

For comparisons of data, we have selected measurements made by the RDCP 600 in the same water level as the RCM 9, that is: 21m below the sea surface (RDCP 600 cell no.13).

Measurements of current speed [cm/s] measured with the RCM 9 (red line) and RDCP 600 (green line) are presented in the leftmost graph above. It is clearly seen that the current speed measured by the two instruments are very similar.



RDCP data from Svalbard

The graph to the left shows the 3D Horizontal current speed [cm/s] from a deployment in very clear water near Svalbard. The measurements were performed by the University of Bergen spring 2004.

The illustration is made in RDCP Studio. Quality data like the single ping standard deviation and the signal strength indicate that the measurements are valid.

Current Profiler

Acoustic centre frequency:	606kHz
Number of Beams:	4 Beams
Processing:	ARMA parametric model
Transducer slant angle:	25°
Tilt range[1]:	-20° to +20°
Speed range[2]:	0 – 500cm/s
Horizontal accuracy[3]:	0.5cm/s
Vertical accuracy:	1.0cm/s
Single ping Statistic noise[4]:	4.0cm/s
Range:	Low power[5]: 35 to 60m High power[5]: 40 to 80m
Blanking Distance[6]:	300m version: 1m 2000m version: 2m
Cell size range:	1 to 10m (0.1m increment)
Cell overlap:	0 to 90%
Maximum no. of cells in one column:	100
Maximum no. of cells in all columns:	150
Power level:	Low: 20W High: 80W
Auto Attenuation[7]:	0,-3dB, -6dB
Parameters measured:	Horizontal speed, vertical speed, single-ping std, signal strength, ping count, pulse attenuation

Compass and Tilt Sensor

Heading Range:	0 to 360°
Heading accuracy:	±4° for 0 to 35° tilt
Tilt range:	±45°
Tilt accuracy:	±1.5°

Temperature Sensor

Ranges:	Wide: -0.64 to +32.87°C Low: -2.70 to +21.77°C High: +9.81 to +36.66°C Arctic: -3.01 to +5.92°C
Accuracy:	±0.05°C

[1] Tilt is compensated for within this range. Tilt will be measured from –45° to +45°.

[2] Upper range slightly lower when the instrument is tilted more than 10°

[3] Statistic noise not included

[4] Based on 4m ping length and cell size

[5] The measurement range is highly dependent on the scattering conditions. For waters with low amount of scatteres, expect a shorter range than for waters with a high amount of scatteres

[6] The blanking distance is defined as the distance to the first data sample

[7] Using Auto-attenuation the initial selected power level will be adjusted according to need

Optional Quartz Pressure Sensor

Sampling interval:	10 to 60s (default: 40s)
Range 0 to 60m version:	0 – 700kPa
Range 0 to 340m version:	0 – 3500kPa
Accuracy:	± 0.03% of full scale

Optional Auxiliary Sensor

Maximum no. of auxiliary sensors:	3
Oxygen optode sensor:	Ref datasheet D335
Conductivity sensor:	Ref datasheet D344/D328
Turbidity sensor:	Ref datasheet D328

Optional RS-485 Connection

Communication type:	Full duplex
Maximum cable length[8]:	1400m @ 38kBaud

Optional Wave sensor

Parameters measured:	Significant Wave Height, Maximum Wave height, Peak Period, Mean Period, Mean Zero Crossing Period, Energy Wave Period, Wave Steepness, Irregularity of Sea-State, AR Wave Period, Wave Spectrum, Time Series

Current drain example

60m range[9,10]:	60mA

Dimensions and Weights

Dimensions:	D: 160mm (fender 187mm) H: 580mm
Weight (in air):	19.0kg (300m version)
Weight (in water):	12.0kg (300m version)

[8] Requires suitable cables for balanced transmission

[9] 60m range, 10min recording interval, 2m ping length, 300pings

[10] Current drain depends on configuration. Refer the power consumption spread sheet available on our web site.

Representative's Stamp

Specifictions subject to change without notice.

Latest version is on the Internet

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