AANDERAA
a xylem brand

Recording Doppler Current Meter 600
a multiparameter platform

is a medium range, 600kHz self-recording Doppler Current Profiler. Being a Doppler shift instrument, the RDCP is insensitive to fouling and highly reliable. 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 in-line 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 harbours** 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

Several profiles simultaneously: The instrument can be configured to deal with several profiles simultaneously for optimal flexibility

Instrument and Surface referred profiles: You can choose both instrument referred and surface referred profiles in one configuration

Surface cell: For measurements carried out at the water surface

4 optional submersible sensors can be mounted onto the RDCP Top-end Plate, making the RDCP 600 a compact instrument for environmental measurements

Tilt Compensation: Advanced vector based tilt compensation with beam adjustment

Easy set up of the instrument: Embedded, Windows CE based, configuration tools

Data storage capacity standard MMC card stores 512MB

Real-time output on PDC4, RS-485 or RS-232. RDCP 600 uses Active-X control

Instant data analysis: Comprehensive Windows based post-processing software, RDCP Studio (not real-time), with 2- and 3-dimensional graphs

Export of data to custom software

300m and 2000m depth capability

Standard parameters: Current speed and direction, signal strength and instrument tilt

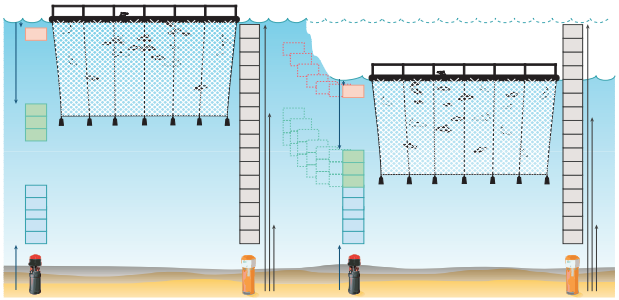
Optional Parameters: Oxygen, turbidity, temperature, conductivity, pressure and wave parameters (refer page 8)

Instruments with Doppler shift technology are insensitive to fouling

Basic Description and Features

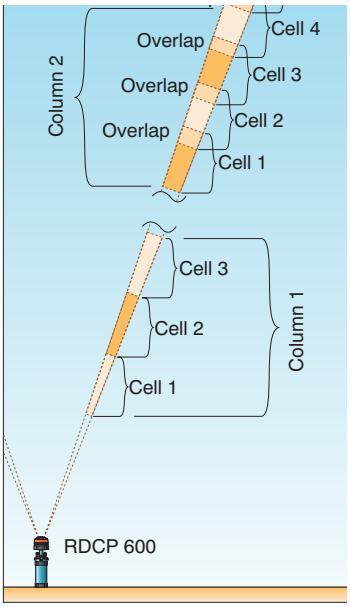
Multiple Columns with Surface referred Cells and Overlap:

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.



Surface referred columns are defined as having constant distance from the surface to the column. In order to achieve this, the RDCP 600 uses a high accuracy pressure sensor (optional sensor which must be installed on the RDCP 600) 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%).



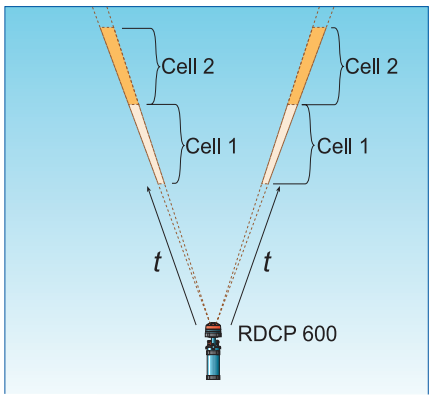
Downwards or upward looking RDCP:

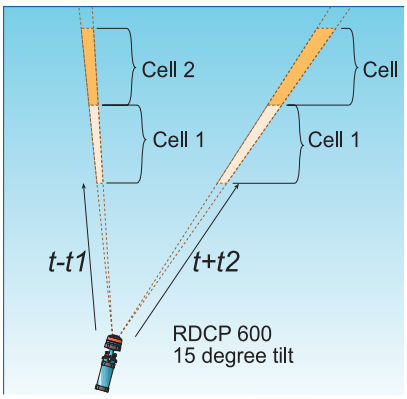
The internal compass enables a downwards looking deployment as well as an upward looking; simply select the deployment situation in the deployment configuration.

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 correct horizontal distance to a specific cell for each beam, refer illustrations below.

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°.

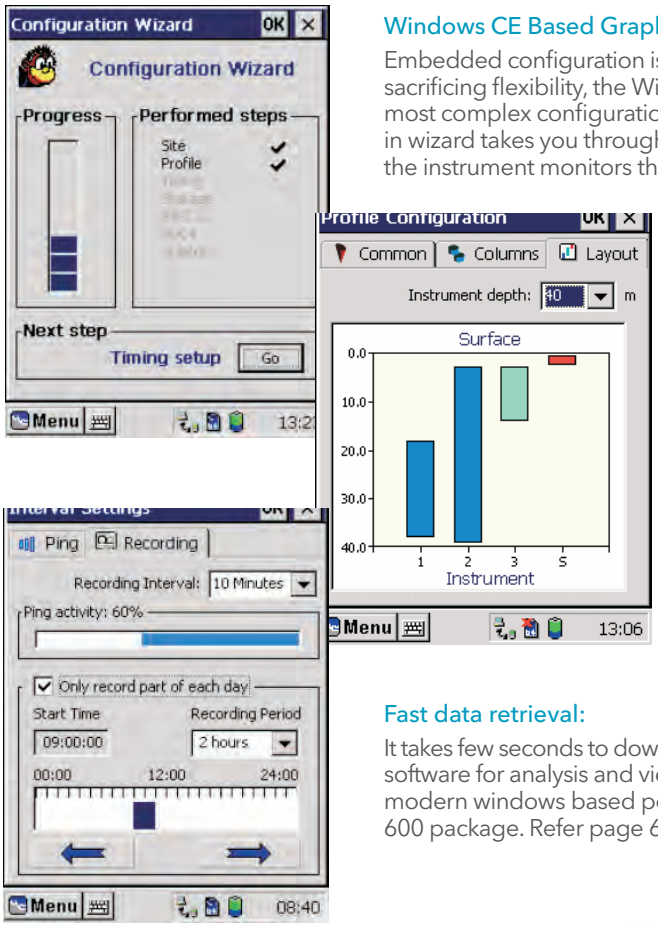




Soundspeed compensation:

Soundspeed adjustment is important in a Doppler system. The RDCP may either use fixed soundspeed or compensate for one or more of the parameters: temperature, conductivity and pressure. Temperature can either be measured by Temperature sensor 4050 or as a second parameter from Conductivity sensor 3919 or Pressure sensor 4017. For conductivity compensation you may use the Conductivity sensor 4019 or 3919 and for pressure compensation, the Pressure sensor 3187.

Basic Description and Features



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 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.

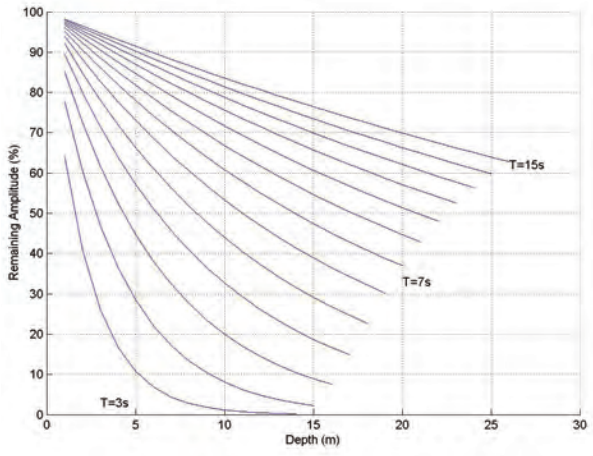
WAVE

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, H_{m0}
- Maximum Wave Height, H_{Max}
- Peak Period, T_{Wp}
- Mean Period, T_{m01}
- Mean Zero Crossing Period, T_{m02}
- Energy Wave Period, J
- Wave Steepness, z
- Irregularity of Sea-State
- AR Wave Period
- Wave Spectrum, shorter deployment
- Time Series, shorter deployment



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 and Optional

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
- 512MB MMC card for data storage
- Stylus
- Real-time output on PDC4 and RS-485/RS-232
- Heading, pitch and roll measurements
- RDCP Studio post-processing suite
- Embedded power calculator
- Shipping container

Optional Features:

- 2000m depth capability
- Up to four sensors or interface features comprising
  - Temperature sensor 4050
  - Conductivity sensor 4019/3919[1)]
  - Oxygen sensor 3835/3830
  - Turbidity sensor 3612/4705
  - Pressure sensor 4017[1)] (not for wave/surface/tide)
- Tide and depth measurements using
  - 60m range quartz based pressure sensor
  - 340m range quartz based pressure sensor
- Surface referred columns
  - Down to 60m installation depth using 60m range quartz based pressure sensor
  - Down to 100m installation depth using 340m range quartz based pressure sensor
- Wave height and period measurements
  - Down to 15m installation depth using 60m range quartz based pressure sensor

Standard Accessories:

- MMC card reader for USB port
- Alkaline battery 15Ah for training[2)], low magnetic

Optional Accessories:

- 35 Ah non-magnetic lithium battery for deployments using low or high power setting
- In-line mooring frame
- Extra protecting rod for in-line mooring frame
- Battery container for in-line mooring
- Bottom mount mooring frame with tilt stabilization
- Maintenance kit 3813
- Tool kit 3986
- Recommended spares
- Deck unit (for PDC4 output)
- Cable for power supply and real-time output in fixed installations
- Floats and accessories for mooring systems
- ActiveX based interface software component for RS-485 real-time output may be used together with software based on Visual C++, Visual Basic or compatible compilers
- Laboratory supply
- Can be interfaced to Aanderaa Real-time system
- Alkaline battery 15Ah for training[2)], low magnetic
- RDCP Report generator that fulfils the requirements in e.g. NS 9415

[1)] *Temperature as second parameter*

[2)] *Alkaline battery will influence the compass and must not be used in field*

Optional Sensors

Turbidity Sensor 3612
Accuracy: 2% of full scale
Resolution: 0.1% of full scale

Dissolved Oxygen 3830/3835
Accuracy: <8µM or 5% whichever is greater
Resolution: <1µM

Accuracy:	*3919A/4019A ±0.005S/m*	*Temperature Sensor 4050*	*Quartz Pressure Sensor 3187*
	3919B/4019B ±0.0018S/m	*Accuracy: ±0.03°C*	*Accuracy: ±0.04% FSO*
Resolution:	*0.0002S/m*	*Resolution: 0.001°C*	*Resolution: ±0.02% FSO*

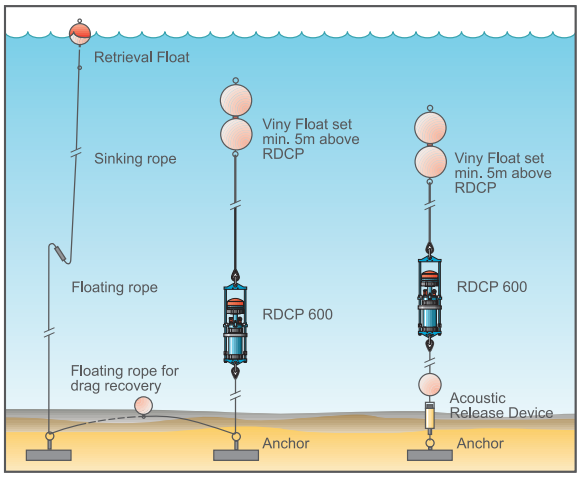
Examples of use:

RDCP 600 with the optional Conductivity sensor 4019 and Quartz Pressure sensor 3187 gives you a highly robust current meter with very good CTD performance!

RDCP 600 with Oxygen sensor 3830/3835 gives you the dissolved oxygen as well as the current measurements. If you add the Conductivity sensor 4019, you will get the temperature- and salinity-corrected oxygen concentration.

RDCP 600 with Quartz Pressure sensor 3187 and Wave Software will give you wave parameters in shallow deployments.

Installations and Applications



The RDCP can be deployed using

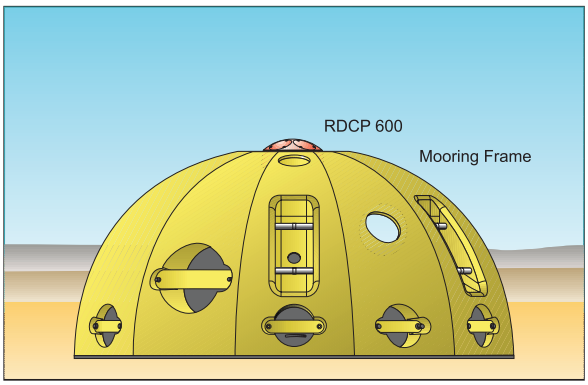
- An in-line string mooring
- A fixed bottom frame mooring
- A data buoy
- An existing fixed installation, e.g. a quay

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 downwards facing application from a data buoy in shallow water. Contact aanderaa.info@xyleminc.com for advice on installation and communication devices.

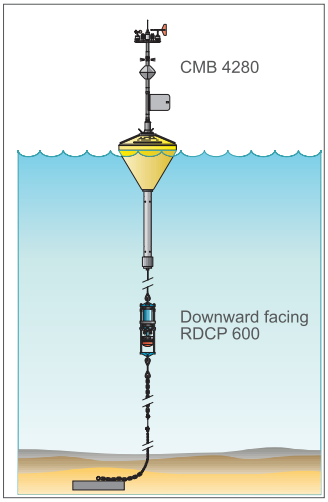
Fixed Bottom Frame mooring (new frame, refer next section this page)

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 (optional features). Data may be output in real-time as RS-485, RS-232 or PDC4 packages (PDC4: limited capacity). *RS-485 is a high capacity real-time output, and a standard feature real-time output for RDCP 600.*



Data Buoy

The RDCP may also be used in a downwards facing application from a data buoy in shallow water. Contact aanderaa.info@xyleminc.com for advice on installation and communication devices.



Other fixed installations, 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, e.g. ropes and poles.

Bottom Frame

A new bottom frame has been designed for the RDCP 600. The instrument can be mounted in several levels. Mounted in the lowest level, the RDCP 600 head is just above the frame, while the entire head and sensors connected to the Top-end Plate are above the frame when mounted in the uppermost level.

The frame has got 4 handles for installation and easy accessible rooms for external batteries (3) and weights (9). The weights that we provide are made from environmental-friendly zink (10 kg each).

You can use external batteries and battery packages from your local supplier; Aanderaa can also provide batteries, rechargeable batteries and battery packages.

The instrument can be inserted into/released from a deployed bottom frame.

Contact factory for installation advice.

Bottom frame Specifications:

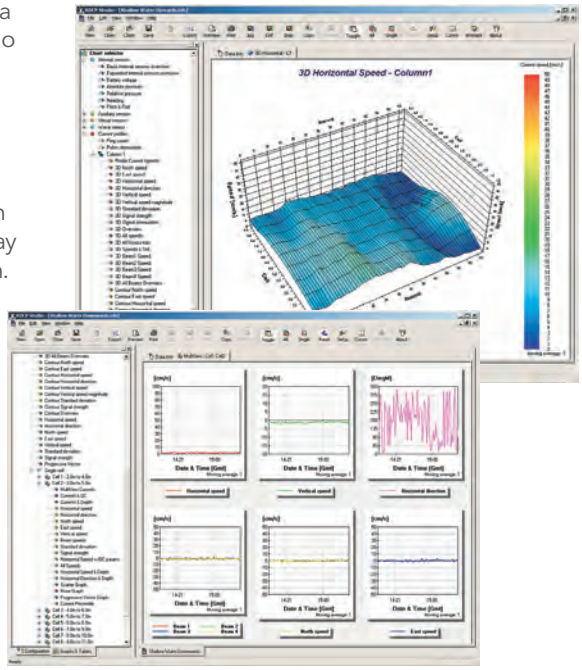
Weight:	50kg in air (without external batteries and weights)
Dimensions HxD:	650x1400mm
Material:	polyethylene
Handles:	4 handles, each can hold at least 500kg

Optional Accessories

Battery pack, batteries, rechargeable batteries, zinc weights.

RDCP Studio

With RDCP Studio, you are less than one minute from full data overview after plugging the MMC card into the reader! A demo CD is available on request (aanderaa.info@xyleminc.com). The different graphs and presentations are conveniently accessed using the graph selector tool in the program's control section area.



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.

With RDCP Studio you can:

- Import deployment data collected by the RDCP 600 on either the 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.
- 2D line graphs and polar presentations.
- 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.

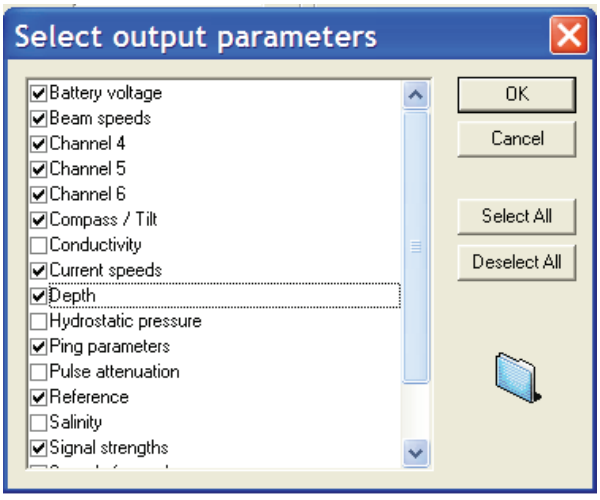
Active-X control
for Real Time monitoring

We offer ActiveX based interface software component for RS-485 real-time output. Hence parameters measured by the RDCP 600 are easy to embed into custom software for real-time monitoring.

Once registered on your PC, the interface components are available for all applications currently installed on your PC. ActiveX may be used together with applications based on Visual C++, Visual Basic and compatible compilers.

When the interface software component is accessed from your custom application, you can perform deployment configuration through a wizard. E.g. set output parameters just as you can directly from the instrument, refer figure to the right. The ActiveX based interface software component also stores incoming data to an internal history buffer.

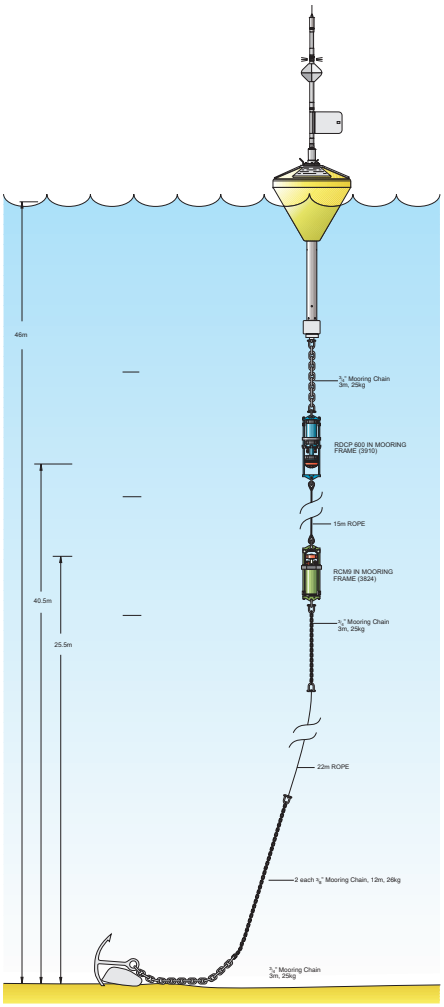
Please contact factory before ordering the Active-X based interface software component.



Examples of measurements

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 600. The test was performed by Aanderaa Instruments AS, refer TN 291.

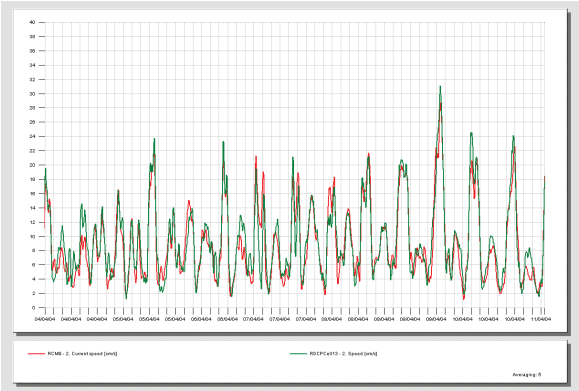
The RCMs have been on the market for a long time, and have proved to be reliable and robust. The RDCP 600 is developed based on the same acoustic technique, hence a comparison between the RCMs and the RDCP 600 indicates the instruments reliability as well.



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.

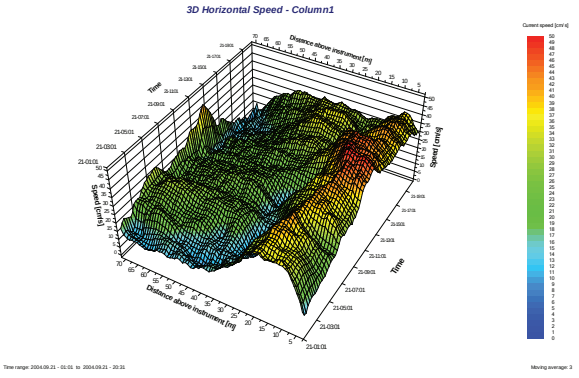
RDCP 600: Burst mode, 2m cell size, 2m pulse length, 50% cell overlap, 300 pings, 10 minutes recording interval. The deployment depth was 6m below the surface. The Instrument was facing downwards. RCM 9: Burst mode, 10 minutes recording interval. The deployment depth was 21m below the surface.



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 the Baltic Sea

The graph to the left shows the 3D Horizontal current speed [cm/s] from a deployment in the Baltic Sea. The measurements were performed by Anders Tengberg at the University of Göteborg and Riikka Hietala at the Finish Institute of Marine Research August 2004, refer B 141.

The illustration is made in RDCP Studio. Notice a layer (a ridge) of strong currents about 20m above the instrument throughout the deployment time. Additional sensors mounted to the RDCP: Turbidty sensor and Oxygen Optode.

RDCP 600 Specifications

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, ±1.5% of reading
Vertical accuracy:	1.0cm/s
Single ping Statistic noise[4]:	4.0cm/s
Range:	Low power[5]: 30 to 70m High power[5]:35 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, singleping std, signal strength, ping count, pulse attenuation, heading, pitch and roll
Operating temperature:	-4 to + 40°C

Compass and Tilt Sensor

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

RS-485 Connection

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

Current drain example

60m range[10,11]:	60mA

External power supply

Power input:	7 - 14 Vdc
High power input:	13 - 42 Vdc

Optional Auxiliary Sensor

Maximum no. of sensors:	4
Temperature sensor	Ref datasheet D360
Pressure sensor	Ref datasheet D357
Conductivity sensor:	Ref datasheet D344/354
Oxygen optode sensor	Ref datasheet D335/355
Turbidity sensor	Ref datasheet D353/384

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 Wave Software[9]

Pressure based:	Wave height, measurement simultaneous with current
Parameters:	Wave height, Wave period, Energy wave direction, Peak direction, Mean direction

Dimension and weights:

Dimensions:	D: 160m (fender 87mm) H: 580m	
Weight:	*in air*	*in water*
300m version:	19.0kg	12.0kg
2000m version:	22.0kg	14.6kg
Frame 4110:	12.0kg	10.2kg
Frame 4110 w/shackles and rods:	15.5kg	13.2kg

[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] Normal scatter condition, statistic noise not included
[4] Based on 4m ping length and cell size
[5] Typical range with normal back scatter conditions. The measurement range is highly dependent on the scattering conditions. For waters with low amount of scatters, expect a shorter range than for waters with a high amount of scatters
[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
[8] Requires suitable cables for balanced transmission
[9] Requires Quartz pressure sensor installed
[10] 60m range, 10min recording interval, 2m ping length, 300pings
[11] Current drain depends on configuration. Refer the embedded power calculator.

Specifications subject to change without notice

Contact aanderaa.info@xyleminc.com for: RDCP Studio demo, RDCP image update, RDCP current consumption spread sheet, RDCP Studio update, additional data sheets, or installation/battery advice.

xylem
Let's Solve Water

Visit our Web site for the latest version of this document and more information

www.aanderaa.com

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