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Aanderaa Application Support Package # 5

Header: The Koljoefjord Observatory
Aanderaa SeaGuard String and RDCP Application

Market segment: Climate Research/Ocean Research

Customer value: On-line coastal observatory with multilevel measurements at high temporal resolution.
System Stability
Data quality control by monthly reference data
Open for addition of sensors and instruments

System description:
The observatory consists of a main hub, which is cable connected to communication and power system on land. The node is prepared to host four experimental modules communicating either with Ethernet or serial protocol. When installed in April 2011 one monitoring module with approximately 30 sensors was connected. Data are stored internally in the instruments (Seaguard with String and RDCP) and the node, and are also available online and retrieved in real-time to the PANGEA database (http://www.pangaea.de/). Remote control over the main hub is implemented and has been used for adjusting measurement system parameters over the Internet. At the moment sensors to measures Temperature, Salinity, Currents, Oxygen, pCO_2, Water level and Waves are operational.

For real time measurements, see this link:
http://mkononets.dyndns-home.com:8080

Supporting docs: 1) Attached document- The Observatory, 2) S-7043 Seaguard sensor string(AiCAP) 3) D388 - SeaGuard String System 4) D343 - RDCP Recording Doppler Current profiler

Price: Contact your Aanderaa representative

Prospective customers:
Research Institutes, Environmental Authorities, Environmental Monitoring Organizations, Navigational Safety

Other:
For data sheets, please see the AADI web-site;
http://www.aadi.no/Aanderaa/Products/Sensors/default.aspx

End User: University of Gothenburg, EU-ESONET and EU-HYPOX projects

Contacts at AADI: Your regular AADI contact

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Aanderaa Data Instruments AS – ASP # 5

The Observatory

Most aquatic life depends on oxygen. It is, thus, an alarming finding that the occurrence of hypoxic (low oxygen) conditions is increasing worldwide. This is mainly thought to be a consequence of anthropogenic eutrophication (nutrient input) and climate change. The intention of the EU-projects ESONET and HYPOX (http://www.hypox.net/) is to improve the capacity to monitor and predict oxygen depletion, by e.g. implementing reliable long-term sensors to different platforms for in-situ monitoring.

In the Koljoefjord an on-line observatory was installed in April 2011 to assess and model the dynamics of a system of fjords on the Swedish west coast. The observatory consists of a main hub, which is cable connected (old fiber optic ROV cable) to communication and power system on land (see figure and photos on next page). The node is prepared to host four experimental modules communicating either with Ethernet or serial protocol. When installed in April 2011 one monitoring module with approximately 30 sensors was connected. Data are stored internally in the instruments and the node, and are also available online and retrieved in real-time to the PANGEA database (http://www.pangaea.de/). Remote control over the main hub is implemented and has been used for adjusting measurement system parameters over the Internet. A web display is developed for checking, plotting and quality control of the data coming in: http://mkononets.dyndns-home.com:8080/

The monitoring module consist of two instruments (Seaguard with a string of sensors and RDCP) to which the following sensors are connected:

- @ 9 m: C and T
- @12 m: O2, pCO2, and T
- @15 m: O2, C and T
- @18 m: C and T
- @21 m: O2, C and T
- @28.5 m: O2, T, P, horizontal currents
- @40.5 m : O2, C, T, P.
- 3D Current profile, starting 3 m above bottom, currents every 1 m including the surface.

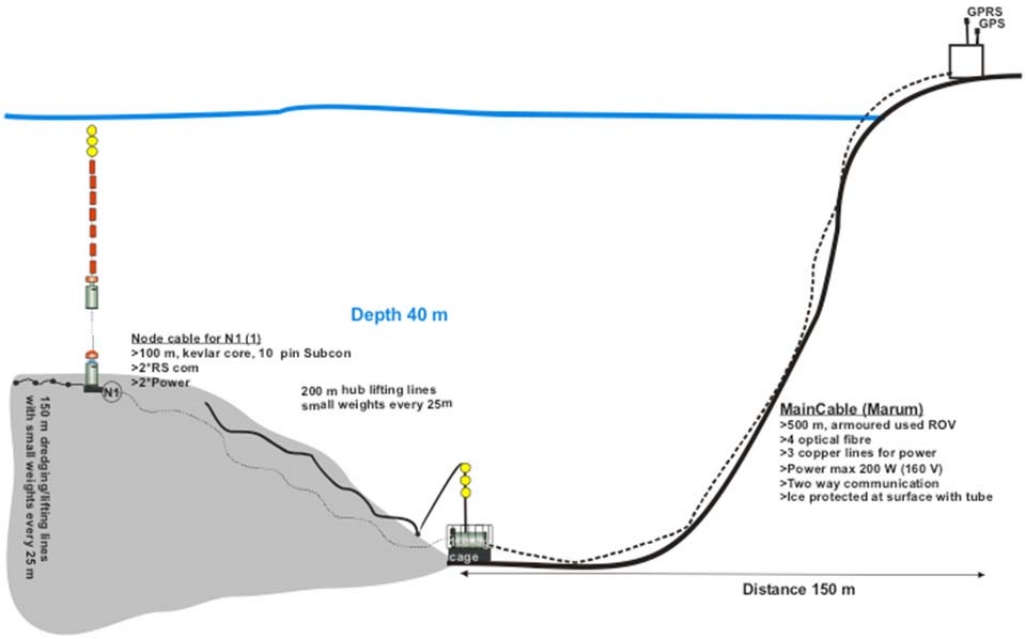
C/T measurements: sensor model 4319A (9-21 m)
O2/T measurements: optode sensor model 4835 (9-21 m) and 4330 (28.5 m)
P/T measurements: tide sensor model 4647C (28.5 m)
Horizontal currents: Doppler current sensor DCS 4420 (28.5 m)
3D current profile: Doppler current profiler RDCP600 (40.5 m), also O2 optode model 3830, C/T sensor 3919A, P sensor 3187 and T sensor.
Measurement interval that has been used 2-30 min.

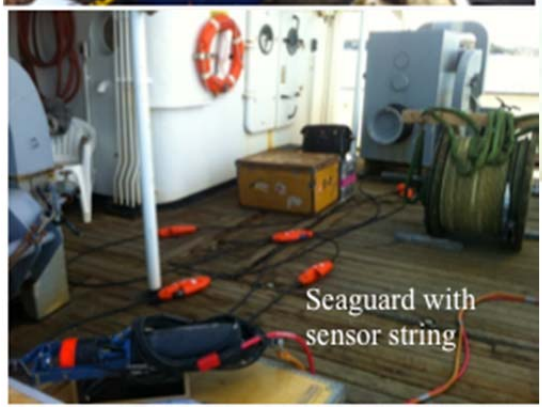
There is also an additional autonomous monitoring module, which is measuring at 10 min interval close to surface. It is deployed away from the fairway and offline, with data stored internally the sensors deployed are:

- @ 4 m: O2 and T (optode 3830), C and T (cond sensor 3919A)

All sensors are from AADI (http://www.aadi.no/). The infrastructure (hub, node cables, land cabinet) was delivered by Develogic (http://www.develogic.de/).

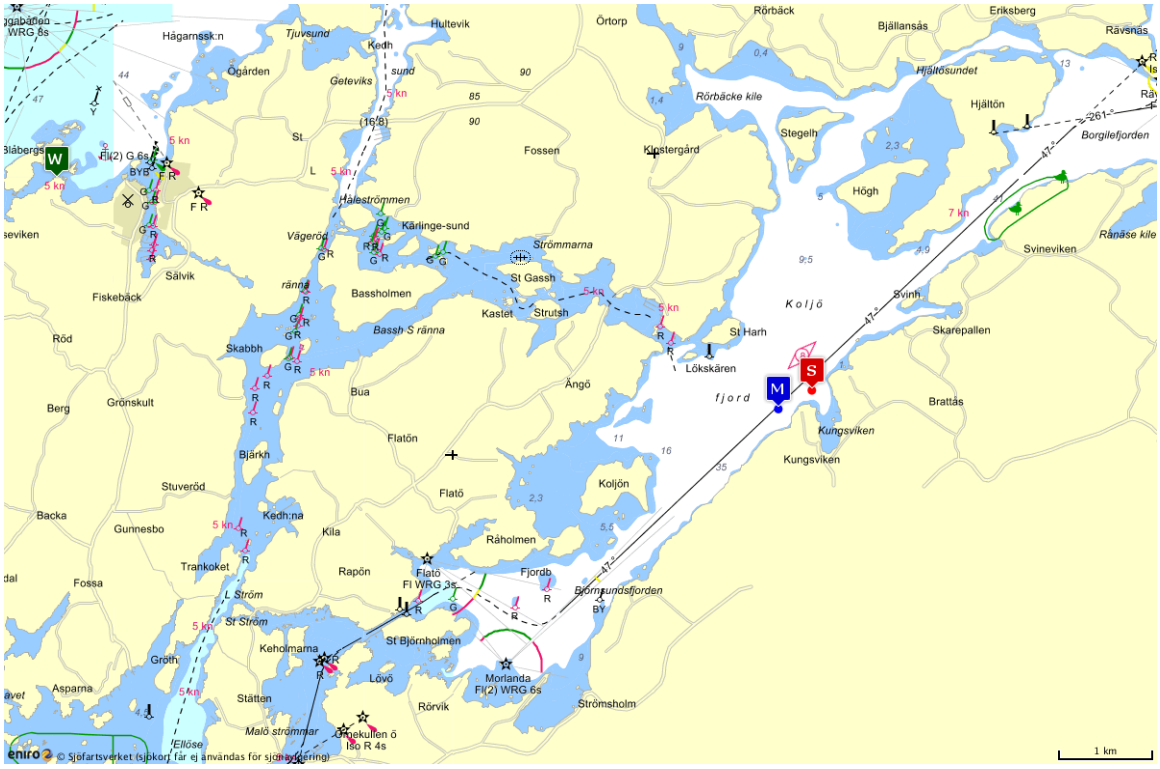
Koljofjord Observatory





Monthly high quality reference data

The observatory is deployed very close to a sampling site of a monthly survey program run by SMHI (Swedish Meteorological and Hydrological Institution), see Fig. below. For comparing current speed measurements with surface currents and mixing we use wind data from Kristineberg Weather Station (at Sven Loven Marine Research Center run by University of Gothenburg). All the reference data are available online and retrieved for displaying automatically from the web databases:
SMHI: http://www.smhi.se/oceanografi/oce_info_data/SODC/download_sv.htm
Kristineberg: http://www.weather.loven.gu.se/data.shtml



The Koljoe Fjord, markers: blue “M” for the main observatory mooring, red “S” for the SMHI sampling site, green “W” for the Kristineberg weather station. The map is created using the Eniro static map API. See http://kartor.eniro.se, Sea Chart.

SMHI data used:

- Depths 5, 10, 15, 20, 30, 39 m (0 and 2 meters are also available)
- Salinity, Temperature, Oxygen are used (Nutrients and some other parameters are available too)

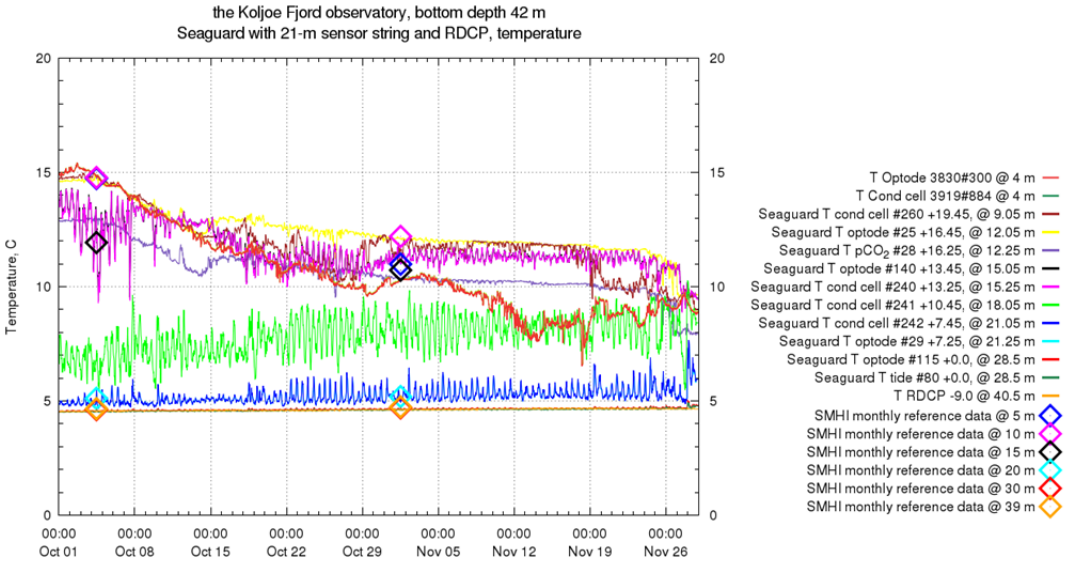
Weather data used:

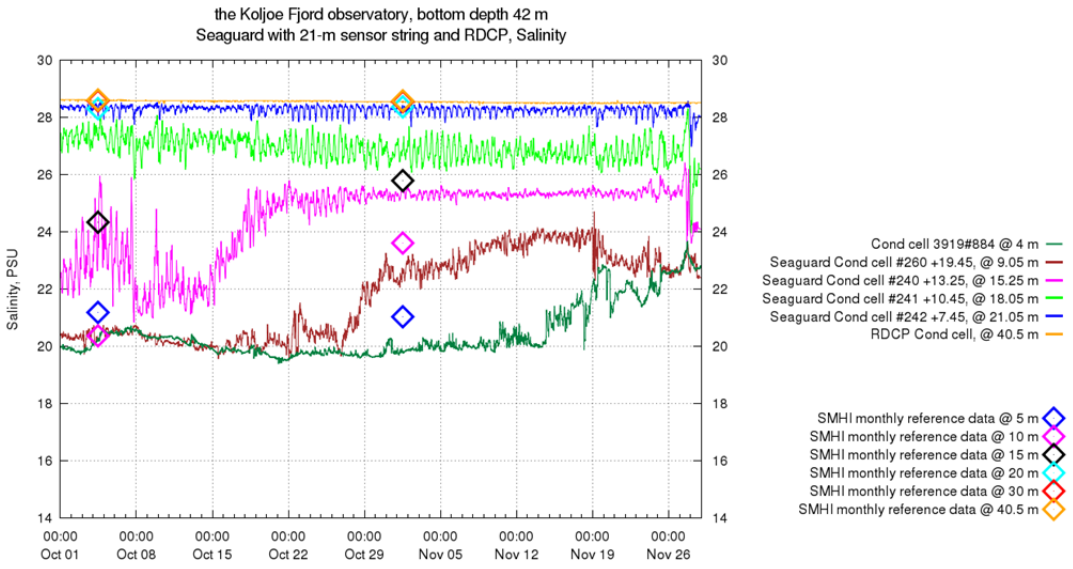
- Wind speed and direction. Many other parameters are available.

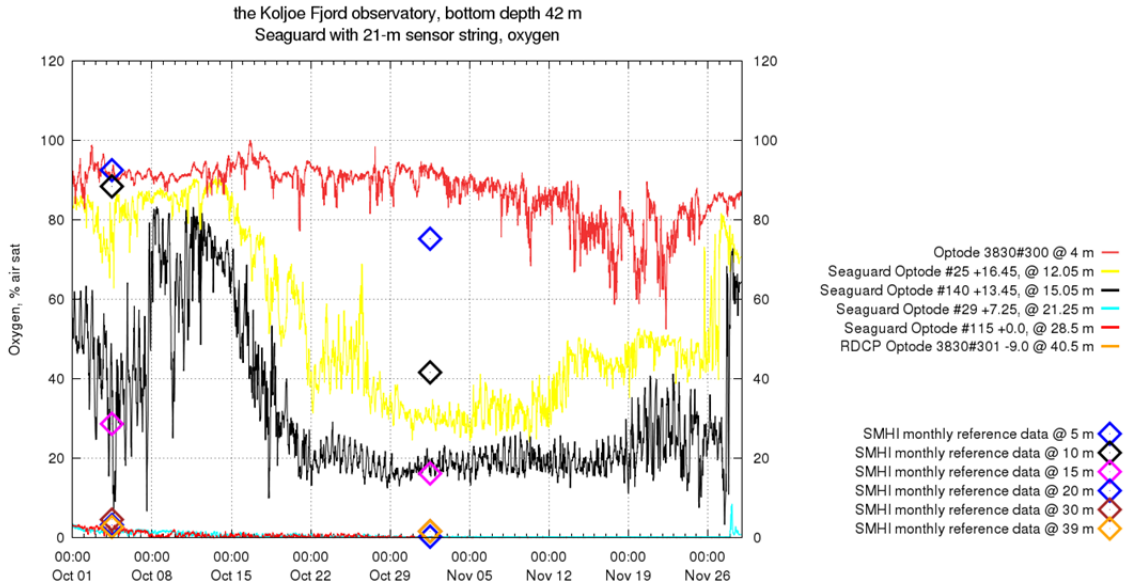
Examples of results

The latest ~5 weeks of data can be checked on the web:
http://mkononets.dyndns-home.com:8080/cgi-bin/recent_data_plots.script

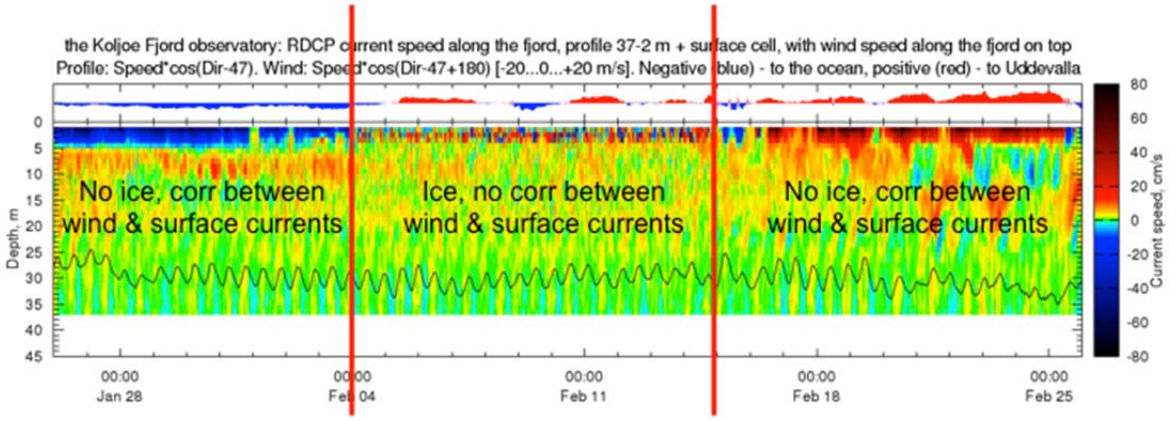
Tidal oscillations result in strong variations in the intermediate layer. Within a few hours temperature can vary with up to 5 C, salinity with up to 2-3 PSU, oxygen with up to 70% air saturation (see figures below). This and because the depth of sensors and reference water sampling are not always the same differences occur frequently between observatory and reference data. Outside the intermediate layer (close to surface and deeper) agreement to reference data is generally good. A possible source of errors appears at low oxygen where reference Winkler data gave higher values probably due to contamination during sampling. Biofouling was observed for O_2 and Conductivity sensor data measured close to surface (result in lower readings) in July-September 2011. Reference data are invaluable in helping to identify this type of interference and to plan how frequently sensors should be cleaned.

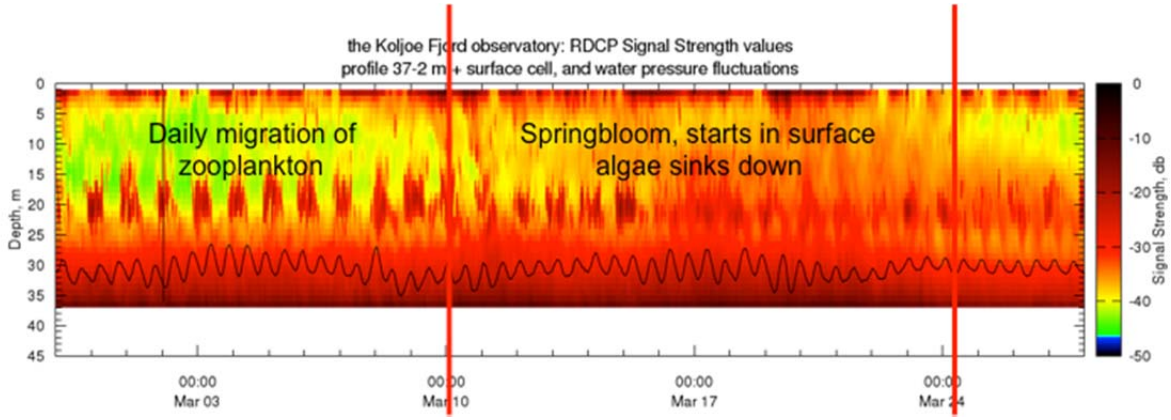




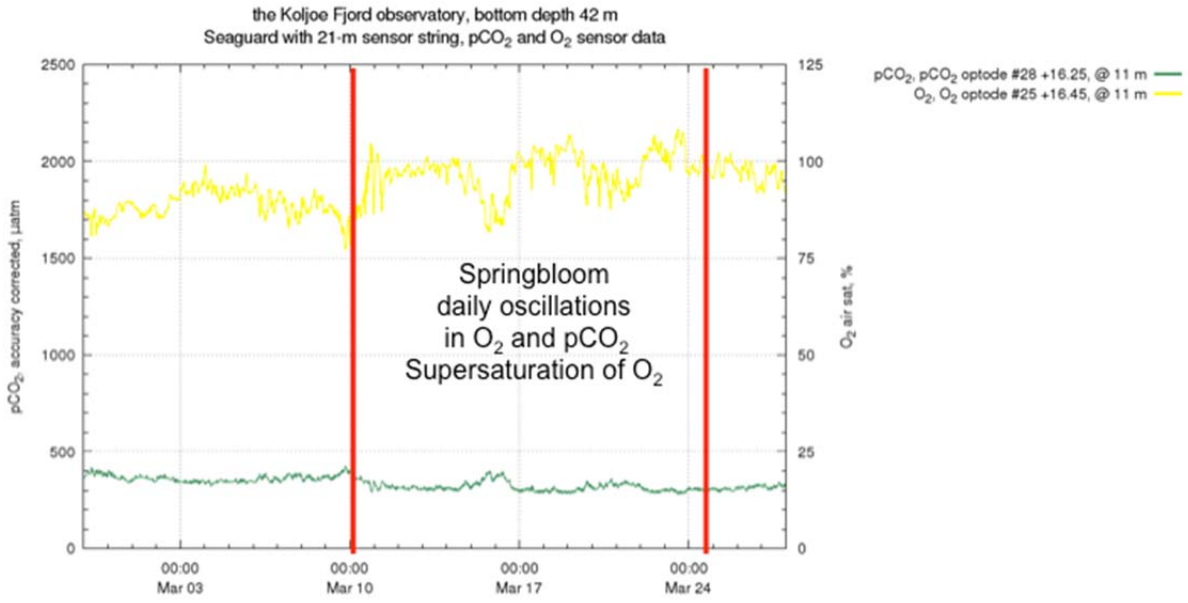


The RDCP-600 scan the entire water column and give valuable information about currents and mixing. Onset of other events such as when ice is forming, migration of zooplankton and the spreading of phytoplankton from the spring bloom are other events visible in the data (see below).

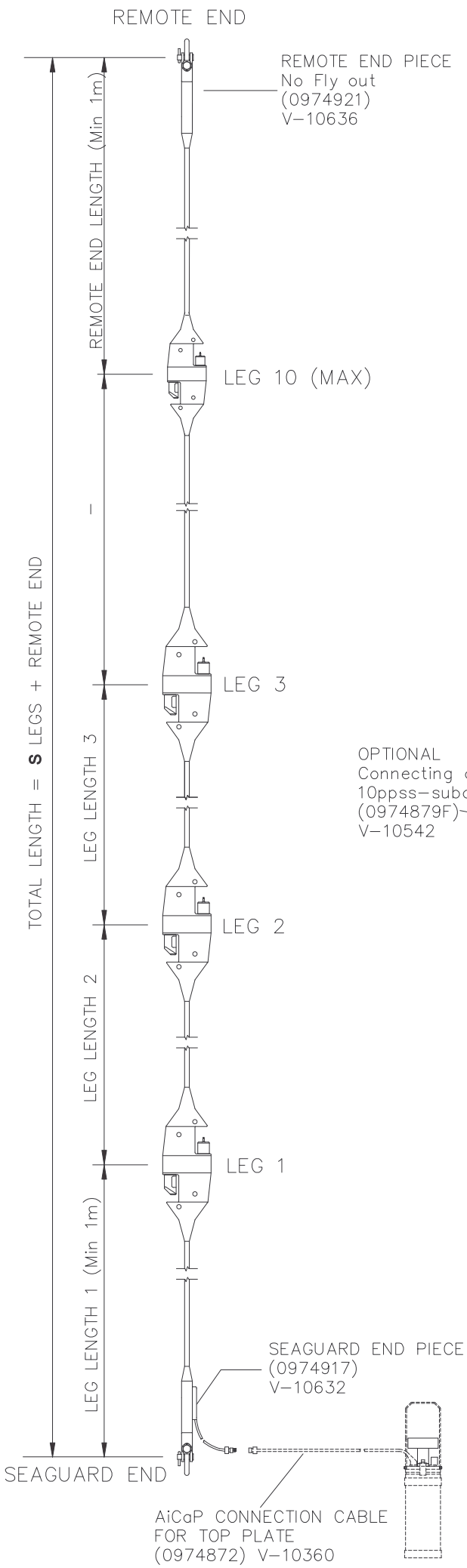


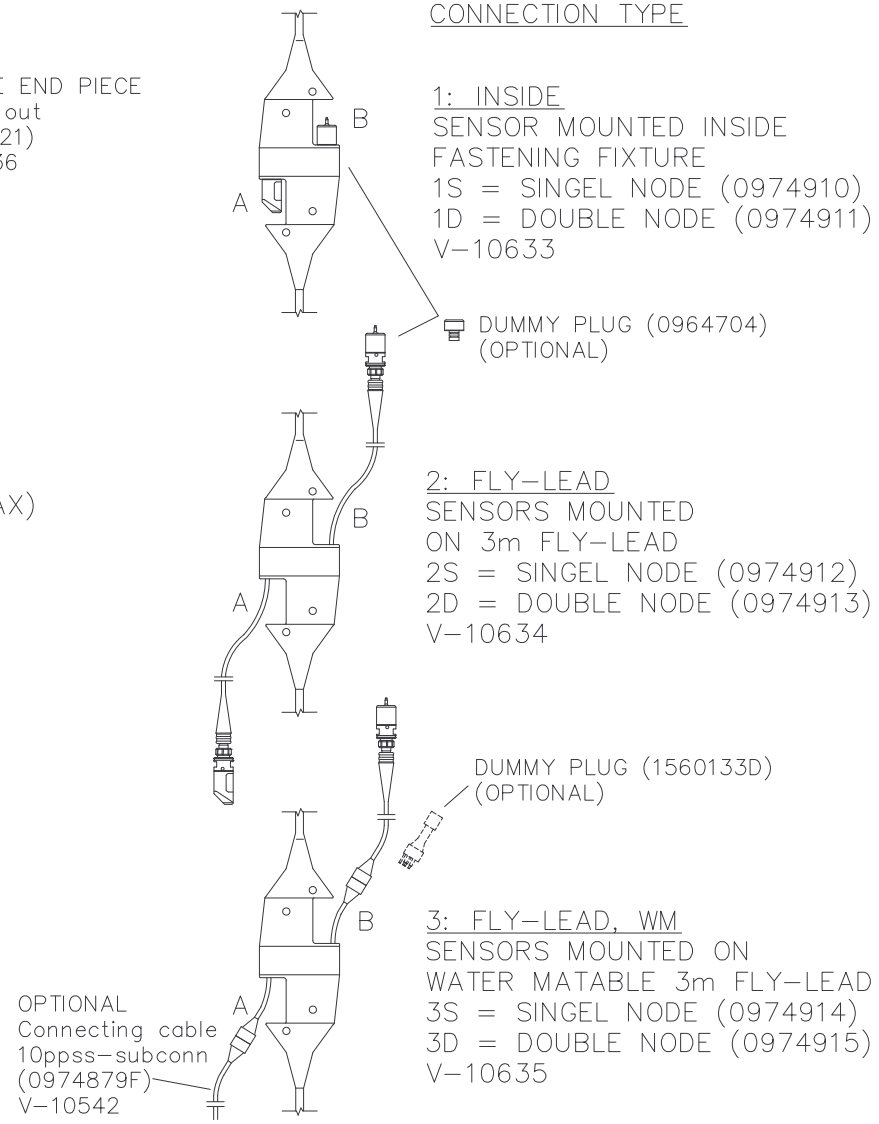


Another function of the Koljoefjord observatory is to serve as a test and development facility for instruments and sensors. The observatory is located 1h sailing time from Kristineberg Research station (http://www.loven.gu.se/english/stations/kristineberg/) where ships/boats/labs/accommodations are available. The observatory can provide power and has free ports with Ethernet/RS232/RS422/AiCaP/Analog communication. New pCO_2 optodes have/are being tested on the observatory demonstrating excellent long-term stability and, as expected, a high anti-correlation with oxygen measured at the same level (see Fig. below).
Lifting nodes or the hub for service/cleaning or to add remove sensors is done by drag lines placed on the bottom. The lifting procedure normally takes about 10 min and require no diver or ROV.



S-7043A





SEAGUARD STRING 4732S, SERIAL NO.411				
STRING CONFIGURATION				
LEG NR.	LENGTH* (m)	CON. TYPE	POS. A	POS. B
1	1	1D	DUMMY	COND
2	3	1D	DUMMY	OXYGEN
3	3	1D	DUMMY	COND
4	3	1D	DUMMY	OXYGEN
5	3	1D	DUMMY	COND
6	3	1D	DUMMY	OXYGEN
7	3	1D	DUMMY	COND
8	–	–		
9	–	–		
10	–	–		
REL**	1	N/A		
TOT. LENGTH	20			

*LENGTH FROM PREVIOUS TO ACTUAL LEG.
**REL = REMOTE END LENGTH

Date: 26.06.09	Constr. by: SG	Drawn by: GN	Ref.: 44250	Date:	Version:	Approved:
SEAGUARD SENSOR STRING GØTEBORG UNIVERSITY (AiCAP ONLY)				05.10.09	A	
				Corrected by:		
AANDERAA DATA INSTRUMENTS 5851 BERGEN, NORWAY-TEL.+47 55 604800-FAX +47 55604801				S-7043		

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SEAGUARD® String system

The AADI SEAGUARD® String System is a complete and flexible subsea observatory, for measurements of e.g. dissolved oxygen, conductivity, temperature, current, pressure and tide etc.

SEAGUARD® String Logger

The AADI SEAGUARD® String Logger is the basic module of the SEAGUARD® String System. The SEAGUARD® String Logger is capable of handling a large number of sensors. Data stored on internal SD-card or Real-time via cable.

SEAGUARD® Sensor String

The new AADI SEAGUARD® Sensor String is designed to be connected to the SEAGUARD® String logger. The SEAGUARD® string system can hold up to 25 AiCaP Sensors. Real-time communication and control is available using the AADI Real-Time Collector.

Advantages:

- Great flexibility: data registration from up to 25 nodes
- Customer specified outlet positions
- Protective fastening fixture with hydrodynamic design
- Each outlet position can hold 2 sensors inside
- Optional, sensors can be connected on fly leads (up to 3m) with or without underwater mateable electrical connectors
- Up to 300m cable length
- Low maintenance
- Extended RAM for large number of nodes
- Large storage capacity on an SD card
- Real-Time XML Output RS-422 (optional)
- Short recording interval
- Plug and play sensor configuration
- AiCaP communication bus for automatic detection and recognition of sensors at power up
- Windows CE interface, display in colours
- SEAGUARD® Studio visualization software
- 300m/2000m/6000m version
- External power supply 12 - 30V internally regulated
- Up to 4 Analog sensor input (0-5V) (optional)
- For use in sea and fresh water

SEAGUARD® String system

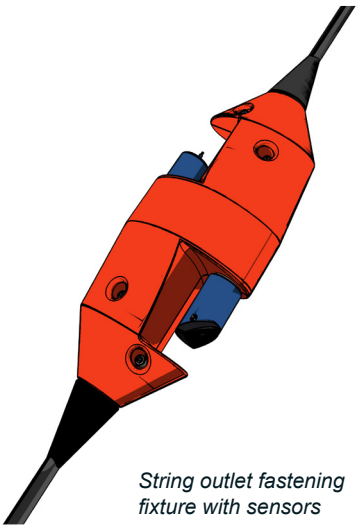
The SEAGUARD® Sensor String is designed to be connected to the SEAGUARD® String Logger. The string system can hold up to 25 AiCaP sensors. The design of the cable ends enables easy extention of the cable or creation of suitable cable subsections; the maximum cable length is 300m. The positions of the string outlets are customer specified.

The SEAGUARD® Sensor String offers a highly flexible configuration making the system a perfect tool for measurements of e.g. dissolved oxygen, conductivity, temperature, pressure and tide etc. A typical application is monitoring of a water column. The fly lead option is suitable for measurements in biological sensitive areas, e.g. coral reefs.

Sensors and SEAGUARD® string mounted onto the Top-end plate are connected to a hub underneath the Top-end plate: simply plug the sensor/string onto the Top-end plate, fasten a set screw, start the instrument, and all sensors are automatically detected and recognized.

The SEAGUARD® String Logger and the AADI smart sensors are interfaced by means of a reliable CANbus protocol (AiCaP) using XML for plug and play capabilities. During power-up, each of the sensors that are connected to the bus will report their capabilities and specifications to the string logger. The string logger then assembles the information and provides the user with the possibility to configure the instrument based on the present nodes. The solution provides for great flexibility in both use and design of the different elements within the system.

String Logger with 300 meter pressure case



String outlet fastening fixture with sensors

SEAGUARD® String Logger is a self recording instrument with data storage on an SD card. The current capacity for this card type is up to 4GBytes, more than adequate for most applications. The instrument is delivered with pressure case, in either 300, 2000 or 6000 meter version. The SEAGUARD® String System can be used with AADI Real-Time Collector for real-time data and real-time communication with the stringlogger.

The output parameters are readable in engineering units; the parameters are easily presented in the post processing software, SEAGUARD® Studio. Each sensor connected to the string can be tagged with e.g. the depth position for easy recognition of correct parameter.

The Top-end plate of the SEAGUARD® String Logger can hold 6 sensors; 4 of which can be analog (0 - 5V) sensors.

The SEAGUARD® String Logger has 2 battery compartments for long deployment time; the AiCaP CANbus based protocol ensures low power drain.

The autonomous sensor topology also gives the sensor designer flexibility and opportunities where each sensor type may be optimized with regard to its operation, each sensor may now provide several parameters without increasing the total system load.

The SEAGUARD® String Logger can be configured to suit your requirements and applications.

The SEAGUARD® String System can be deployed in an in-line string mooring, fixed bottom frame mooring, buoy deployment, long term/short term deployment.

Specifications

Stringlogger capability: Up to 25 nodes can be connected to the String Logger

Sensor node capability[1]: Up to 6 sensors can be mounted onto the Top-end plate, of which 4 can be analog sensors (0-5V), and 1 can be a SEAGUARD® String (max 300m)

Outlet capacity: 2 sensors per outlet. Single sensor option available on request.

Outlet position: Customised (on the cable)

Sensor protocol: AiCaP CANbus based protocol

Serial communication: RS-422

Outlet dimensions: 344x150mm (LxW)

Cable length: Maximum 300m

Cable breaking strength: Maximum 2300kg

Cable capacity: Maximum 20 AiCaP sensors including DCS and other sensors on the Top-end plate

Recording system: Datastorage on SD card

Storage capacity: ≤ 2GB

Battery: 2 batteries inside the instrument

- alkaline 3988: 9V, 15Ah (nominal 12.5Ah; 20W down to 6V at 4°C)
- or lithium 3908: 7V, 35Ah

External battery: 7-14 V. Diode protection required, unconditionally, when using an external battery. Internal power boost.

External power[2]: 12 - 30V, 2A (depends on supply cable). External power through string or separate cable. Internal power boost.

Recording interval: From 2s, depending on the node configuration for each instrument

Recording settings: Fixed interval settings or customized sequence setting

Operating temperature: -5 – +40˚C (23 – 104˚F)

Depth capacity: 300m/2000m/6000m

String Logger dimensions:

300m version (SW):	H: 356mm OD: 139mm
2000m version (IW):	H: 352mm OD: 140mm
6000m version (DW):	H: 368mm OD: 143mm

External materials:

300m version:	PET, Titanium, Stainless Steel 316
2000/6000m version:	Stainless steel 316, Titanium, OSNISIL,

Fastening fixture material: PA66

Optional sensor connections: up to 3m fly leads In-line underwater mateable connector on fly leads

[1] The total number of sensors depends on type of sensor

[2] External Power is required in applications with long deployment time and/or long string length

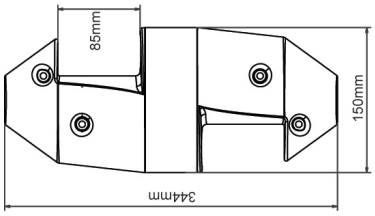
Specifications subject to change without prior notice.

Weight:	in air	in water
300m version (SW):	5.9kg	1.5kg
2000m version (IW):	11.8kg	7.1kg
6000m version (DW):	12.7kg	8.3kg

Cable weight in air: ~40kg per 100m cable

Outlet weight in air: <1kg ex sensors

Outlet fastening fixture



Accessories included:

SEAGUARD® Studio
SD card: 2 GB
Alkaline battery 3988
Documentation on CD

Optional accessories:

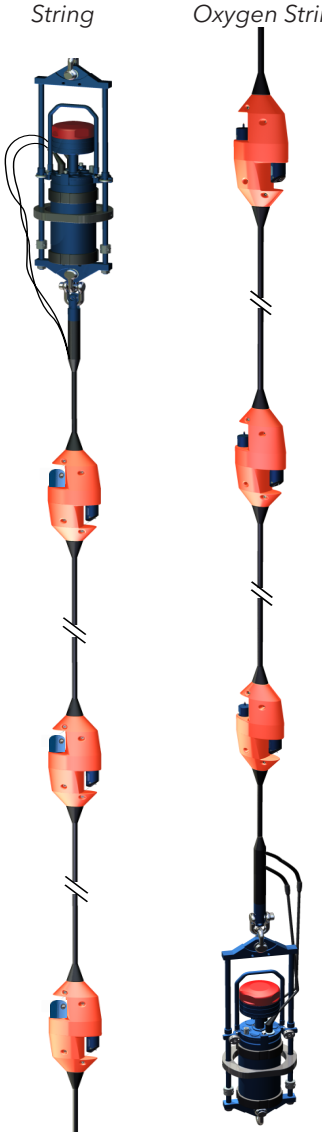
Carrying handle 4132,4032,3965
SD card with capacity up to 4GB
AC/DC adapter 4908 for lab use
Real-time licence and collector 4715
Offline Configuration 4811
In-line mooring frame 4044/ 3824A,
Protecting rods 3783
Bottom mooring frame 3448R
Internal lithium battery 3908
Internal alkaline battery 3988
Internal battery shell 4513
Maintenance kit 3813/3813A
Tools kit 3986A
Conductivity sensor 4319, refer D369
Temperature sensor 4060, refer D363
Temperature sensor 4880, refer D391
Pressure sensor 4117, refer D362
Oxygen optode 4330, refer D378
Turbidity 4112 (analog), refer 377
Electrical terminal for cable connection
Real-time cables 4902/4901
Analog cable/license 4564/4802
SEAGUARD® end cable 4784
AiCaP connection cable 9634
SEAGUARD® end cable 9635

for optional cables refer *www.aadi.no*
SEAGUARD® product tag
for current measurements, refer
SEAGUARD® RCM (D368)
for wave and tide measurements, refer
SEAGUARD® WTR (D386)

SEAGUARD® String system

CT String

Temperature - Oxygen String



AADI Real-time

The data message from the instrument is in XML format.
A user application can access the AADI Real-Time Collector over the Internet or Intranet. Each user application will experience an individual connection to the instrument data due to a queue management system in the collector. One license per SEAGUARD® instrument serves multiple user applications. Including AADI Real-Time Collector, AADI Real-Time Viewer, Style Sheets and example application. (Refer B163)

Available sensors for string or top-end plate

Examples of string configurations.
Leftmost:
String below instrument with Conductivity and Temperature sensors monitoring the water column.
Rightmost:
String above instrument with Temperature and Oxygen sensor.
Note! The platform can also be equipped with optional sensors.

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Let's Solve Water

Visit our Web site for the latest version of this document and more information
www.aadi.no

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D388 - March 2012

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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 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.

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 512MByte.

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.

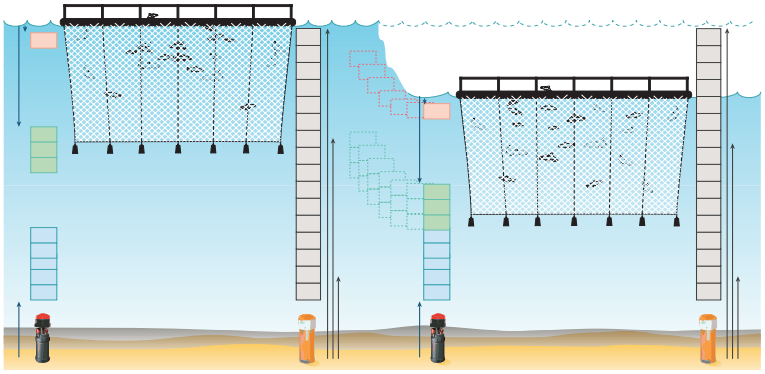
Optional Parameters: Oxygen, Turbidity.

Instruments with Doppler shift technology are insensitive to fouling

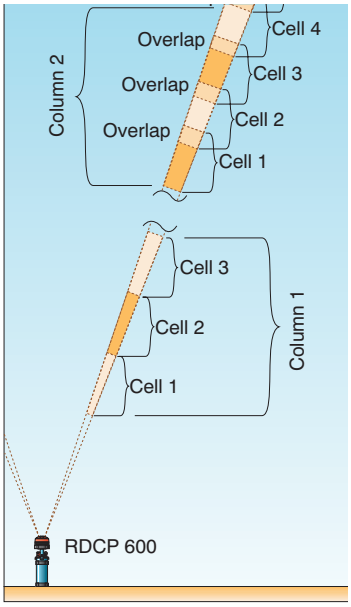
Basic Description and Features

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 distant 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%).

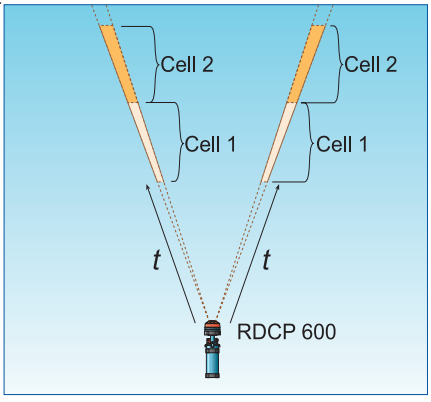
Downwards or upward looking RDCP:

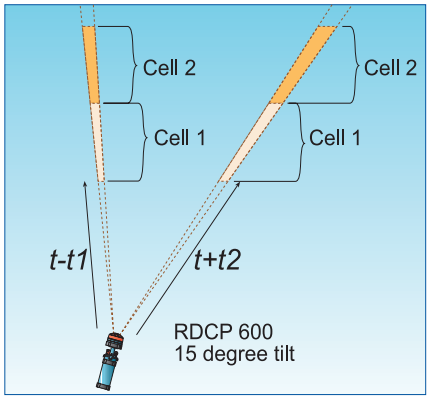
The internal compass enables a downwards looking deployment as well as an upward looking; simply select the deployment situation in the deployment configuration.

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°.

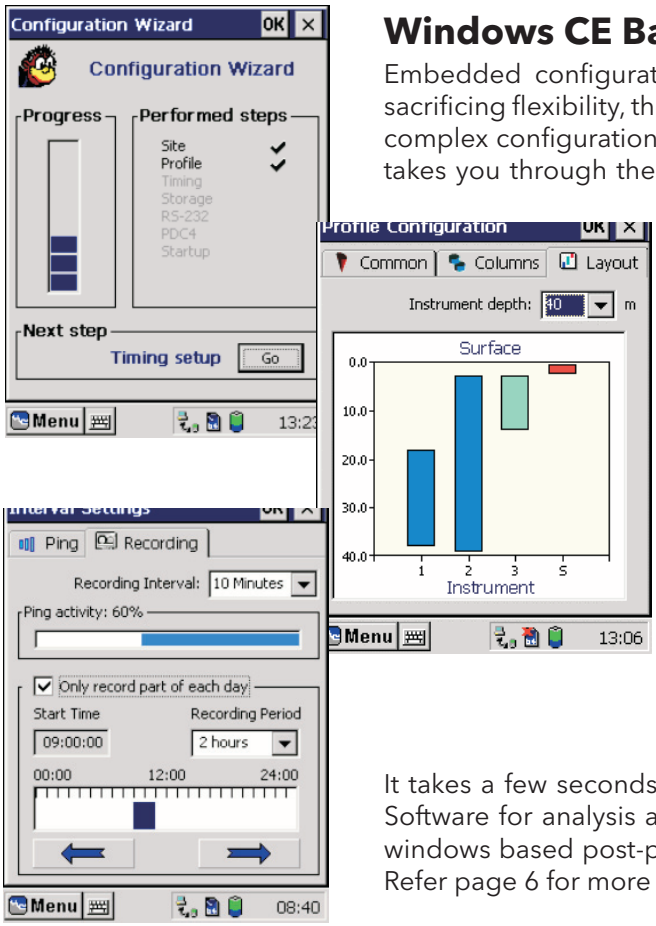




Soundspeed compensation:

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

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.

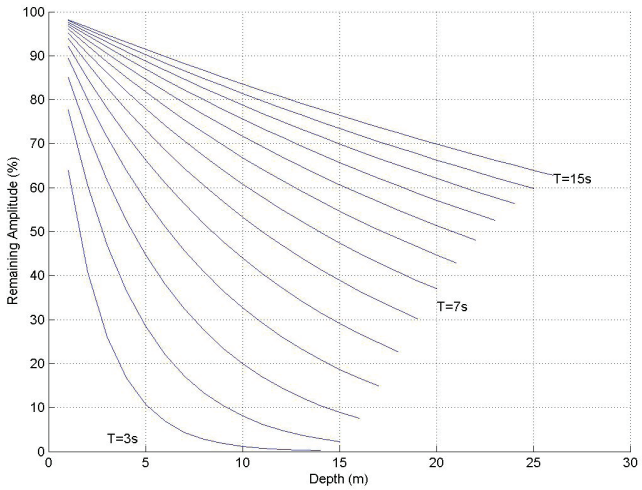
Fast data retrieval:

It takes 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, 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
- 512MByte 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 sensor or interface features comprising
  - RS-232/RS-485 real-time output
  - 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 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:

- 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
- Inline mooring frame
- Extra protecting rod for inline 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 AADI Real-time system
- MMC card reader for USB port
- 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*

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

Conductivity Sensor
Accuracy: 3919A/4019A ±0.005S/m
3919B/4019B ±0.0018S/m
Resolution: 0.0002S/m

Temperature Sensor 4050
Accuracy: ±0.03°C
Resolution: 0.001°C

Quartz Pressure Sensor 3187
Accuracy: ±0.04% FSO
Resolution: ±0.02% FSO

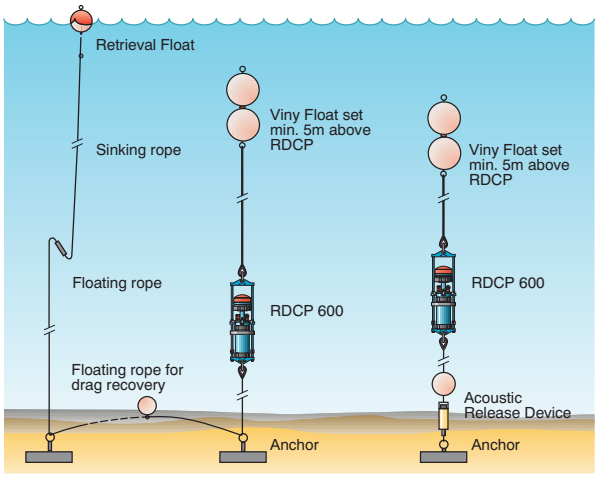
Examples of use:

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 Applica-

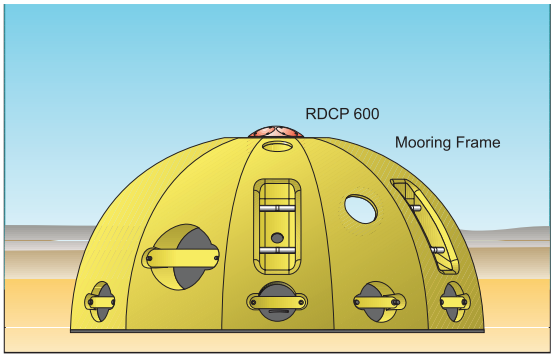


The RDCP can be deployed using

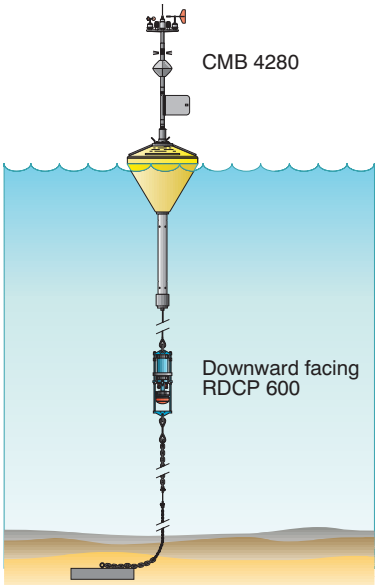
- An In-Line string mooring
- A Fixed Bottom Frame mooring
- A Data Buoy
- An existing fixed installation, like e.g. a quay

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 (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 aadi.info@xyleminc.com 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.

Bottom Frame

A new bottom frame has been designed for 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; AADI 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.

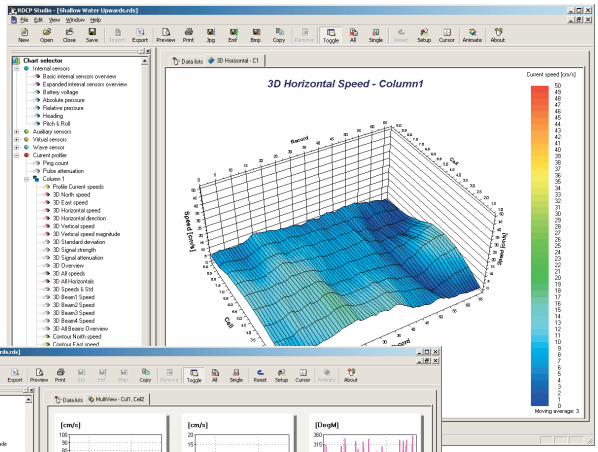
Bottom frame Specifications:

Weight:	50 kg 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

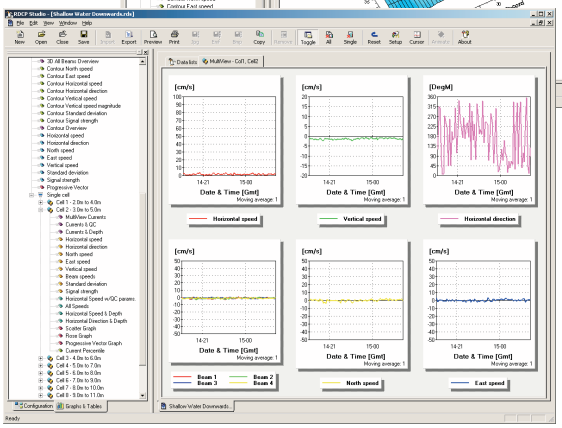
RDCP Studio

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 (info@aadi.no).



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:

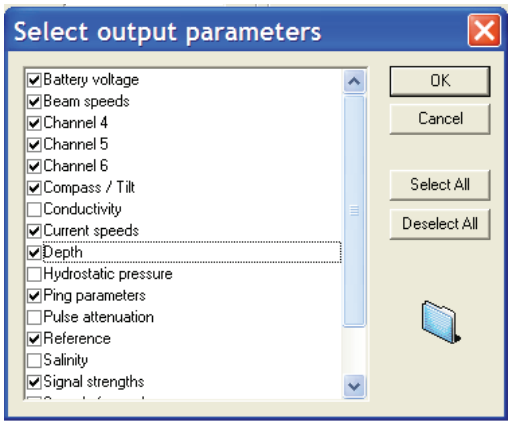
- Import deployment data collected by the RDCP 600 on either the MMC or CF card.
- Display configuration setting used in the deployment.
- List and edit listed data.
- Export data to ASCII text files.
- Display 2D and 3D presentations of single cells or complete profiles.
- Customize 2D and 3D graphs 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 RS485 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

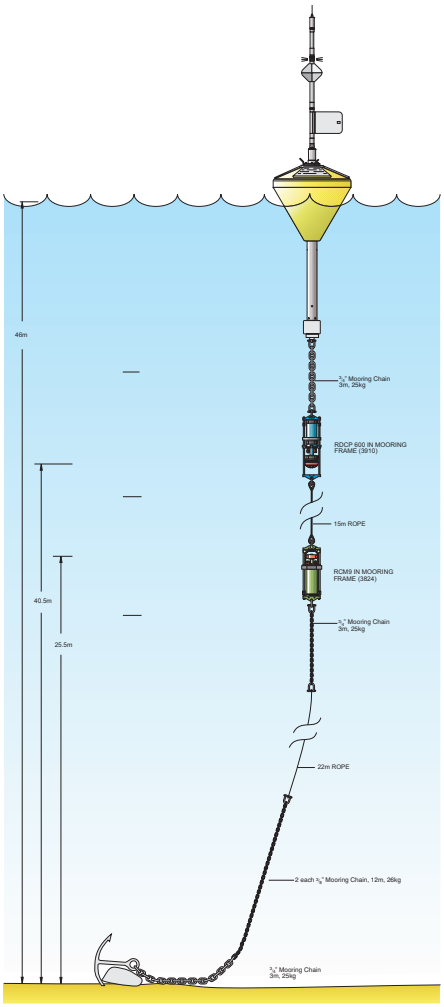


output parameters just as you can directly from the instrument, refer figure to the right. The ActiveX based interface software component also stores incoming data to an internal history buffer.
Please contact factory before ordering the Active-X based interface software component.

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.

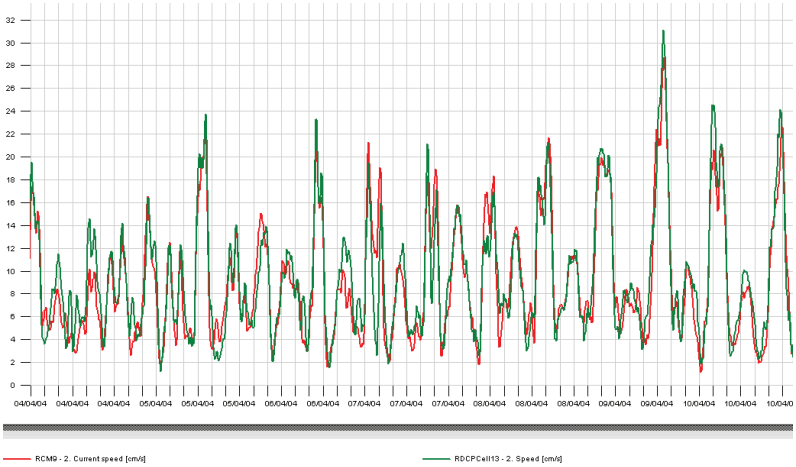
The RCMs have been on the market for a long time, and have proven to be reliable and robust. The RDCP 600 is developed based on the same acoustic technique, hence a comparison between the RCMs and the RDCP 600 indicates the instruments reliability as well. Refer Data Sheet D 331 for RCM 11 measurements 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.

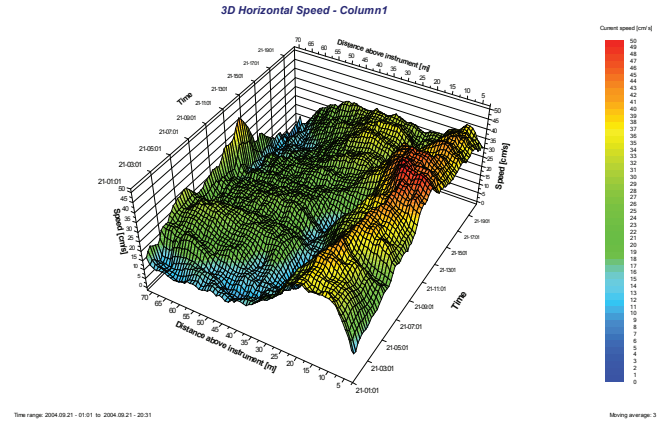
RDCP 600: Burst mode, 2m cell size, 2m pulse length, 50% cell overlap, 300 ping, 10 minutes recording interval. The deployment depth was 6m below the surface. The Instrument was facing downwards.RCM 9: Burst mode, 10 minutes recording interval. The deployment depth was 21m below the surface.



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 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]: 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, 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 lenght[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 360
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

Dimention 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 aadi.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

Visit our Web site for the latest version of this document and more information
www.aadi.no

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