RCM Blue 5450

/AANDERAA

a **xylem** brand

1st version	27 February 2013	PRELIMINARY
2nd version	19 April 2013	Updated with new features
3rd version	12 August 2016	General updates and description of new Pressure Sensor

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Introduction

Purpose and scope

This document describes the Aanderaa RCM Blue 5450; how to operate and maintain the instrument, and how to configure and communicate with the instrument through the Bluetooth.

Document overview

CHAPTER 1 gives a short description of the Aanderaa RCM Blue 5450.

CHAPTER 2 gives an overview of sensor output parameters.

CHAPTER 3 describes wireless connection to PC.

CHAPTER 4 describes configuration of the Aanderaa RCM Blue using AADI Real-Time Collector.

CHAPTER 5 describes how to view data in Aanderaa Data Studio.

CHAPTER 6 describes operating instructions.

CHAPTER 7 describes maintenance issues.

Appendix 1 gives a short introduction to the ZPulse® DCS technology

Appendix 2 gives a definition of terms

Appendix 3 gives a block schematic of Doppler Current Sensor

Applicable documents

V11463	Assembly Drawing, RCM Blue
Form 754	Test & Specification Sheet, RCM Blue
TN236	Calibration Accuracy DCS products
D406	Data sheet, RCM Blue

Abbreviations

ADC	Analogue to Digital Converter
ASCII	American Standard Code for Information Interchange
CAN	Controller Area Network - referred to as CANbus
DAC	Digital to Analogue Converter
DCS	Doppler Current Sensor
DSP	Digital Signal Processor
EIA	Electronic Industry Alliance
EPROM	Erasable Programmable Read Only Memory
RTC	Real Time Clock
UART	Universal Asynchronous Transmitter and Receiver
UNESCO	The United Nations Educational, Scientific and Cultural Organization
USB	Universal Serial Bus

CHAPTER 1 Illustration and short description of RCM Blue

The Aanderaa RCM Blue is a single point ZPulse recording current meter based on the Doppler principle. Refer Appendix 1 for a description of the measurement principle of ZPulse DCS.

The instrument is intended for use as a standalone recorder for moored applications and includes a battery container and data storage. The RCM Blue is depth rated to 300m.

Bluetooth and storage

Status LED and Temperature probe

Battery container ON/OFF switch inside
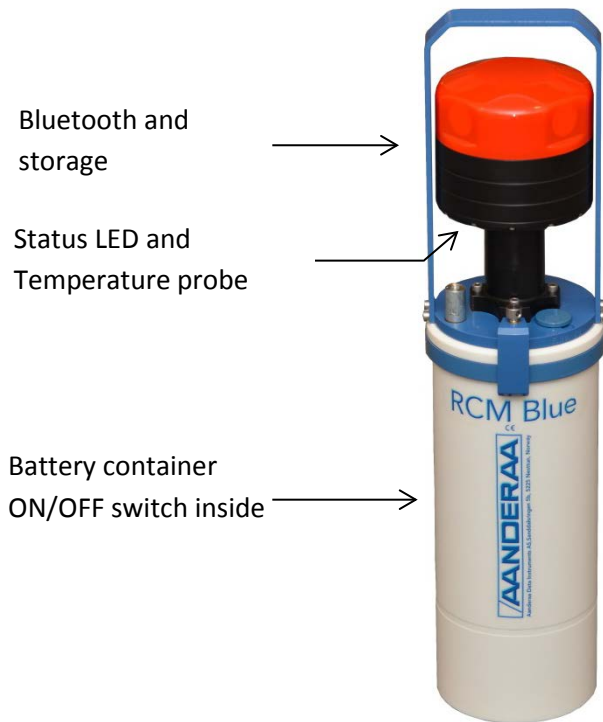
Features

- The instrument is configured in AADI Real-Time Collector (PC software) using Bluetooth connection between the PC and the instrument.
- Measured data are stored in the instrument; data are easily transferred to PC using Bluetooth .
- The instrument can start immediately or be configured with delayed recording start.
- The instrument will automatically detect if it is deployed in water; the acoustic transducers are automatically activated in water and automatically deactivated in air.
- The status LED provides information about the instrument operating status as e.g. if the instrument is armed, if recording, if Bluetooth is activated, or error state. Refer Table 1-1 for the different LED signals.
- When the recording is stopped it will enter sleep state after a short time without instrument operation. We recommend that you switch the instrument OFF for long time storage.
- Build-in temperature measurement and optional pressure measurement available.

Table 1-1 Interpretation of status LED signals.

LED signal		Description of LED signal
Color	Pattern	
Green	Blink	RCM Blue is recording. Pinging is active (instrument in water) Blink for each ping and every 8 sec. between pings.
Green	Double blink @0.125HZ, 8 sec. interval	RCM Blue is armed for a delayed start
Yellow	Blink	RCM Blue is recording. Pinging is deactivated (instrument in air) Blink for each (deactivated) ping and every 8 sec. between pings.
Yellow	Continuous	Bluetooth is activated and ready for connection
Blue	Continuous	Bluetooth connection is established and open
Blue	Blink	Bluetooth connection is established and open and recorder is running.
Red	Blink	The number of stored folders has reached at least 80% of maximum. If this happens we recommend to delete old folders before deployment
Red	Continuous	Error state or number of max folder on SD card is exceeded.
None	More than 10 sec.	Instrument has stopped recording or is not powered.

1.1 Transducer orientation

The four horizontally outward facing transducers are placed with 90˚ spacing around the transceiver head, i.e. two and two transducers are placed on the same axis. The axis formed by Transducer 1 and 3 are called the X-axis and the axis formed by Transducer 2 and 4 are called the Y-axis. The LED and temperature probe are close to Transducer 4.
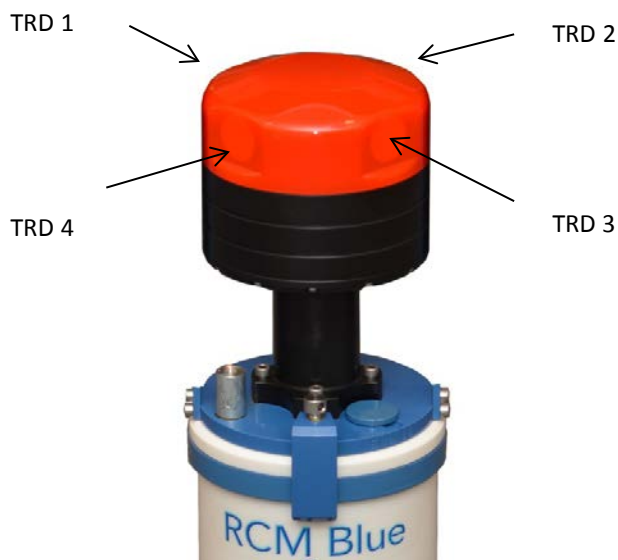
Figure 1-1 Orientation of RCM Blue

1.2 Current measurements

To minimize the effect of marine fouling and local turbulence, the RCM Blue measures the horizontal current at least 0.4 meter (minimum blanking distance) away from the instrument, refer Figure 1-2.

To avoid problems with turbulence in the beams caused by the instruments itself a "forward ping" setting is available. If "forward ping" is activated the instrument will try to only measure upstream. It will try to only ping with the transducer on each axis that returns a positive Doppler shift. This is done to avoid measurements in the wake of the instrument.

The current measurements are compensated for instrument tilt and referred to magnetic north by using an internal solid state compass. The instruments motion compensation is performed at 1Hz during the sampling period. Current speed and direction is vector averaged over the last minute of the recording interval in "Burst Mode' or is measured in evenly spaced samples during the sample interval in "Spread Mode".
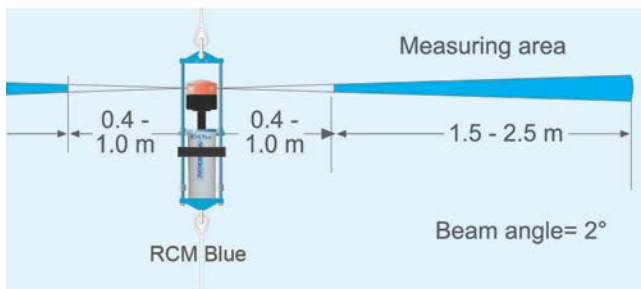

Figure 1-2 Measuring area of RCM Blue.

1.3 Standard RCM Blue 5450

The complete RCM Blue instrument 5450 as delivered from Aanderaa Data Instruments includes:

- 1 battery package, alkaline
- 1 empty battery shell (for e.g. lithium batteries)
- 2 magnetic tip pens to activate Bluetooth (one located inside the battery container).
- USB to Bluetooth adapter
- Configuration software, AADI Real-Time Collector
- Data visualization and analysis Software, Aanderaa Data Studio.
- Documentation CD including operating manuals and SW installation files.

1.4 Pressure meassurement

When using RCM Blue to collect current data there are in some applications a needs to validate that the data is collected at the correct depth. An Aanderaa pressure sensor on the top end plate will then measure the actual pressure and covert this to depth using fixed values for air pressure. Additional part needed:

- Aanderaa Pressure Sensor 4117
- Patch Cable 5623

1.5 Optional accessories for RCM Blue 5450

- In-line mooring frame 5744/4044/3824A
- Bottom mooring frame 3448R
- Protecting Rods 3783
- Internal Lithium battery 3908
- Internal Alkaline battery 3988
- Internal Battery Shell 4513
- AC/DC adapter, lab. 4908
- Maintenance Kit 3813
- Tools kit 3986A
- Vane Plate 3781,3681

1.6 Specifications for Aanderaa RCM Blue 5450

For detailed specifications refer Datasheet D406 which is available on our web site www.aadi.no or contact aanderaa.info@xyleminc.com

You will find the latest versions of our documents on the web.

CHAPTER 2 Parameters

Table 2-1 Overview of available data parameters for Aanderaa RCM Blue.

Parameter	Unit	Description
Abs speed	cm/s	The average absolute speed from the orthogonal current vectors (vector averaged).
Direction	°M	The current direction, i.e. the direction of the absolute speed vector referenced to magnetic north.
North	cm/s	North current speed vector.
East	cm/s	East current speed vector.
Heading	°M	The last measured compass heading during a sample interval.
Tilt X	Deg	The last measured tilt in x-axis, refer Figure 1-1.
Tilt Y	Deg	The last measured tilt y-axis, refer Figure 1-1.
SP std	cm/s	Single ping standard deviation, i.e. the standard deviation of all speed measurements (ping) in an interval.
Strength	dB	Acoustic Echo Return Signal strength combined average value.
Ping count		Number of pings performed in an interval.
Abs Tilt	Deg	Averaged absolute instrument tilt (ref horizontal plane) during a recording interval.
Max Tilt	Deg	Maximum instrument tilt (ref horizontal plane) during a recording interval.
Std Tilt	Deg	Standard deviation of instrument tilt during a recording interval.
Temperature	°C	The ambient water temperature.
Strength X	dB	Last measured Echo Return Signal strength, X-axis: available parameter if enabled. Default is disabled.
Strength Y	dB	Last measured Echo return Signal strength, Y-axis: available parameter if enabled. Default is disabled.
Depth	m	The actual deployment depth calculated based on reading from External Pressure Sensor

Table 2-2 Overview of available system parameters for Aanderaa RCM Blue.

Parameter	Unit	Description
Input Voltage	V	Battery/power supply voltage
Input Current	mA	Current draw sampled in active mode, typ 60mA. Does not indicate average current consumption
Memory Used	Bytes	Internal RAM use
Internal Temperature	°C	Temperature inside sensor

CHAPTER 3 Wireless connection to PC

RCM Blue connects to PC using Bluetooth. The Bluetooth adapter will set up a COM port. The cable connector is only for factory use.

Chapter 3.1 describes first time set up and connection to PC using Bluetooth. Chapter 3.3 describes the procedure for opening the RCM Blue connection in AADI Real-Time Collector for configuration and transfer of data.

3.1 Set up Bluetooth and add RCM Blue device using Win 7

This description and procedure is intended for first time set up and connection. For regular connection with PC, please refer Chapter 3.3.

Aanderaa recommends using the Bluetooth adapter delivered with the RCM Blue.

Many PC's have integrated Bluetooth. Most adapters supporting Bluetooth v2.0 and higher will work and have similar setup. Instructions are shown herein are for Windows®7.

Procedure for first time set up of Bluetooth:

- Insert the Bluetooth USB adapter in PC.

- New hardware is automatically detected and installed. Follow the instructions on screen. Correct installation can be verified in Control Panel – Hardware and Sound – Device Manager.
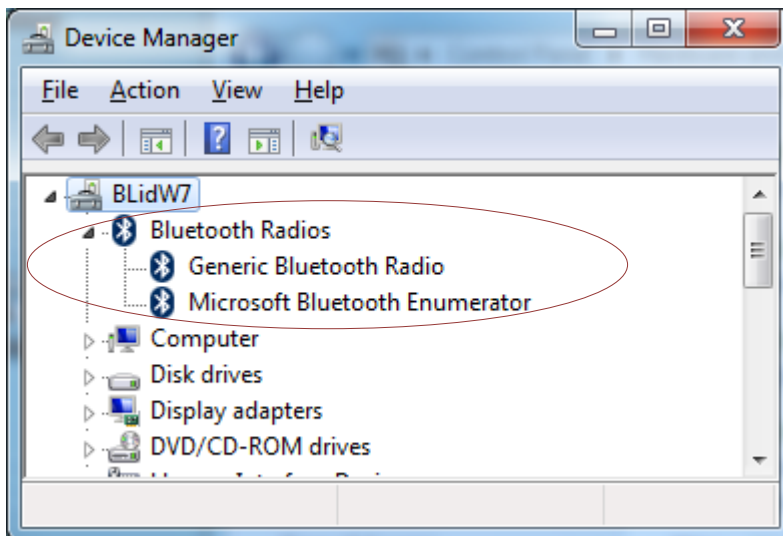

Figure 3-1 Verify Bluetooth.

- Add device: Open Control Panel – Hardware and Sound and select "Add a Bluetooth device" under Devices and Printers.
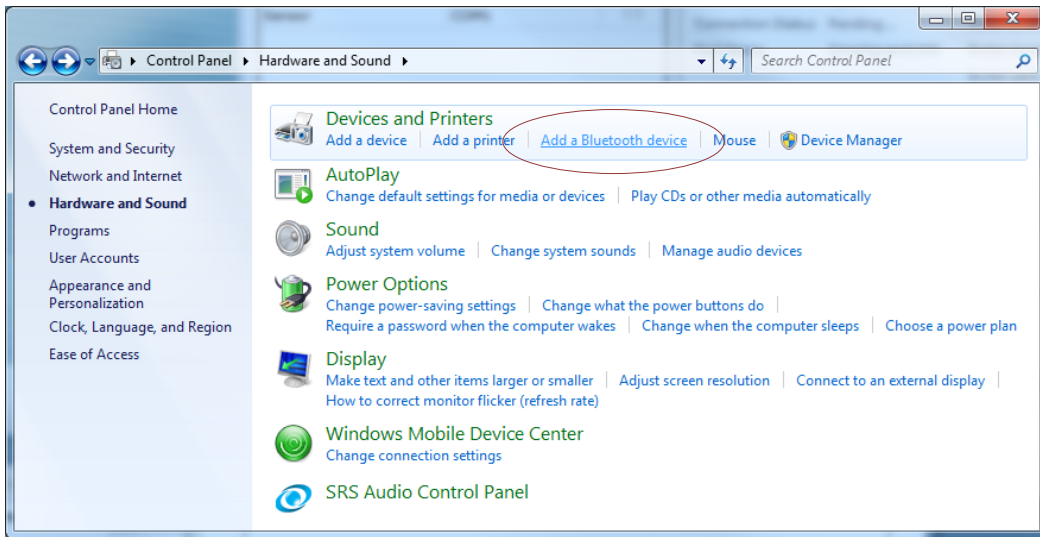
Figure 3-2 Add device.

- Insert a battery to the RCM Blue, or connect power adapter 4908 to the device. Switch ON the instrument.

- Insert the magnetic stylus into the Bluetooth activation pinhole on the side of RCM Blue, underneath transducer 1, to initiate pairing.
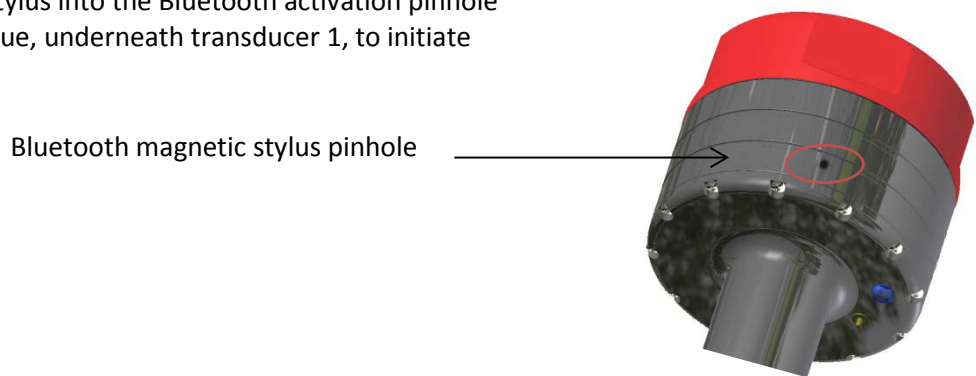
Bluetooth magnetic stylus pinhole

Figure 3-3 Insert stylus.

A yellow continuous LED signal indicates auto discovery mode; RCM Blue will try to establish a connection.

RCM Blue should now appear on screen after approximately 15 sec. The name will be RCM-5430, the serial number, and an ID number.

If no connection is established within 2 minutes the RCM Blue will exit auto discovery mode (*activation timeout* can be configured in User Maintenance once connection is established). Reactivate Bluetooth pairing by inserting the stylus in the pinhole and the instrument try again.
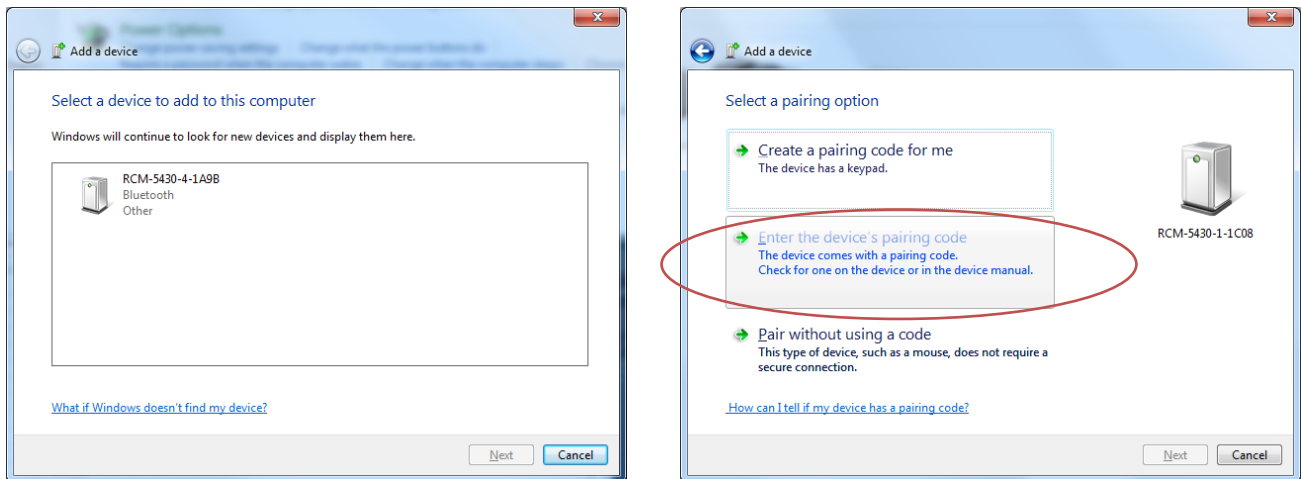
Figure 3-4 Select device. Enter pairing code.

- Once the device appears select the icon and click *Next*. Click 'Enter the device's pairing code'. The code is 1234. Retry if you do not get a message that the device has been successfully added.

- Open *Device Manager* to verify the connection (or right click the device symbol and select *Properties and Hardware*). The connection will show as 'Standard Serial over Bluetooth link (COMxx)' under Ports (COM & LPT). Often two Bluetooth COM ports will appear in Device Manager. Only one of them will work.

Note! Several RCM Blue instruments can be added creating their own COM ports. The PC will normally remember the RCM Blue device, but might change the COM port number if another USB port is used for the adapter.

Set up new connection in Aanderaa Real-Time Collector:

- Open Real-Time Collector and select the *New* button. Set your own *Connection Name*.

- Port Settings:

  o RCM Blue Bluetooth

  o COM – select the correct port (found under Properties - Hardware for the RCM Blue Bluetooth device).

- Press OK.

3.2 Set up Bluetooth and add RCM device using Win XP

This description and procedure is intended for first time set up and connection. For regular connection with PC, please refer Chapter 3.3.

Aanderaa recommend using the Bluetooth adapter delivered with the RCM Blue. Many PC's have integrated Bluetooth. Most adapters supporting Bluetooth v2.0 and higher will work and have similar setup. Instructions are shown for Windows XP. See chapter 3.1 for Windows 7.

Procedure for first time set up of Bluetooth:

- Insert the Bluetooth USB adapter in PC.

- New hardware is automatically detected and installed. Follow the instructions on screen. Correct installation can be verified in Device Manager. (Start – Settings – Control Panel – System – Hardware – Device Manager)

Figure 3-5 Verify Bluetooth.

- Add device: Open Bluetooth Devices (Start – Settings – Control Panel – Bluetooth Devices)
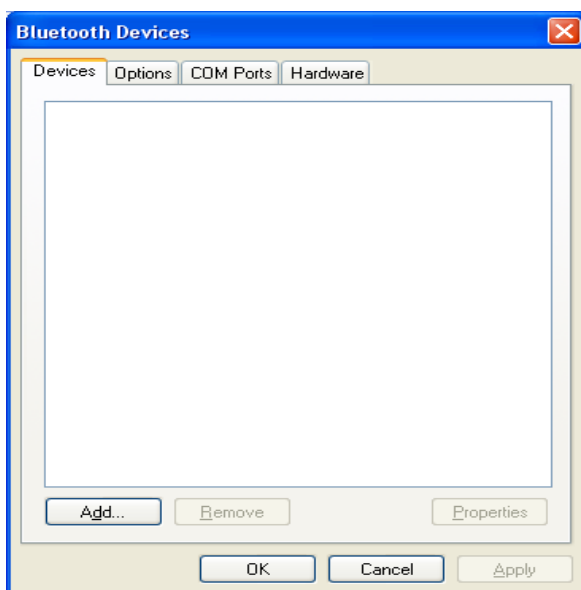

Figure 3-6 Add device.

- Insert a battery to the RCM Blue to power the instrument, or connect power adapter 4908 to the instrument. Switch ON the instrument.

- Insert the magnetic stylus into the Bluetooth activation pinhole on the side of RCM Blue, underneath transducer 1.
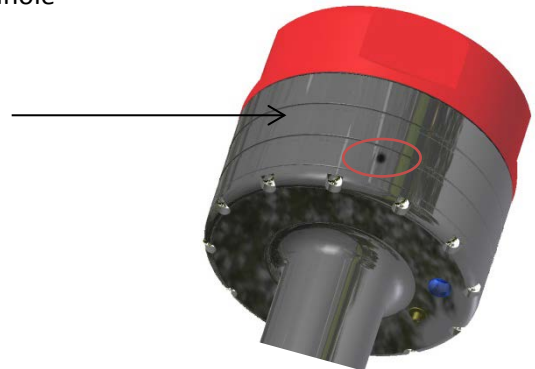
Bluetooth magnetic stylus pinhole

Figure 3-7 Insert stylus.

A yellow continuous LED signal indicates auto discovery mode; RCM Blue will try to establish a connection.

In the Bluetooth Devices window click the Add button. Check the box and click Next.

Figure 3-8 Add Bluetooth device wizard.

After a few seconds the device appears. The name will be RCM-5430, the serial number, and an ID. If no connection is established within 2 minutes the RCM Blue will exit auto discovery mode (*activation timeout* can be configured in User Maintenance once connection is established). Activate Bluetooth by inserting the stylus in the pinhole and try again.
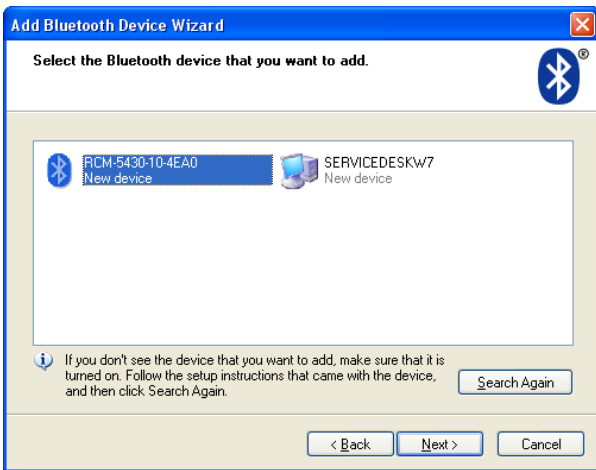
Figure 3-9 Select device.   **Figure 3-10 Enter pairing code.**
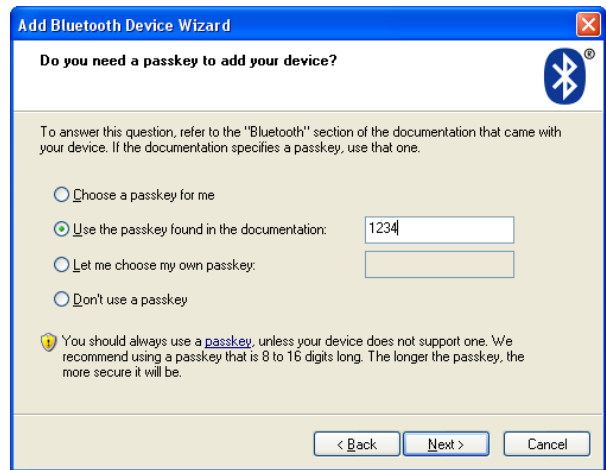
- Select the icon and click *Next*. Click 'Use the passkey found in the documentation'. The code is 1234. Click Next. Retry if you do not get a message that the device has been successfully added.

Figure 3-11 Completing wizard

- Click Finish

- Verify the connection by selecting the device and click COM Ports in the Bluetooth Devices window. Normally two COM ports will be created. Use the one marked Outgoing and SPP when setting up a connection in AADI Real-Time Collector.

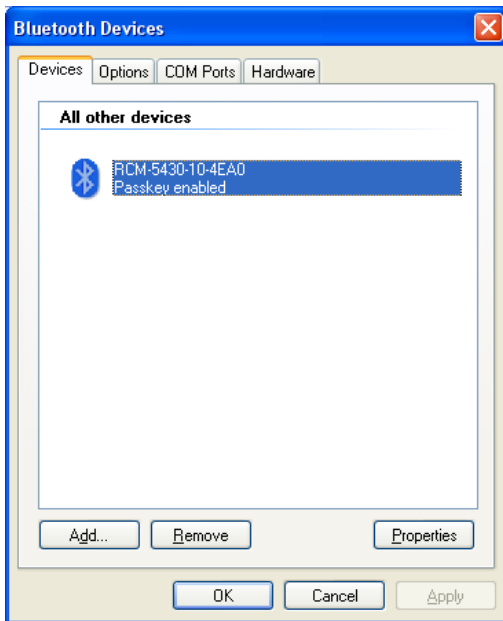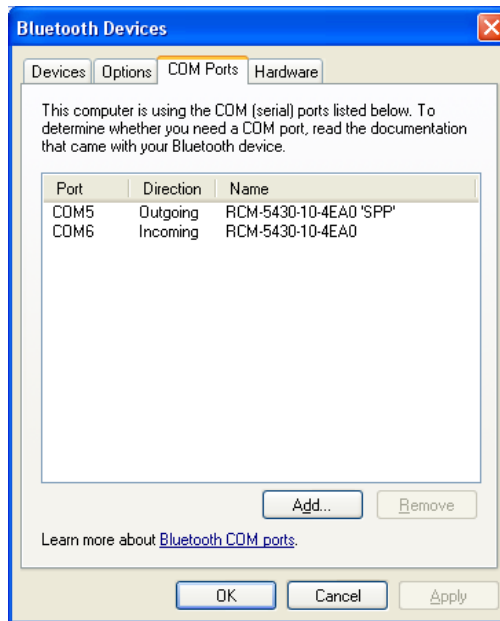**Figure 3-12 Overview of all bluetooth Devices**   **Figure 3-13 Overview of COM Ports**

Note! Several RCM Blue instruments can be added creating their own COM ports. The PC will normally remember RCM Blue, but might change the COM port number if another USB port is used for the adapter.

Set up new connection in Aanderaa Real-Time Collector:

- Open Real-Time Collector and select the *New* button. Set your own *Connection Name*.
- Port Settings:
  - o RCM Blue Bluetooth
  - o COM – select the correct port (found under COM Ports for the RCM Blue Bluetooth device).
- Press OK.

3.3 Procedure to open an existing connection

- Select the RCM Blue connection.
- Insert the magnetic stylus in the pinhole on RCM Blue to activate Bluetooth. A yellow continuous LED signal indicates auto discovery mode.
- Click *Open Port* button. You should get a connection established message and green status on the connection. RCM Blue LED will light blue when connected.

Figure 3-14 Open Port
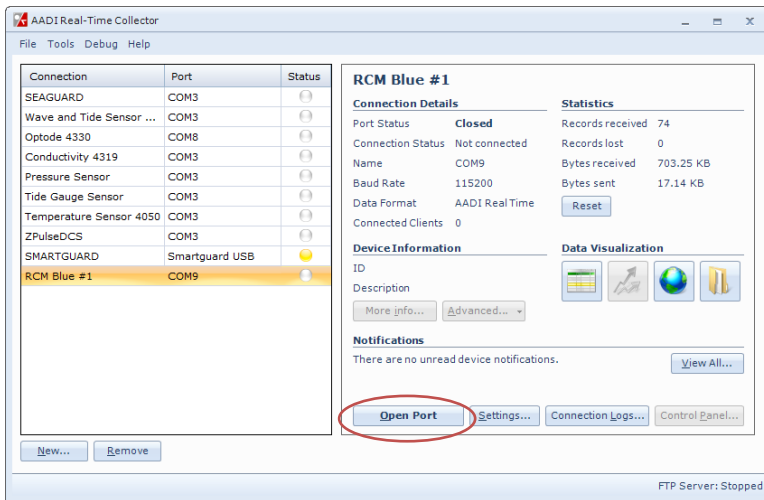
If the Bluetooth connection is lost, Real-Time Collector will try to reopen the COM port automatically; it will take approximately 1 minute to reestablish the connection.

Please note that the sensor will stop all other activity when in Bluetooth search mode, continues yellow LED. A power reset will switch of the search mode and you will need to use the magnetic tip pen to get it back.

CHAPTER 4 Configuration using AADI Real-Time Collector

Aanderaa RCM Blue is configured using AADI Real-Time Collector. Open the RCM Blue connection as described in CHAPTER 3 and press control panel.

When the connection is established you can start and stop recordings in the Recorder Panel, refer Figure 4-1
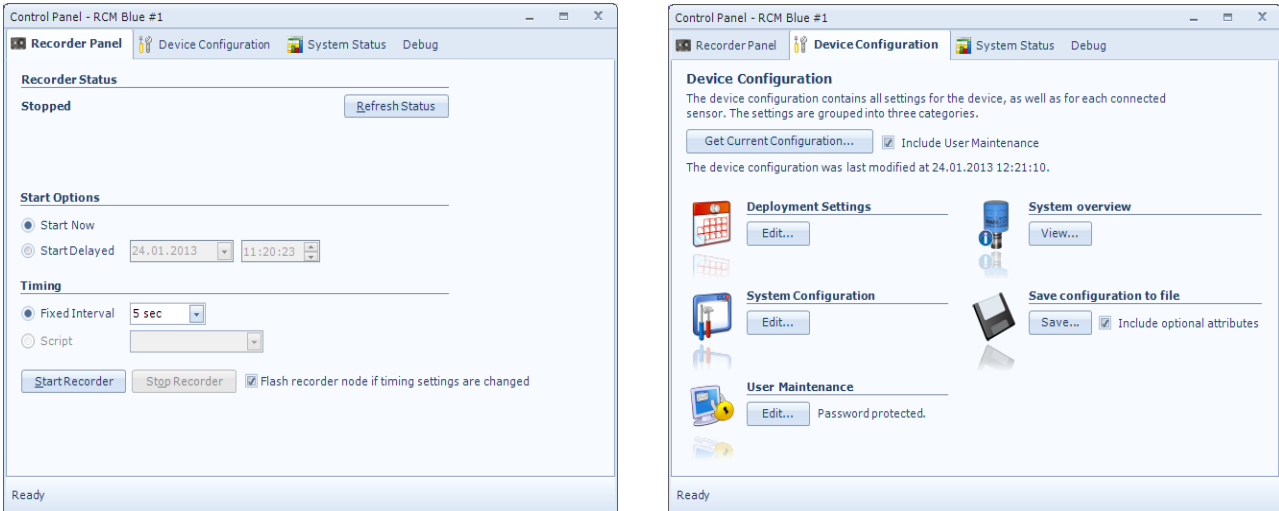
Figure 4-1 AADI Real-Time Collector screen views.

User accessible properties are found in Deployment settings, System Configuration and User Maintenance. To edit the configuration, click in the value-field and enter new value. Press *Next* to store changes. Open Device Configuration and press Get Current Configuration. Check Include User Maintenance to view maintenance settings. The password is 1000. Note that you need to stop the recorder before you get access to the Device Configuration.

4.1 Deployment Settings

Figure 4-2 shows the deployment settings including Common Settings and Site Info. Refer Table 4-2 in chapter 4.1 for an overview of the properties.

Figure 4-2 RCM Blue deployment settings.

Note that the interval may also be changed in the recorder panel before you start the recorder. The interval properties in t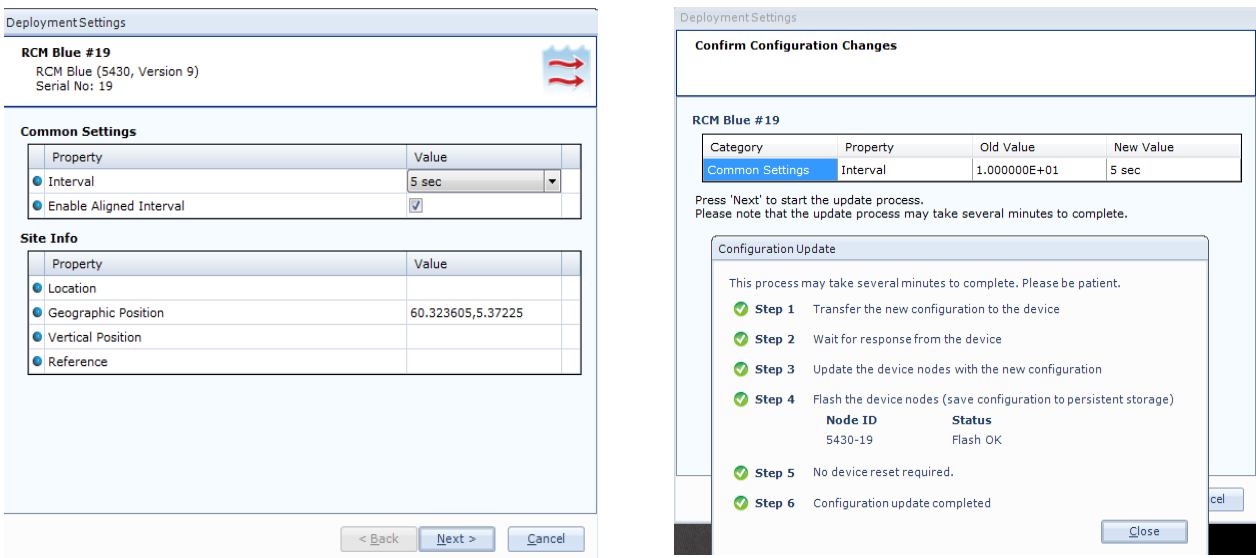he deployment settings menu and in the recorder panel is the same properties so if you change the value in one of the windows it will automatic also be changed in the other. With Enable Aligned Interval selected the recorder will start at the next possible time that is dividable with the interval. If you start the recorder with 30 minutes interval at 12:21:23, with Enable Aligned Interval the first recording will be 13:00:00 and without Enable Aligned Interval the first recording will be at 12:51:23. This setting is useful if you want to synchronize the recording interval between different measurement points.

The values under site info are optional but Geograhical position is needed if you want to present the location in a map using the globe icon in Real-Time Collector.

4.2 System Configuration
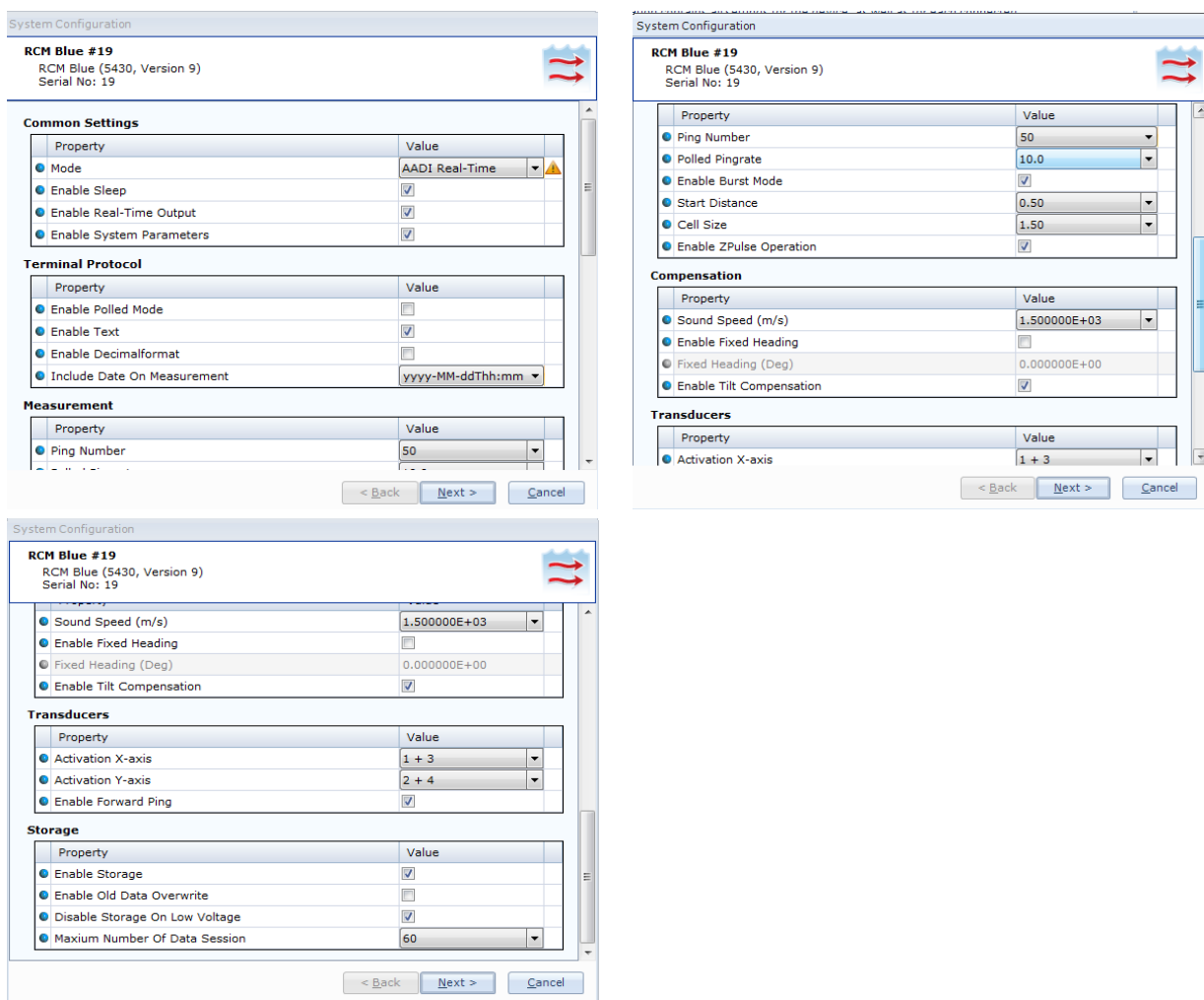
Figure 4-3 RCM Blue system configuration.

Figure 4-3 shows all the properties that are included under System Configuration. Refer Table 4-3 in chapter 4.1 for an overview of the properties. Please not that we recommend using the Enable Data Overwrite with care. This is because it might overwrite important historical data. The best practice is to always remove historical data sessions from the internal memory after downloading data. If the total number of data

sessions in the internal memory reach 80% of maximum the indication LED under the DCS with start to blink with a red color. When you reach the maximum number of data sessions it will turn to continues red light.
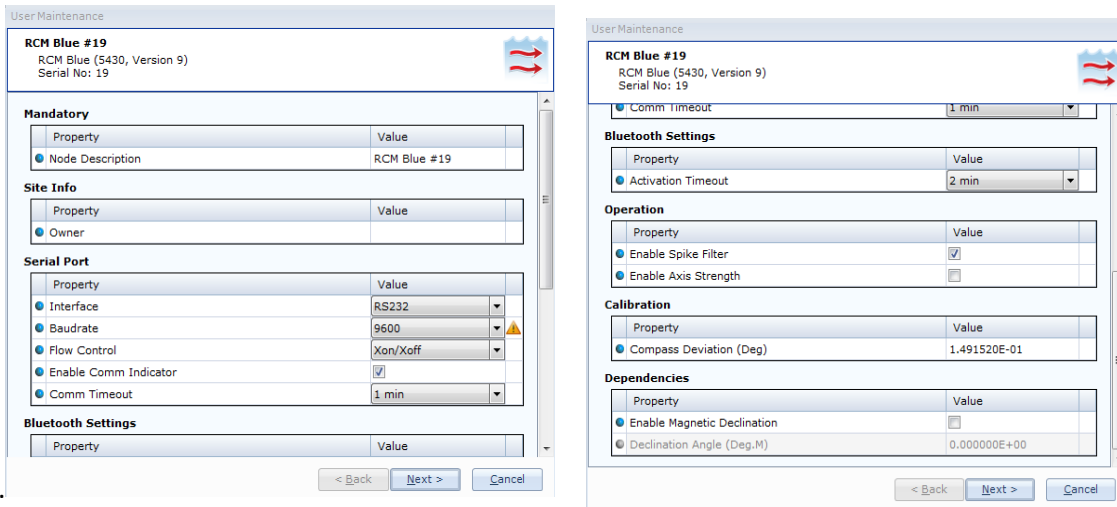
Figure 4-4 RCM Blue user maintenance.

Figure 4-4 shows all the properties that are included under User Maintenance. Refer Table 4-4 in chapter 4.1 for an overview of the properties. These are properties that you normally don't need to alter. Please note that Compass Deviation (Deg) is a factory setting calculated based on a calibration procedure performed at the factory. Changing this value is only recommended if a new calibration is performed.

Figure 4-5 RCM Blue system status

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Figure 4-5 shows RCM Blue system status.

4.3 Properties

Table 4-1 Factory Configuration –an overview

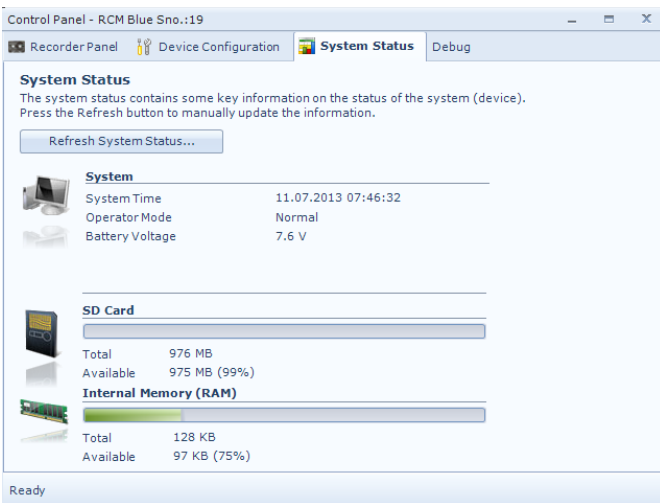| Property	Type	No of elements	Use
Product name	String	31	AADI Product name.
Product Number	String	6	AADI Product number.
Serial Number	Int	1	Serial Number.
SW ID	String	11	Unique identifier for internal firmware.
Software Version	Int	3	Software version (Major, Minor, Built).
HW ID X	String	19	Electronic Identifier, X =1,2.
HW Version X	String	9	Electronic Identifier, X =1,2.
System Control	Int	3	For AADI service personnel only.
Production Date	String	31	AADI production date, format YYYY-MM-DD.
Last Service	String	31	Last service date, format YYYY-MM-DD, empty by default.
Last Calibration	String	31	Last calibration date, format YYYY-MM-DD.
Calibration Interval	Int	1	Recommended calibration interval in days.

Table 4-2 Deployment settings –an overview

Property	Type	No of elements	Use
Interval	Float	1	Recording Interval in seconds. Default value is 30 sec.
Enable Aligned Interval	Bool	1	Check to align the time of each recording with the internal clock; e.g. if you start recording with 10 min interval at the time 12:41:00, the first recording will take place at 12:50:00, the next at 13:00:00, then 13:10:00 etc. Default is unchecked.
Location	String	31	User setting.
Geographic Position	String	31	User setting Note: enter the position as [latitude] [space] [longitude] in decimal degrees to locate position in AADI Real-Time Collector. Example: 60.3236 5.37230. Click the Globe in the Data Visualization header.
Vertical Position	String	31	User setting.
Reference	String	31	User setting.

Table 4-3 System configuration –an overview

Property	Type	No of elements	Use
Mode	Enum	1	Sets the instrument operation mode: Use AADI Real-Time. Smart Sensor Terminal and Smart Sensor Terminal FW2 are for internal use only.
Enable Sleep	Bool	1	Enable sleep mode. Default value is yes.
Enable Real Time Output	Bool	1	For test purposes only. Enable real time output on Bluetooth. Leave unchecked for deployments (data are stored internally).
Enable System Parameters	Bool	1	Includes system parameters in the real time data output session. Default value is checked.
Enable Polled Mode	Bool	1	Factory use only.
Enable Text	Bool	1	Factory use only.
Enable Decimalformat	Bool	1	Factory use only.
Include Date On Measurement	Enum	1	Adds a timestamp to data output. Select between None, or one of the listed date formats. Default is none.
Ping Number	Enum	1	Sets the integer number of pings required in one measurement interval. The maximum ping number is 600. Default value is 150.
Polled Pingrate	Enum	1	Factory use only.
Enable Burst Mode	Bool	1	Check to enable Burst mode; uncheck for spread mode. Default value is unchecked.
Start Distance	Enum	1	Set the distance for the pulse propagation before measurements starts (Blanking Distance). Default value is 0.50 m/s.
Cell Size	Enum	1	Set the cell size. Default value is 1.50 m/s.
Enable ZPulse Operation	Bool	1	Activate/deactivate ZPulse operation; Set yes to activate. Default value is yes. Deactivate ZPulse operation for single frequency DCS operation.
Sound Speed	Float	1	Sets the speed of sound in water. The sound speed is approximately 1500m/s in seawater. Default is 1500.0 m/s.
Enable Fixed Heading	Bool	1	Enable/disable fixed heading; check to enable fixed heading. Uncheck for the instrument to use the measured compass heading as reference. Default value is unchecked.
Fixed Heading	Float	1	Sets the fixed heading (0 - 360°) to be used as reference. Default value is 0.0 re direction of transducer number 1.
Enable Tilt Compensation	Bool	1	Enable/disable tilt compensation to correct the measured current speed according to the instrument tilt. Default value is checked.
Activation X-axis	Enum	1	Controls active transducers on the X-axis: 1, 3, 1+3. Default value is 1+3.
Activation Y-axis	Enum	1	Controls active transducers on the Y-axis: 2, 4, 2+4. Default value is 2+4.
Enable Forward Ping	Bool	1	Check to enable forward ping to improve the current speed accuracy, The instrument will try to measure upstream to reduce problems related to turbulence in the downstream measurement volume. Default value is checked.
Enable Storage	Bool	1	Always check for data to be stored internally.
Enable Old Data	Bool	1	If storage is full, this enables overwriting older data. We

Overwrite			recommend you to use this property with care; please remove old data sessions from storage prior to a deployment. We recommend that you create a data backup in a safe environment. Default is unchecked.
Disable Storage On Low Voltage	Bool	1	Check to disable data storage when supply voltage is less than sufficient level to avoid storage of corrupt data. Default is checked.
Maximum Number Of Data Sessions	Enum	1	Sets the maximum number of folders to be stored internally. Select between 10, 20, 30, 40, 50, and 60. The unit starts a new folder for each new recording start and each power restart. Default is 60.

Table 4-4 User Maintenance –an overview

Property	Type	No of elements	Use
Node Description	String	31	User text for describing node, placement etc.
Owner	String	31	User setting.
Interface	Enum	1	Factory use only.
Baudrate	Enum	1	Factory use only.
Flow Control	Bool	1	Factory use only.
Enable Comm Indicator	Bool	1	Enable communication sleep ('%') and communication ready ('!') indicators.
Comm TimeOut	Enum	1	Time communication is active (Always On, 10 s, 20 s, 30 s, 1min, 2 min, 5 min, 10 min).
Enable Spike Filter	Bool	1	Activate/deactivate spike filter; Check to activate. Default is checked. Spike filter tracks and eliminates spikes in measured data.
Enable Axis Strength	Bool	1	Enables output of strength X and strength Y. Default is unchecked.
Compass Deviation	Float	1	Compass offset correction value (deg. M).
Enable Magnetic Declination	Bool	1	Enables correction of compass reading to present true north instead of magnetic north. Default is uncheked.
Declination Angle	Float	1	Sets the correction angle when magnetic declination is enabled; use a value between ±180. The declination angle is positive when the magnetic north is east of true north Default is 0.
Activation TimeOut	Float	1	Set the time for Bluetooth to stay active for opening a connection. Once connected, Bluetooth is connected until disconnected or power is lost. Default is 2 min.

4.4 Configuration

The next pages contain a more detailed description of some property settings.

The *Ping Number* property describes the number of acoustic pulses (pings) transmitted by the instrument during one measurement interval; the received backscattered signal from these transmitted pulses are tilt/compass corrected and averaged into the final measured output.

The *Interval* property describes the measurement interval in seconds; the instrument provides a set of averaged measured data for every measurement interval.

The *Enable Burst* mode property describes the transmission of the acoustic pulses (pings). In Burst mode, the acoustic pulses (pings) are transmitted during the very last minute of the measurement interval; the measurement interval must be larger than 60s. The opposite of Burst mode is *Spread* mode; in spread mode the acoustic pulses are transmitted equally spaced in time over the entire measurement interval.

The *Start Distance* property describes the distance which the pulse propagates before the measurement starts, (blanking distance) refer Appendix 1.

The transducers continue to receive backscattered signal from particles present in the beam until the pulse has propagated a distance equal to the Cell Size. Setting a large cell size provides the best measurement results with lowest standard deviation (since more scatterers are present within a larger area); a smaller cell gives a higher standard deviation. A 1.5m cell size is sufficient for most applications.

The interval setting controls the time between every data output from the instrument. The number of current speed measurements done in one interval is controlled by the Ping Number setting.

Use *Fixed Heading* if e.g. the instrument is placed in a fixed known position for example close to a magnetic object which will interfere with the internal compass. Fixed Heading is set as the angle between transducer 1 and the Magnetic North. Rotating transducer 1 clockwise increases the heading angle. The compass heading is used to split the current speed into the East and North component.

The property *Enable Fixed Heading* must be set for the instrument to actual use the Fixed Heading instead of the compass reading.

The *Tilt Compensation* can be disabled if e.g. the instrument application is vertical measurements. When tilt compensation is enabled, the tilt measurements are used to derive the horizontal speed (assuming that the vertical speed is zero). When tilt compensation is disabled and a fixed reading is used, the instrument will still output the last compass reading (heading), tilt x and tilt y.

The property *Sound Speed* describes the speed of sound in the sea water. The value must be set as close to the true speed of sound as possible for most correct measurements of the current speed.

The *Activation X-axis and Activation Y-axis* property describes which of the four transducers are enabled. Normally all four transducers should be enabled together with the property Forward Ping. Always enable at least one transducer on each axis, refer CHAPTER 1 (e.g. transducer 1 and 2, or 2 and 3, or 3 and 4 or 1 and 4). Three transducers can also be enabled. If the instrument is deployed close to a known obstruction, e.g. a riverbank, wall, quay etc, the two transducers transmitting in the direction of the obstruction should be disabled.

Setting the property *Enable Forward Ping* to Yes will inactivate the transducers in the downstream direction (direct current) to avoid poor measurements due to e.g. local turbulence in front of the transducers. ***Note! We recommend Forward Ping when both transducers on one axis are active.***

Examples:

1. Select all transducers:

Set Activation X-axis(1+3)

Set Activation Y-axis(2+4)

The instrument will ping simultaneously on one transducer in each axis, refer Figure 1-1. If forward ping is enabled the instrument selects the transducers in the upstream direction. If forward ping is disabled the instrument will alternate between the simultaneously pinging the two opposite transducers in each axis; the instrument will transmit/receive on transducers 1 and 2 simultaneously, next on transducers 3 and 4, and continue transmitting/receiving from these pairs every other time for the entire deployment.

2. Select single transducer on each axis:

Select either transducer 1 or 3 on X-axis, and either transducer 2 or 4 on Y-axis. The instrument will ping only the two transducers that have been selected. Forward ping will be disregarded.

Set Activation X-axis(1) (selects transducer 1 on X-axis).

Set Activation Y-axis(2) (selects transducer 2 on Y-axis)

3. Select three transducers:

The instrument can use any combination of three transducers. If forward ping is enabled the instrument will select the transducer in the upstream direction on the common axis (refer Figure 1-1).

Set Activation X-axis(1+3) (selects transducer 1 and 3 on X-axis).

Set Activation Y-axis(2)   (selects transducer 2 on Y-axis)

Check *Enable Sleep* for the instrument to go to sleep between recordings, uncheck for the instrument to stay continuously switched on between recordings (drains more power).

4.5 Pressure Sensor

Pressure sensor 4117 is connected via patch cable 5623 to the Doppler current sensor. The pressure sensor is configured to send a RS-232 data string with pressure measurement in kPa to the DCS. This measurement is then converted to depth in meter inside the DCS and presented as a new parameter. To communicate directly with the pressure sensor please refer to Technical Manual for Pressure sensor 4117.

4.6 Set the internal clock

The internal clock is set using AADI Real-Time Collector. First establish contact with the instrument. Then in the start window select **Advanced** and the **Time Sync…**, In the Device Time windows you will find three alternatives. Select one of the three alternatives and press Set Device Clock.
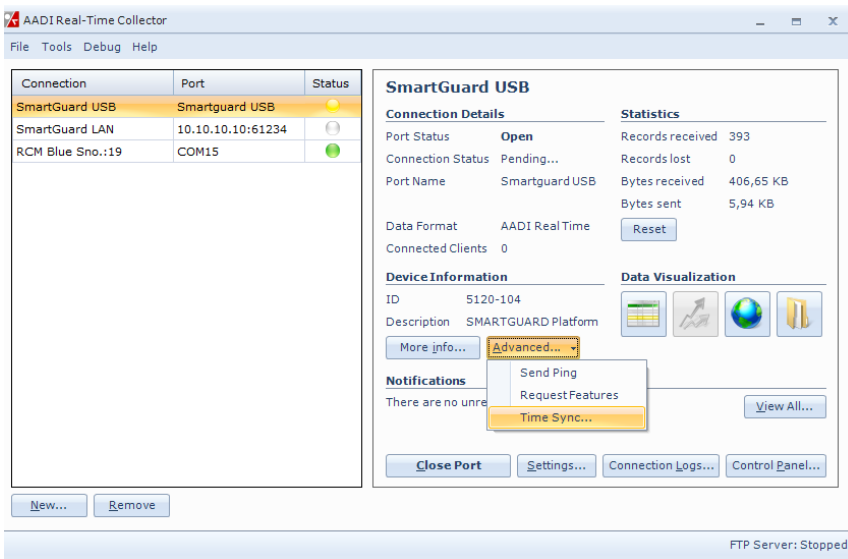
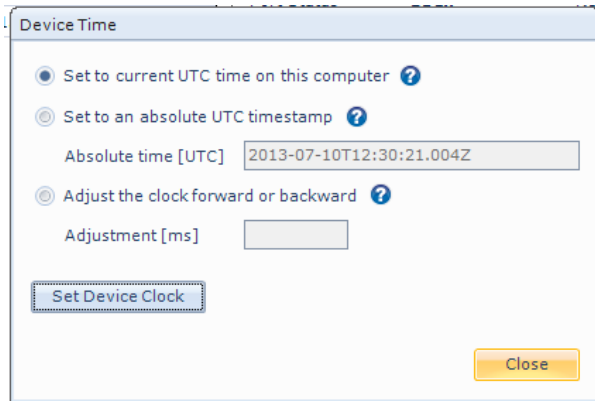

**Figure 4-6 RCM Blue clock adjustment.**

Figure 4-7 RCM Blue clock adjustment alternatives.

CHAPTER 5 View and analyze data using Aanderaa Data Studio

Data are transferred to PC using Bluetooth. Refer CHAPTER 3 to set up Bluetooth and open a connection in AADI Real-Time Collector.

5.1 Copy data to local PC and remove data session from instrument storage

- Open AADI Real-Time Collector.

- Power the instrument.

- Open the RCM Blue connection, refer Chapter 3.3.

- Open *Folder Viewer* in the *Data Visualization* header. If you miss this folder icon on your screen then select Tools in the top left corner of the picture

- Then select settings and advance. In this windows select Activate debug settings and features. When you press OK the folder icon will show up.

- RCM Blue *Data Sessions* (one continuous recording) stored inside the unit is listed in the upper part, left part of the window.

- Your local PC's C-drive is listed in the lower, left part of the window. Browse for the correct folder in which to store RCM Blue data sessions.

- Select the correct Data Session to transfer to PC from the upper, left window. Right click and hold and drag the folder into the correct location on your PC; into the lower right window. When completed, the data session can be opened in Aanderaa Data Studio for analysis.

- To delete data session from RCM Blue storage: right click the data session in the upper, left part of the window and select delete. ***Note! Avoid deleting files that are not copied to PC.***
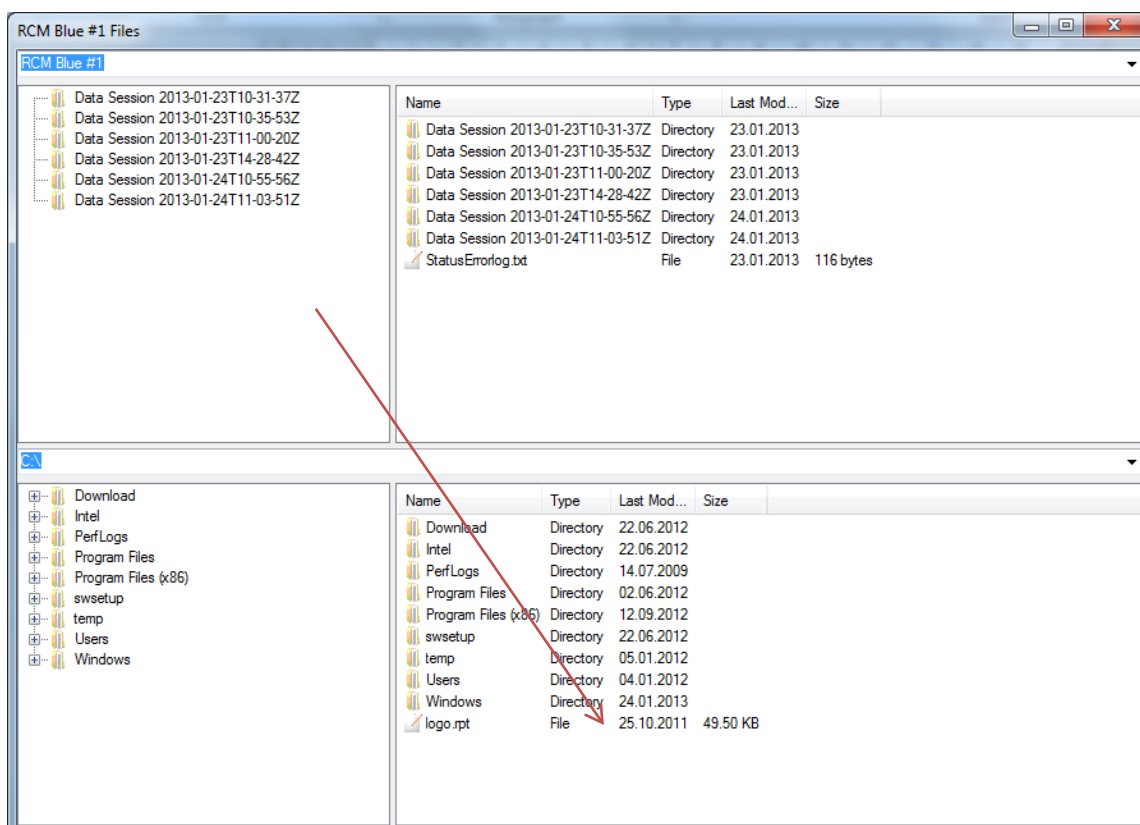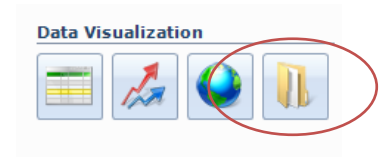
5.2 Analyze data in Aanderaa Data Studio

RCM Blue data sets (Data*.bin) are stored in data sessions; one data session can hold several .bin files. Data sets are arranged into projects in Aanderaa Data Studio. When you have created a project you can include one or more datasets into that project.

Features of Aanderaa Data Studio: view measured parameters in data lists, view configuration settings, time plot of measured parameters, tag data, save plot to clipboard or file, and export dataset to CSV file format e.g. Excel.

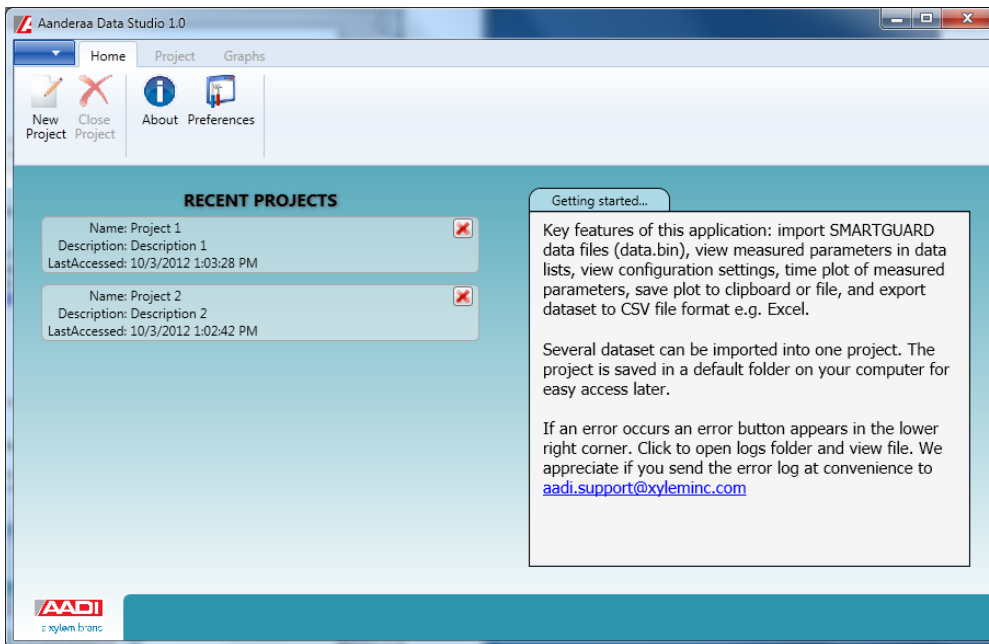*Note! Please refer TN 355 for operating manual of Aanderaa Data Studio.*

Figure 5-1 Aanderaa Data Studio main window.

Procedure to import dataset into Aanderaa Data Studio:

- Open an existing project from the recent project list (double click to open) or click New Project in the ribbon to start a new project.

- Click Import Binary XML Data to browse for your RCM Blue data session folder.

- Open the data session folder and select all the .bin files you wish to import. Click Import. The lower line in the application window gives import status.

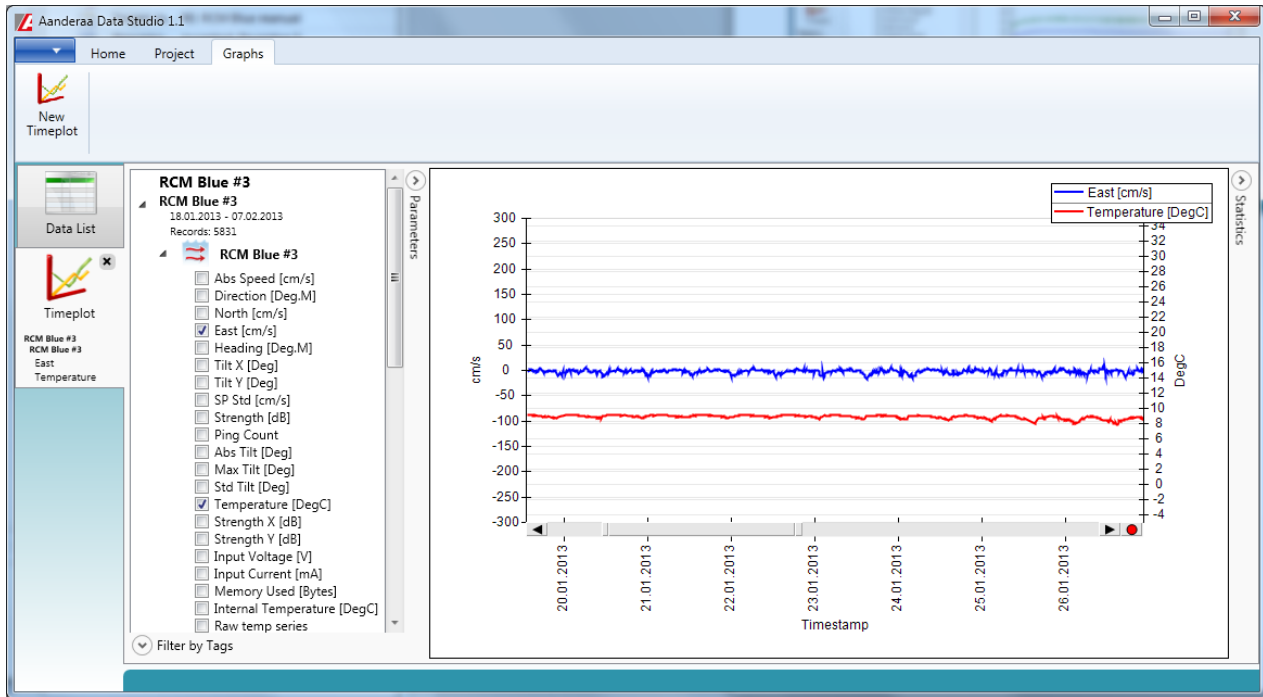 Data is now available for view and analyzes. An example is given in Figure 5-2.

Figure 5-2 Example of data viewed in Data Studio.

CHAPTER 6 Operating instructions

6.1 Preparations for use

- Perform deployment configurations and recording configurations.

- When the system is configured and ready for deployment, the instrument must stay powered.

  When you have started the recorder you may check the collection of data by observing that the numbers of records are increasing according to the selected interval. You may also select the data view icon to observe the incoming data, refer Figure 5-2.
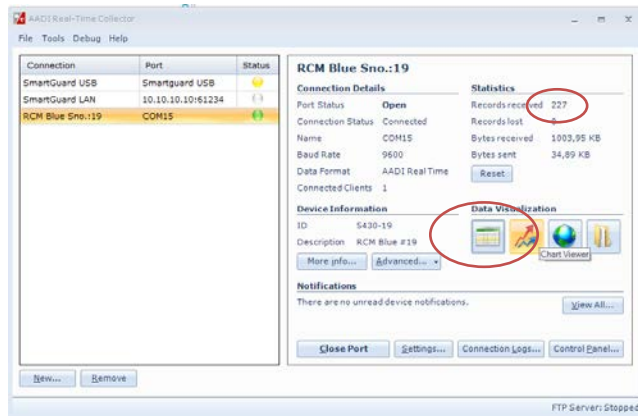

Figure 6-1 Received data.

- Figure 6-2 showing the data viewer picture. Please note that some of the data are displayed with a yellow background. The yellow color indicates that there is not enough information to display this parameter. In this case it's due to the fact that RCM Blue is not pinging in air the yellow color is perfectly normal. You will see that the ping count is zero. And all parameter depending on the pings will appear yellow. To check the RCM Blue, tilt it in one direction and see that the tilt reading is increasing.
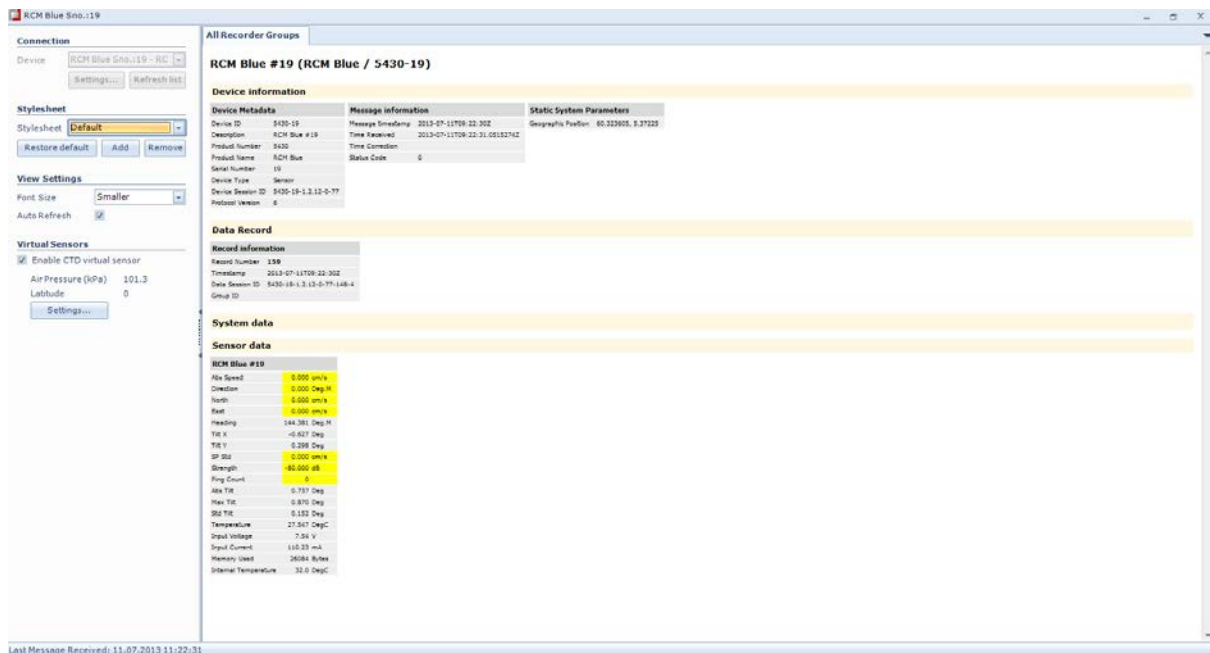

Figure 6-2 Data viewer.

- Before putting the instrument into its pressure case check that the indication LED is according to your configuration. See table 1-1 on page 8 for a description of the different LED signals.

- When placing the instrument into its pressure case we recommend that you insert the instrument and let it rest on the o-ring on the top of the case. Then turn the instrument 180°, holding the pressure case in position.

- Tighten the C-clamps until the Top-end plate rests against the top of the case. Avoid over tightening, as this will damage the clamp.

- When you put the instrument into water please check that the LED color is changing according to table 1-1 on page 8.

6.2 Illustrations of deployment preparations
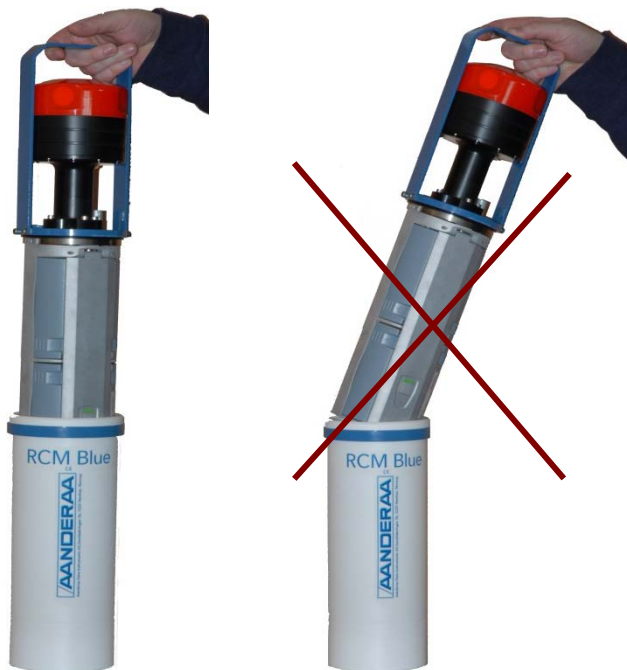
Note! Lower the instrument carefully straight down into the pressure case, do not pinch or nick o-ring.

With the instrument Top-end plate seated into pressure case, turn the Top-end plate assembly 180º on the o-ring in order to seat the o-ring and remove any possible contamination from between the o-ring and its sealing surfaces.

Figure 6-1 Insert Instrument into Pressure Case.

Figure 6-2 Tighten C-clamps until the pressure case rests on the Top-End plate. Avoid over tightening as this will bend the C-clamps.

Figure 6-4 Fasten shackle in frame. Tighten thoroughly.

Important! When connecting one shackle to another, remember to use shackles of same type of metal to avoid corrosion.

Figure 6-3 Mount the instrument into the frame. Illustrated with a Seaguard RCM.

Figure 6-5 Splice the rope and fasten it to the thimble attached to the shackle.

Figure 6-6 Lock the shackle with strips or locking wire. Locking wire is recommended for higher security in long deployments.

6.3 Retrieval of the instrument

When the instrument is retrieved after deployment, remove marine growth and barnacles from the instrument using a hand scrub. To remove seashells, barnacles or corals it is recommended to soak the instrument for an hour in white vinegar or muriatic acid then while washing in water (mild dish detergent may also be used to clean the instrument) using a soft scrub brush with plastic handle or similar tools to clean away growth and grime. Repeat process as necessary.

Note! Do not use any kind of steal brush or any sharp objects; this might damage the acoustic elements.

Finish by Rinsing the instrument in clean fresh water and dry it.

The unit can then be opened and the instrument removed from its pressure case.

6.4 Battery

The battery compartment at the rear of the RCM Blue has room for two batteries.

Note! If the manufacture date of your lithium battery has expired one month, or you have not used the instrument the last month, you probably have to rejuvenate the battery to remove oxidizing, ref chapter 6.5.

6.4.1 Removal and insertion of batteries

To remove a battery from the RCM Blue, follow the instructions below:

1. Place the instrument on the desk with the front facing down.
2. Open the battery cover at the rear.
3. Flip up the battery cover.
4. Lift the battery straight out.

To insert the battery, follow these instructions:

1. Place the instrument on the desk with the front facing down.
2. Open the battery cover at the rear and remove the battery to be replaced, refer procedure listed above.
3. Place the battery with the connection pins towards centre, refer Figure 7-17.
4. Lock the battery cover.

Figure 6-17 The battery compartments are in the rear of the instrument.

6.5 Rejuvenating Lithium batteries

If the manufacture date of your lithium battery has expired one month, or you have not used the instrument the last month, you should rejuvenate the battery to remove oxidizing.

The rejuvenating can be done in two ways. Either start the instrument and wait for about 10 minutes while the battery is loaded or use a 100 Ω resistor up to 6.3 V, refer Figure 7-19.

Important! Lithium batteries must be handled with care.

Figure 6-18 Check the manufacture date

Figure 6-19 Use a 100 Ω resistor up to 6.3 V to rejuvenate the battery. Note! Illustration shown with older Lithium batteries; todays batteries has connection pins at the side, not on top.

CHAPTER 7 Maintenance

Fouling of the RCM Blue will occur during deployment, especially at low latitudes. The use of anti-fouling paint must be considered based on your own experience.

7.1 Yearly maintenance, maintenance at retrieval of the instrument

The procedure below indicates the minimum maintenance that must be carried out each year or every time the RCM Blue has been retrieved depending on the environmental conditions. We recommend you to send the instrument every 3 years for factory service.

- Remove marine growth and barnacles using a hand scrub. To remove sea shells or corals use plastic handle or similar tools. Refer to 6.3 above

- Rinse the exterior of the instrument in fresh water and let dry.

- Clean the transducer head after each deployment.

- Replace the zinc anodes and corroded parts if necessary.

- Remove/replace the pressure case o-ring.

- Make sure that the o-ring seat is clean and free of any mechanical damage, should be a nearly mirror smooth surface.

- Lubricate the o-ring with grease (Klüber Lubrication Syntheso Glep 1 or similar synthetic grease).

- Replace the o-ring.

- Check for deformation of the C-clamps. Replace if necessary.

- Always apply TECTYL® on screws if replaced to avoid crevice corrosion. Add also TECTYL® around sealing plug if replaced.

- Check for scars on the EPOXY coating, the Top-end plate and the frame.

- Clean the scars with Acetone.

- Apply Repair Lacquer to repair the scars.

Note!

Do not use any form of steel brush or any sharp objects on the Transducer Head, as this will damage the acoustic elements.

The transducer housing will tolerate most cleaning agents. Often 30% Hydrochloric acid (HCL) (Muriatic acid) or acetic acid will be useful for removing barnacles and similar fouling.

Be sure to follow the safety precaution for such acids.

7.2 Test of RCM Blue 5450

We recommend that you perform a function test in water to verify the readings. First: Connect to AADI Real-Time Collector and configure the instrument. Deploy the instrument in sea/water for a short period of time. Transfer data to PC and verify reasonable parameter readings.

RCM Blue test procedure:

1. Connect the RCM Blue to AADI Real-Time Collector as described in CHAPTER 3. Open the connection.

2. Set the recording interval to 30 seconds and start recorder.

3. Deploy instrument in sea/water for a period of time. Retrieve the instrument.

4. Connect the RCM Blue to AADI Real-Time Collector. Open the connection.

5. Copy data to PC and verify reasonable parameter readings:

    *   The Abs Speed will give a variable reading from measurement to measurement.

    *   The Direction will normally give variable readings.

    *   North and East (Speed) will give variable readings.

    *   The Heading (compass heading) depends on the sensor orientation. Placing transducer 1 towards magnetic north will give a value close to 0 or 360˚.

    *   Tilt X and Tilt Y depend on the sensor tilt. If the sensor is placed upright, both should be close to 0˚.

    *   The Strength will be higher than -50dB.

    *   The Ping count depends on the ping setting.

Please note that transducers are not active in air.

7.3 Tools- and maintenance kit

The manufacturer always keeps a stock of spare parts, accessories and consumable parts for quick delivery. Orders may be placed by fax, telephone or e-mail. Refer Table 7-1 for a description of Maintenance kit for RCM Blue.

Table 7-1 Maintenance Kit 3813E for RCM Blue

Part. no	Description	Pieces 3813E
963352	Zinc Anode, Ø16	1
865000	O-Ring, SOR 72 (114.5x3.0mm)	2
260087	Kluber, Syntheso GLEP l.	1
972579B	Repair Lacquer, Jotun Blue	1
972577	Tectyl 506. 10cl.	1

7.4 Factory service

Factory service is offered for maintenance, repair or calibration.

When returning the RCM Blue for service, always include the Instrument Service Order, Form No. 135, see our web pages under 'Support and Training'.

Normal servicing time is four to six weeks, but in special cases the service time can be reduced.

A main overhaul and service is recommended at the factory every three years.

Appendix 1 Short introduction to the ZPulse® DCS technology

Four transducers transmit short pulses (Pings) of acoustic energy along narrow beams. The same transducers receive backscattered signals from scatterers that are present in the beams which are used for calculation of the current speed and direction.

Complex acoustic pulses comprising several distinct frequencies are combined into a single acoustic pulse which is sent out in two orthogonal directions at regular time intervals. The ZPulse based DCS separates the received signal into different frequency bands, one for each frequency in the transmitted signal.

Further it analyses the frequency shift using a high speed Digital Signal Processor. An ARMA based parametric model processing algorithm is used to find the Doppler frequency.

The current speed is derived from the measured frequency shift, the correct speed of sound of the sea water, the measured Instrument Tilt and the Compass Heading. The current speed components are: correct horizontal speed, the current speed in the North direction and the current speed in the East direction (the north and east speeds are saved for later average calculations).

In ZPulse mode, a measurement interval comprising 150 pings (150 on each axis) will normally provide a good estimate of the current speed. The number of pings can be reduced to lower the power consumption, but this also increases the statistical noise (standard deviation).

The ZPulse technology reduces statistical variance with a factor of 2. This again reduces the required number of Pings needed in order to achieve an acceptable statistical error.

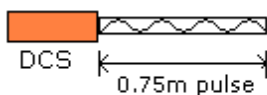# Appendix 2 Definition of terms

The transmitted pulse has a fixed length of 0.75m and a +/-2 degree beam width. Internal ringing in the transducers will always occur after transmitting acoustic pulses; the transducers cannot receive backscattered signal until the ringing stops.

For the DCS the pulse must have travelled at least a distance of minimum 0.4m before backscattered signals from the pulse can be received by the transducers. This is called the Start or Blanking Distance. The transducers continue to receive backscattered signal from particles present in the beam until the pulse has propagated a distance equal to the Cell Size (configured by the user). Refer Figure A - 1 for an illustration.

The total area from which the DCS receives backscattered energy is called the Measurement Area (Volume). Due to the shape of the pulse, the main contribution to backscattered energy is from particles that are present in an area around the Cell Centre.

The measurement area outside the defined cell volume contributes very sparsely to the measured Doppler frequency shift.

Surrounding objects must be further away from the DCS than the defined measurement area to avoid influencing the measurements.
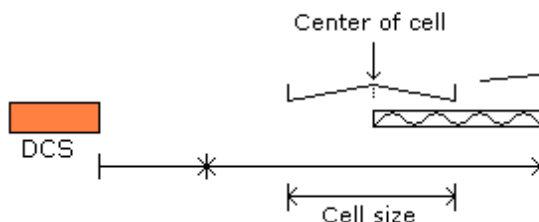

Figure A - 1 Illustration of Pulse, Cell and the Measurement area.

The Measurement Area is defined as the $Pulse\ Length + Cell\ size$

The Cell Start is defined as: $Start\ distance + \dfrac{Pulse\ Length}{2}$

The Cell End is defined as: $Cell\ start + Cell\ size$

The Cell Centre is defined as: $Start\ distance + \dfrac{Pulse\ Length + Cell\ Size}{2}$

Appendix 3 Block schematic of Doppler Current Sensor

The four transducers are placed with 90˚ spacing around the transceiver head, i.e. two and two transducers are placed on the same axis. The axis formed by Transducer 1 and 3 are called the X-axis and the axis formed by Transducer 2 and 4 are called the Y-axis, refer Figure A - 2 for a block schematic illustration measurement process and Figure 1-1 for an illustration of the sensor orientation.
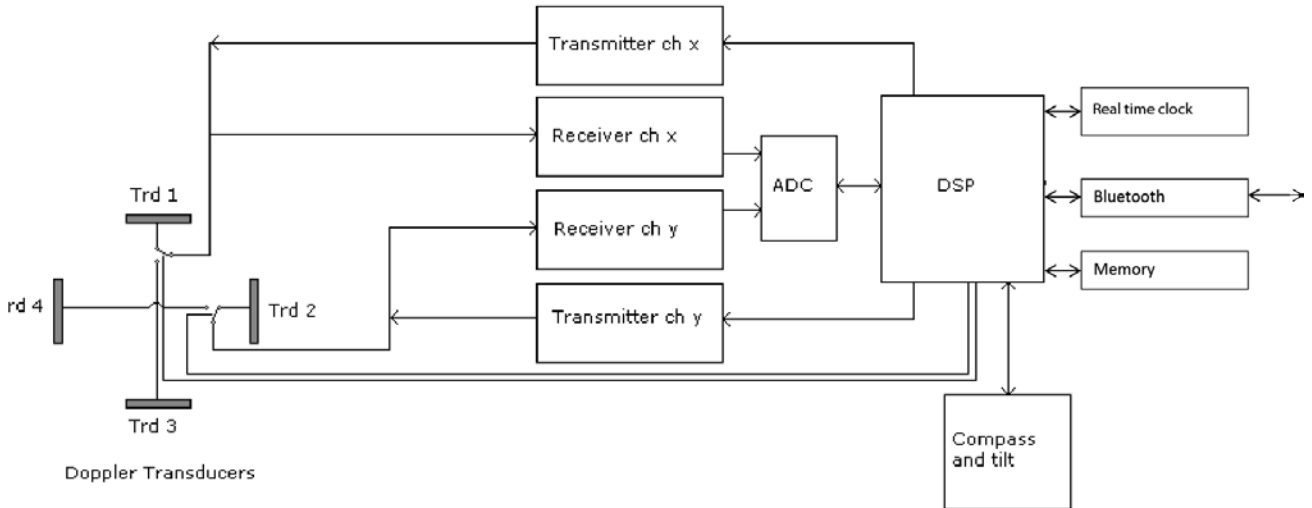

Figure A - 2 Block schematic illustration of the DCS measurement process.

Illustration of transport case – RCM Blue at delivery

Figure 0-7-1 RCM Blue in long life transport box.

Figure 0-2 RCM Blue in shipping box.

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