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TD 304 OPERATING MANUAL
Doppler Current Profiler Sensor
June 2024

Doppler Current Profiler Sensor 5400,5400P,5402,5403

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Contact information:

Aanderaa Data Instrument AS	Visiting address:	TEL: +47 55 604800
PO BOX 103, Midttun	Sandalsringen 5b	
5843 Bergen, NORWAY	5843 Bergen, Norway	

EMAIL: aanderaa.support@xylem.com
WEB: http://www.aanderaa.com

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INTRODUCTION

Purpose and Scope

This document is intended to give the reader knowledge of how to operate and maintain the Aanderaa Doppler Current Profiler Sensor 5400/5402/5403-series. These sensors are described in a single manual since the measurement principle and electronics are the same for all sensors.

The DCPS 5400 is the shallow water version with a maximum depth rating of 300 meters. DCPS 5400P is a special version of DCPS 5400 with integrated pressure sensor. The DCPS 5402 is the intermediate water version with a maximum depth rating of 4500 meters, and the DCPS 5403 is the deep-water version with a maximum depth rating of 6000 meters.

The standard version can be used with either RS-232 or AiCap depending on logger. The sensor is designed to fit directly on the top-end plate of the Aanderaa SeaGuardII Platform using a sensor foot and AiCaP. It can also be used together with the Aanderaa SmartGuard Datalogger using RS-232 or AiCaP or it can be used as a stand-alone sensor using RS-232. The R-version (5400R, 5400PR, 5402R, 5403R) are fitted with RS-422 interface and is intended for stand-alone use with longer cables than with the RS-232 version. R-versions has only RS-422 and not RS-232 or AiCaP.

Aanderaa Smart Sensors utilize common communication protocols at the RS-232 and RS-422 interface where the Smart Sensor Terminal protocol is a simple ASCII command string-based protocol and the AADI Real Time is an XML based protocol. When used together with one of the Aanderaa Dataloggers the CAN bus based AiCaP communication protocol is used.

To configure and control the sensor we use sensor properties. A complete list of user accessible sensor properties is listed in ***chapter 1.10***. The sensor properties are divided in 4 groups with different access levels. Some properties may be set on or off when others may contain different values. To change these setting you can either use AADI Real-Time Collector, described in ***CHAPTER 3*** and ***CHAPTER 4*** or terminal software like Terra Term, described in ***CHAPTER 6*** .

Note! Some settings are only visible when certain properties are enabled. Acoustic Wave is only available in AiCaP mode and when Wave software 5759 license key is installed and DCPS are used on a SeaGuardII with a Pressure, Tide or Wave and Tide Sensor connected to the same logger.

Surface cell and Surface reference is only recommended when DCPS is used on a SeaGuardII with a Pressure Sensor, Tide Sensor or Wave and Tide Sensor connected to the same logger. However Surface Cell and Surface reference is also available without these sensors but are then using the fixed pressure setting and requires a precise depth setting and no tide variations. If there are any wave movement on the surface, we recommend using Tide or Wave and Tide sensor and not Pressure Sensor. Pressure sensor is doing a point measurement and are not compensating for surface movements.

Document Overview

CHAPTER 1 is a short description of the DCPS including dimension, connectors and properties.

CHAPTER 2 gives the theory of operation and list of all output parameters including calculations.

CHAPTER 3 is an overview of how to configure the sensor with AADI Real-Time Collector when connected via an Aanderaa logger such as SmartGuard.

CHAPTER 4 is an overview of how to configure the sensor with AADI Real-Time Collector when the sensor is used stand-alone.

CHAPTER 5 describes how to log data using AADI Real-time Collector.

Error! Reference source not found. describes sensor configuration using terminal software such as Tera Term.

CHAPTER 7 describes output parameters and error codes.

CHAPTER 8 describes the use of External Compass.

CHAPTER 9 describes the sensor electromagnetic compatibility (EMC) and cables.

CHAPTER 10 describes the transducer orientation and how to check tilt and compass

CHAPTER 11 gives information about maintenance.

CHAPTER 12 covers information and configuration guidelines for Acoustic Wave

CHAPTER 13 describes installations of sensor in frame and available cables for stand-alone use.

Applicable Documents

Form 572	Test & Specification Sheet
Form 859	Calibration Certificate, DCPS
Form 726	Calibration Certificate, Temperature Sensor 4080
Form 667	Pressure Certificate
D-409	Data Sheet SeaGuardII DCP
D-422	Data Sheet SeaGuardII DCP Wave
D-411	Data Sheet DCPS 5400/5400R, 5402/5402R, 5403/5403R
TD 310	Theoretical Primer for Doppler Current Profiler
TD 312	Configuration guide for DCPS and SeaGuardII DCP
TD 293	Operating manual SmartGuard
TD 303	Manual for SeaGuardII Platform
TD 268	AADI Real-Time collector operating manual

References

Abbreviations

AiCaP	Aanderaa Protocol: Automated idle Line CANbus Protocol
ASCII	American Standard Code for Information Interchange
CAN	Controller Area Network - sometimes referred to as CANbus
COM port	Communication port used for Serial communication RS232/RS422
DCPS	Doppler Current Profiler Sensor
DCS	Doppler Current Sensor (Single point)
EMC	Electromagnetic compatibility
EIA	Electronic Industry Alliance
GND	Ground
hPa	Hectopascal unit for measuring pressure, 1hPa=1mbar
Hz	Hertz is the derived unit of frequency in the International System of Units (SI)
kPa	Kilopascal unit for measuring pressure
Mbar	Millibar unit for measuring pressure, 1mbar=1hPa
NOAA	National Oceanic and Atmospheric Administration
PSU	Practical Salinity Unit
RS-232	Recommended Standard 232 refers to a standard for serial communication of
RS-422	Differential serial communication for longer cables
RXD	Serial communication Received data
SD-Card	Secure Digital Card a storage device used to store data
TXD	Serial communication Transmitted data
USB	Universal Serial Bus
QA	Quality Assurance, how it establishes a set of requirements for creating
QC	Quality Control, the operational techniques and activities used to fulfil

CHAPTER 1 **Short Description and Specifications**

1.1 Description

The Aanderaa Doppler Current Profiler Sensor is an acoustic current profiling sensor based on the Doppler shift principle. It can operate either in narrowband or in broadband mode; the two measurement techniques are described in TD 310, Primer for Doppler Current Profiler. Broadband is only recommended to use in fixed installation, not on moving platforms.

To measure current speed and direction the sensor transmits acoustic pulses into the water and samples the backscattered (echo) signal from different distances away from the sensor. The sampled data from the received signal is processed to find the Doppler shift in the different layers/cells away from the sensor. It uses four acoustic transducers (beams) to be able to calculate the 3D-current in each layer/cell. Only 3 beams are necessary to obtain a 3D-current measurement and the 4th beam is used for additional quality controls (more information available in Technical Description TD 310).

The acoustic profiling range depends on the acoustic backscatter conditions, i.e. how much particles, plankton, air bubbles etc. present in the water column along the sensor beams. The DCPS operates at 600 kHz frequency which gives typical profiling range from 40 to 80 meters from the sensor with good backscatter conditions. Extremely good backscatter conditions may give even longer profiling range while low backscatter can reduce the measurement range.

The sensor includes a solid-state 3-axis magnetometer and inclinometer providing the tilting and compass heading of the sensor. The tilt is necessary for correct placement of the cells away from the sensor and the correct calculation of the 3D-current components. The compass also uses the tilt internally to find the correct horizontal components of the earth magnetic field to be able to calculate the correct compass heading from the earth magnetic field. The compass heading and tilt (pitch, roll) is measured for each acoustic ping and is used for calculation of the current vectors (north, east and vertical) for each ping. At the end of the recording interval a vector average is calculated for each cell to obtain the correct averaged horizontal speed and direction. The sensor can also output the horizontal north and east speed components in addition to the horizontal speed and direction.

In addition to the 4-beam calculation for current speed and direction, the sensor can also calculate and output all the four different 3-beam solutions. This can be useful as quality control of the data and to check if one of the beams has any kind of disturbance in one or several cells. An auto-beam solution can also be enabled; in this case the sensor uses a specific algorithm and define, for each cell and each ping, the best beam solution automatically (based on the use of 3 or 4 beams depending on the disturbance).

To measure wave you will need a 5400P with pressure sensor integrated or a standard sensor mounted on a SeaGuardII Platform with Pressure Sensor 4117, Tide Sensor 5217 or Wave & Tide Sensor 5218 and DCPS with Wave software 5759 license enabled. If there are any wave movement on the surface, we recommend using Tide or Wave and Tide sensor and not Pressure Sensor. Pressure sensor is doing a point measurement and are not compensating for surface movements. Acoustic wave is not available from a stand-alone DCPS and only in AiCaP mode.
By using Wave and Tide Sensor 5218 you will also get redundant wave measurement for QA/QC.

The measurement of waves and current are independent even though they are using the same transducers. The interval for waves and current are selectable by user. The standard ping frequency when measuring waves are 4Hz, user selectable option for 2Hz. The transmission pulse is automatically adapted to the current sea conditions to provide best measurement achievable; a low noise broadband mode is used for smaller waves, an extended range broadband mode used for medium range waves and a narrowband mode is applied for higher waves. This broadband/narrowband setting is done automatically and are not related to the bandwidth setting in Sensor Configuration.

The sensor also calculates and outputs several quality parameters which can be used to identify any suspicious data (user enabled). The different quality parameters from the sensor are described in detail in this manual. If the user chooses to not enable all the quality parameters, the sensor always outputs a *Cell State1 and Cell State2* parameter for each cell and a *Record State* for each measurement output. These status parameters indicate if the conditions have been good or not. Listing of all Cell States and Record Status see ***chapter 7.3*** and ***7.4***

The DCPS 5400/5400P sensor (300-meter version) has a POM Housing and titanium base plate while DCPS 5402 and DCPS 5403 also have titanium housing. The DCPS 5403 has a higher titanium grade (grade 5) than DCPS 5402 (grade 2) and withstand higher pressure.

The sensor is available in two output versions either the standard version 5400, 5400P, 5402 and 5403 with AiCaP and RS-232 output or an R-version, 5400R,5400PR, 5402R and 5403R with RS-422. This sensor is intended for use as stand-alone sensor on longer cable since the cable length for RS-232 is limited especially with higher baudrate.

The sensor can be ordered with an additional Temperature Sensor 4080. Default this sensor is not included. Special version 5400P/5400PR are fitted with a pressure sensor for measuring water depth and are also used for an exact placement of cells either referred to surface or instrument.

1.2 Sensor Dimension

Figure 1-1: Sensor Dimension SW version

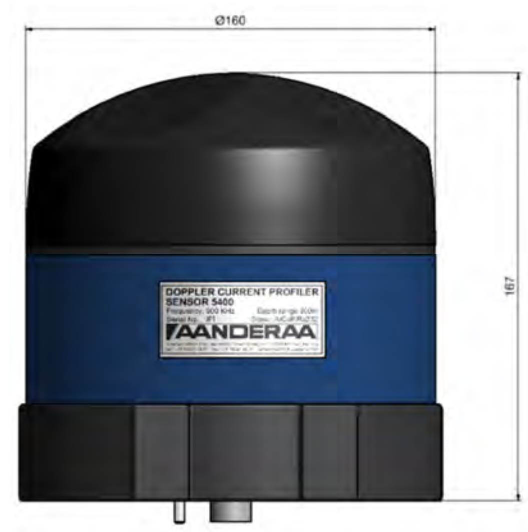


Figure 1-2: Sensor Dimension IW/DW version

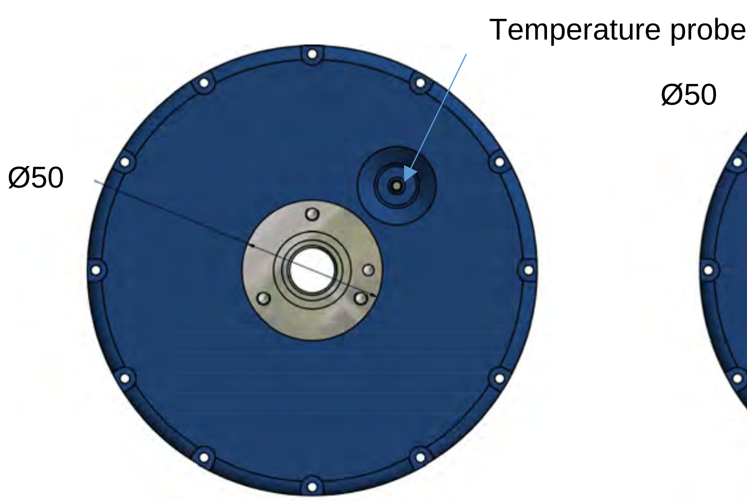


Figure 1-3: 5400 bottom view

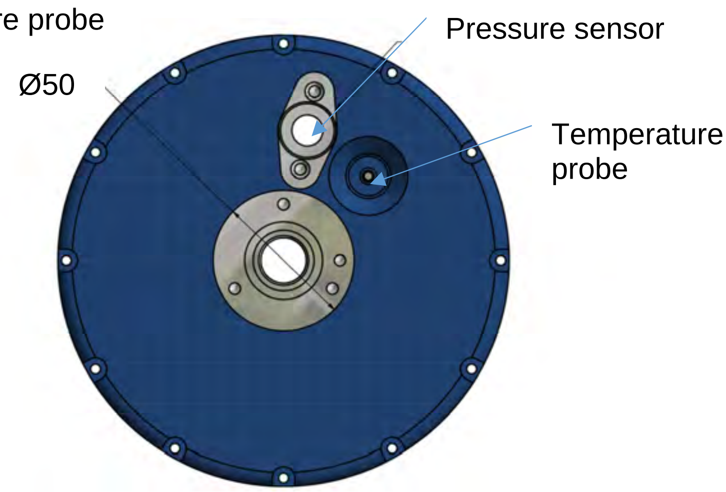


Figure 1-4: 5400P Bottom view

1.3 Sensor pin configuration and data output

DCPS 5400/5400P/5402/5403 are using a 10-pin lemo plug for RS-232 and AiCaP communication between sensor and logger; see ***Figure 1-5*** for pin configuration. DCPS 5400R/5402R/5403R is using a 10-pin lemo plug for RS-422 connection to external logger; see ***Figure 1-6***Error! Reference source not found. for pin configuration. For a list of available cables see ***chapter*** *Error! Reference source not found.* or contact aanderaa.sales@xylem.com.

1.3.1 Pin configuration 5400/5400P/5402/5403 with RS-232 and AiCaP communication

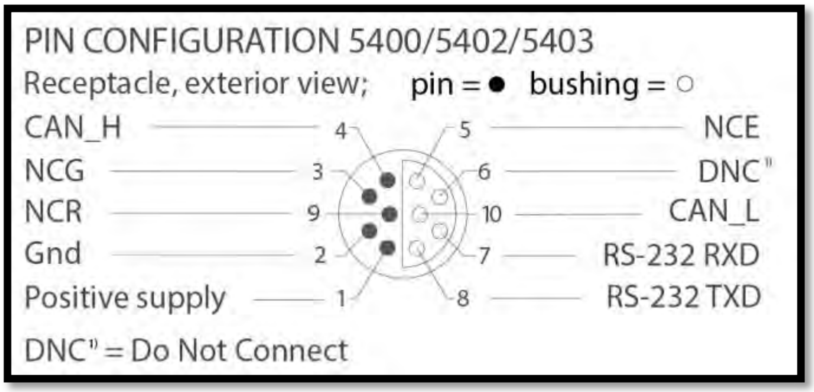


Figure 1-5 5400/5400P/5402/5403 Sensor communication 10-pin plug with RS-232 and AiCaP

Table 1-1: 5400/5400P/5402/5403 Sensor pin configuration 10-pin plug AiCaP and RS-232

Sensor Signal name	Input (I) Output (O)	Sensor plug MCBH10M. Pin no:
TXD	O	8
RXD	I	7
Positive supply		1
GND		2
NCE		5
NCR		9
NCG		3
CAN_H		4
CAN_L		10
BOOT ENABLE	I	6

1.3.2 Pin configuration 5400R/5400PR/5402R/5403R with RS-422 communication

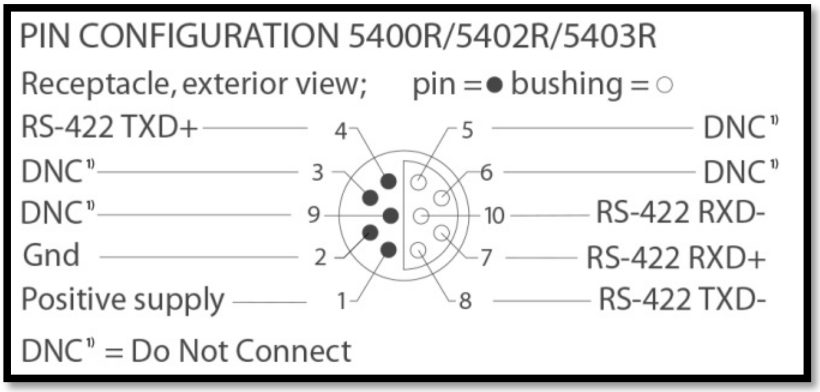


Figure 1-6 5400R/5400PR/5402R/5403R Sensor communication 10-pin plug with RS-422

Table 1-2: 5400R/5400PR/5402R/5403R Sensor pin configuration 10-pin plug RS-422

Signal name	Input (I) Output (O)	Sensor plug Pin no: MCBH6F
RX-	I	10
RXD/RX+	I	7
TXD/TX-	O	8
TX+	O	4
GND		2
Positive supply		1

1.4 Sensor Connection

Aanderaa offers a wide range of cables for different use of the sensors, both standard cables for use with loggers using AiCaP, RS-232 and RS-422 but also special customer specified cables for use in project. See ***chapter** Error! Reference source not found.* **Error! Reference source not found.** for an overview of standard cables or contact aanderaa.sales@xylem.com for more info. To configure the sensor it need to be connected to an Aanderaa logger using AiCaP, a real-time RS-232/RS-422 cable or you need a RS-232/RS-422 configuration cable.

1.4.1 Configure sensor using RS-232 configuration cable

Connect your sensor to one of the COM ports on your PC. See alternative cables available in ***chapter 13.3.***

1.4.2 Using PC without COM-port

If your PC comes without a COM-port we recommend using a USB to serial converter.

Error! Reference source not found. shows one alternative, FTDI Serial to USB, recommended for use with Win10 and newer.

Connect the USB plug to your PC USB-port and then your sensor to the 9pin DSub.

Figure 1-7: Serial to USB converter

1.4.3 Configuration Cable 3855

The 3855 cable is a non-watertight 1.5-meter cable for laboratory use only used for connection between sensor and PC in the office/lab. This is a standard cable that can also be used to configure most other Aanderaa Smart Sensors as well.
The cable is supplied with a USB port providing power to the sensor from the PC USB port. Please note that a standard laptop does not deliver more than 5V on the USB port. Therefore a USB extension cable is supplied with the cable so alternatively you may connect the free end to an external power (6-14V). An alternative solution is *to use a 9V alkaline battery (6LF22) to set the sensor up or log it in the laboratory.* Sensor Cable 3855 is also available in other lengths. Do not use this cable underwater.

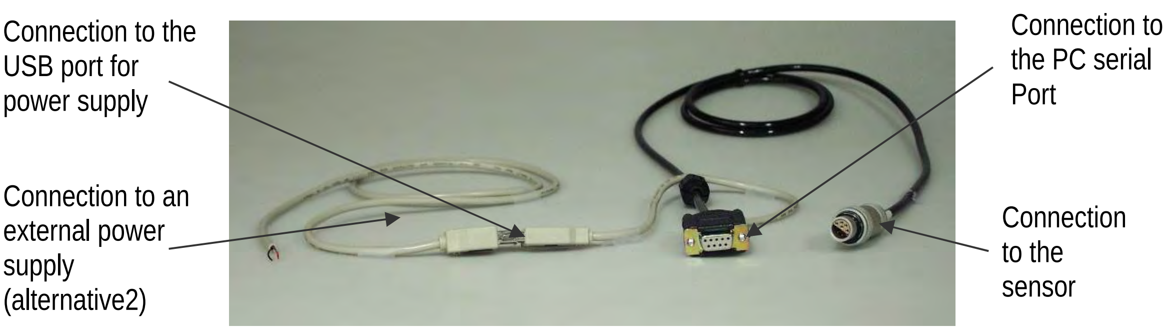


Figure 1-8: Set-up and configuration cable 3855

Table 1-3: Cable 3855 pin configuration

Signal name	Sensor plug	9-p D-Sub	USB
TXD	1	2	
RXD	2	3	
Boot Enable	3		
BV	4		4 (black)
GND	7	5	1 (red)
Positive Supply	8		
RTS short to CTS		7-8	

1.4.4 Configure sensor using RS-422 configuration cable 5618

Connect your sensor to one of the COM ports on your PC using the RS-422 to RS-232 adapter or use an RS-422 port if available. If your PC comes without serial ports (COM ports) you may also use an USB to Serial Adapter. We recommend FTDI Serial to USB, for use with Win10 and newer.

The 5618F is a 3 meter cable for laboratory use only used for connection between sensor and PC in the office/lab. This cable can also be used to configure most of the other RS-422 Aanderaa Smart Sensors with RS-422 as well.
The cable is supplied with a USB port providing power to the sensor from the PC USB port. Please note that a standard laptop does not deliver more than 5V on the USB port. Therefore a USB extension cable is supplied with the cable so alternatively you may connect the free end to an external power (6-14V). An alternative solution is to use a 9V alkaline battery (6LF22) to set the sensor up or log it in the laboratory. A RS-422 to RS-232 converter is also Included with the cable. Sensor Cable 5618 is also available in other lengths. Do not use this cable underwater.

1.4.5 Configuration Cable 5618

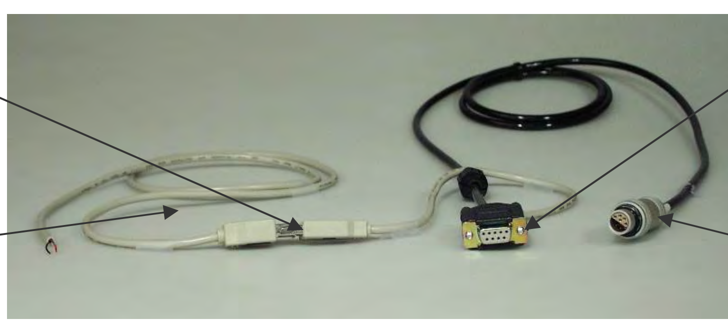


Figure 1-9: Set-up and configuration cable 5618

Table 1-4: Cable 5618 pin configuration

Signal name	Sensor plug	9-p D-Sub	USB
RS-422 Tx-	1	2	
RS-422 RX+	2	3	
NC(Not Connected)	3		
NC(Not Connected)	4		
RS-422 Tx+	5	7	
NC(Not Connected)	6		
Gnd	7	5	Black
Positive Supply / V+	8		Red
RS-422 RX-	9	8	
NC(Not Connected)	10		

1.5 Configuration of sensor using Aanderaa logger

If your sensor is connected to a Aanderaa logger, SeaGuardII or SmartGuard you may also configure the sensor through this logger. For more information about this see ***CHAPTER 3***

1.6 Specifications for Doppler Current Profiler Sensor

Doppler Current Profiler Sensor 5400/5400P/5400PR/5402/5402R/5403/5403R Specifications Refer to Datasheet D 411 which is available on our web site http://www.aanderaa.com or contact aanderaa.info@xylem.com.
You will find the latest versions of our documents on Aanderaa website.

1.7 Manufacturing and Quality Control

Aanderaa Data Instruments products have a record for proven reliability. With over 50 years' experience producing instruments for use in demanding environments around the globe you can count on our reputation of delivering the most reliable products available.
We are an ISO 9001, ISO 14001 and OHSAS 18001 Certified Manufacturer. As a company we are guided by three underlying principles: quality, service, and commitment. We take these principles seriously, as they form the foundation upon which we provide lasting value to our customers.

1.8 User accessible sensor properties

All configuration settings that determine the behavior of the sensor are called properties and are stored in a persistent memory block (flash). One property can contain several data elements of equal type (Boolean, character, integer etc.). The different properties also have different access levels.
To read the value of a certain properties you need to send ASCII string starting with the command get and then followed by the property name to the sensor, see example below.
To change the content of a property an ASCII string starting with set and then followed by the property name and new value in brackets need to be sent to the sensor.

Get Interval	//When sending this string to the sensor, it will then return the value stored in this property.
Interval 5400 17 1min	//Returned from sensor, where 5400 is the product number, 17 is the serial number of the sensor and 1min is the value stored as interval. To change the value you might send the following command:
Set Interval(10min)	//This will change the value for this property to 10 minutes.
Save	//Always end with save to store setting in flash.

The interval will now be changed to 10 minutes.

For more details see ***CHAPTER*** 5

1.9 Passkey for write protection.

To avoid accidental change, most of the properties are write-protected. There are four levels of access protection, refer ***Table 1-5***.

A special property called ***Passkey*** must be set according to the protection level before changing the value of properties that are write-protected. After a period of inactivity at the serial input, the access level will revert to default. This period corresponds to the ***Comm TimeOut*** setting, or 1 minutes it the ***Comm TimeOut*** is set to ***Always On.***

Set Passkey(1000) *//Will set the access level to high*

Table 1-5: Passkey protection

Output	Passkey	Description
No		No Passkey needed for changing property.
Low	1	The Passkey must be set to 1 prior to changing property
High	1000	The Passkey must be set to 1000 prior to changing property. This Passkey value also gives read access to factory properties that usually are hidden.
Read Only	Factory	The user has only read access.

1.10 Sensor Properties

When using AADI Real-Time Collector you don't need to think about the command string sent to the sensor since this is fully controlled by the software, see CHAPTER 3 and ***CHAPTER 4*** .
Some properties of the 'AiCaP' sensor will not be applicable / visible when the sensor is connected to a SeaGuardII or SmartGuard Datalogger, as these properties will then be controlled by the logger.
The wave properties are only applicable / visible if used in AiCaP mode and Acoustic Wave is enabled; see ***CHAPTER 12*** for more details. To enable Acoustic Wave you need to order and enter the Acoustic Wave License Key. For older versions of DCPS a hardware upgrade might also be needed. Please contact aanderaa.support@xylem.com for assistance.
All sensor properties are listed in ***chapters 1.10.1*** through ***1.10.4***.

1.10.1 Factory Configuration

All properties in this section are Read Only, not possible to overwrite for the user. Only certified Aanderaa service personal can alter these settings. The access level for reading the status of this properties is however different for each property, see table for more details. In this group we find information about Software and hardware settings, Production, Service and Calibration dates See ***chapter 7.3*** and ***7.4*** for more details.

Table 1-6: Sensor properties for Doppler Current Profiler Sensor 5400/5400P/5400R/5400PR, 5402/5402R, and 5403/5403R ENUM=Enumeration, INT =Integer, BOOL=Boolean ('yes'/'no')

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Product Name	String	31	AADI Product name, default Doppler Current Profiler Sensor	FC	No / Read Only
Product Number	String	6	AADI Product number, default 5400, 5400P, 5400R, 5400PR, 5402, 5402R, 5403 or 5403R		
Serial Number	INT	1	Serial Number		
SW ID	String	11	Unique identifier for internal firmware		
SW Version	INT	3	Software version (Major, Minor, Built)		
HW ID X	String	19	Hardware Identifier, X =1..3[1)] unique identifier for hardware		High / Read Only
HW Version X	String	9	Hardware Identifier, X =1..3[1)] (Rev. x)		
System Control	INT	3	For AADI service personnel only		
Production Date	String	31	AADI production date, format YYYY-MM-DD (Not in use)		
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 (Not in use)		
Calibration Interval	INT	1	Recommended calibration interval in days (Not in use)		
Cross Diff Limits	INT	3	Set limits 1, 2, and 3 for "Cell has High cross difference, above cross difference limit", default values are 10, 25 and 40. If value exceeds the limits a bit in Cell State1 will be set. See Cell State definition in ***chapter 7.3.***		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Strength Limits NB	INT	4	Set limits 1, 2, 3 and Discard Data2) for “Cell has weak signal, strength below weak limit for narrowband”, default values are -40, -44, -48 and -50. If value exceeds the limits a bit in Cell State1 will be set. If Beam Strength Output is set a status for each individual beam will be shown in Cell State 2. See Cell State definition in ***chapter 7.3***.	FC	High / Read Only
Strength Limits BB	INT	4	Set limits 1, 2, 3 and Discard Data2) for “Cell has weak signal, strength below weak limit for broadband”, default values are -40, -44, -48 and -50. If value exceeds the limits a bit in Cell State will be set. If Beam Strength Output is set a status for each individual beam will be shown in Cell State 2. See Cell State definition in ***chapter 7.3***.		
SP Stdev Limits NB	INT	3	Set limits 1, 2 and 3 for “Cell has high standard deviation for narrowband”, default values are 60, 80 and 100. If value exceeds the limits a bit in Cell State 1 will be set. See Cell State definition in ***chapter 7.3.***		
SP Stdev Limits BB	INT	3	Set limits 1, 2 and 3 for “Cell has high standard deviation for broadband”, default values are 10, 30 and 50. If value exceeds the limits a bit in Cell State1 will be set. See Cell State definition in ***chapter 7.3.***		
Vertical Current Limits	INT	3	Set limits 1, 2, 3 and for “Cell has High vertical current above high vertical limit”, default values are 10, 20 and 30. If value exceeds the limits a bit in Cell State1 will be set. See Cell State definition in ***chapter 7.3.***		
Cross Correlation High Limit	INT	2	Set high limit for “broadband cross correlation beam1-beam4, outside cross correlation limit”, default values are 0.6. If value exceeds the limits a bit in Cell State1 will be set for each individual beam. See Cell State definition in ***chapter 7.3.***		
Noise Limit 1	INT	1	Set limit for “High ambient noise measured on Beam1 – Beam4”, default values are -48. If Noise Level Output is enabled and value exceeds the limits a bit in Record Status will be set for each individual beam. See Record Status definition in ***chapter 7.4***.		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Noise Limit 2	INT	1	Set limit for “Higher ambient noise measured on Beam1 – Beam4”, default values are -38. If value exceeds the limits a bit in Record Status will be set for each individual beam. See Record Status definition in ***chapter 7.4***.	FC	High / Read Only
Noise Limit 3	INT	1	Set limit for “Even higher ambient noise measured on Beam1 –Beam4”, default values are -28. If exceeds the limits a bit in Record Status will be set for each individual beam. See Record Status definition in ***chapter 7.4***.		
Air Detect Threshold	INT	1	Set limits for air detect. Default values are 500. Used to disable ping pulse from the transducers when sensor is in air. If value exceeds the limits a bit in Record Status will be set. See Record Status definition in ***chapter 7.4***.		

1) Hardware ID 1 is Analog Board for Transducer 1 and 2. Hardware ID 2 is Analog Board for Transducer 3 and 4 and Hardware ID 3 is for Digital Board

2) When value exceeds the Discard Data limit, Discard Data will also be output in parameter status.

1.10.2 Deployment Settings

Deployment Settings contains settings for instruments metadata like position and owner, but also site dependent properties storing data that might influence the measurement. Value stored in these setting can be used as default values but might also be exchanged with real-time measured data if sensors are connected to the AiCaP bus.

Table 1-7: Sensor properties for Doppler Current Profiler Sensor 5400/5400P/5400R/5400PR, 5402/5402R, and 5403/5403R ENUM=Enumeration, INT =Integer, BOOL=Boolean ('yes'/'no')

<table>
<tr><th>Property</th><th>Type</th><th>No of elements</th><th>Use</th><th>Configuration Category</th><th>Access Protection Read/Write</th></tr>
<tr><td>Interval</td><td>ENUM</td><td>1</td><td>Set the output interval in seconds, minutes or hours. Minimum available interval is dependent on configuration (time to do all ping measurements).[1]</td><td rowspan="10">DS</td><td rowspan="5">No / No</td></tr>
<tr><td>Location</td><td>String</td><td>31</td><td>User setting for location</td></tr>
<tr><td>Geographic Position</td><td>String</td><td>31</td><td>User setting for geographic position</td></tr>
<tr><td>Vertical Position</td><td>String</td><td>31</td><td>User setting for describing sensors vertical position/depth</td></tr>
<tr><td>Reference</td><td>String</td><td>31</td><td>User setting for describing sensor reference, user definable.</td></tr>
<tr><td>Enable Magnetic Declination</td><td>BOOL</td><td>1</td><td>Enables use of magnetic declination angle input (see Declination Angle for value used)[2]</td><td rowspan="5">No / Low</td></tr>
<tr><td>Declination Angle</td><td>Float</td><td>1</td><td>A value to correct for the magnetic variation on the site where the sensor is used. This is the angle in degrees between magnetic north and true north.[2]</td></tr>
<tr><td>Sound Speed</td><td>Float</td><td>1</td><td>Fixed sound speed setting in m/s. This value is used for cell positioning in the profile and for calculation of current speed values. Variable sound speed values can be used while sensor is running. [3][4]</td></tr>
<tr><td>Air Pressure</td><td>Float</td><td>1</td><td>The air pressure in kPa. The air pressure value is used when calculating depth. Can be altered while sensor is running to compensate for variable air pressure.</td></tr>
<tr><td>Local Gravity Constant</td><td>Float</td><td>1</td><td>Gravity constant in m/s^2 used for calculation of depth.</td></tr>
</table>

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Salinity	Float	1	Salinity in PSU used for calculation of density, sound speed and depth. Can be altered while sensor is running to compensate for variable salinity. 3)	DS	No / Low
Fixed Temperature	Float	1	The temperature in degree centigrade. The value is used for calculation of Salinity, Sound speed and Density. Can be altered while sensor is running to compensate for variable temperature.3)		
Fixed Installation Pressure	Float	1	The pressure in kPa at the deployment site. Can be altered while sensor is running to compensate for variable pressure. 3) This value is used for calculation of depth if the surface cell or surface reference is enabled without parameter input from a pressure sensor. 5)6) Not recommended.		
Enable Derived Sound Speed	BOOL	1	If enabled, it will calculate the sound speed from the other available sensors or fixed values. This overrides the Sound Speed setting. If a parameter is available from another sensor it will use this in the calculation, otherwise it will use the fixed value.		
Pressure Sensor Id	ENUM	1	When the DCPS is connected to AiCaP, a list of other available sensors connected to the SmartGuard/SeaGuard Datalogger is shown. This makes it possible to get a correct depth input from another sensor through the datalogger7) Only in AiCaP mode		
Pressure Parameter Id	ENUM	1	A list of all available Pressure parameters with kPa as unit is shown in the dropdown menu. Make sure that the correct pressure parameter is selected. Only in AiCaP mode.		
Air Pressure Sensor Id	ENUM	1	When the DCPS is connected to AiCaP, a list of other available sensors connected to the SmartGuard/SeaGuard Datalogger is shown. This makes it possible to get a correct air pressure input from another sensor through the datalogger7) Only in AiCaP mode		
Air Pressure Parameter Id	ENUM	1	A list of all available Air Pressure parameters with hPa or mbar as unit is shown in the dropdown menu. Make sure that the correct pressure parameter is selected. Only in AiCaP mode.		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Temperature Sensor Id	ENUM	1	When the DCPS is connected to AiCaP, a list of other available sensors connected to the SmartGuard/SeaGuard Datalogger is shown. This makes it possible to get a correct temperature input from another sensor through the datalogger[7)] Only in AiCaP mode	DS	No/ Low
Temperature Parameter Id	ENUM	1	A list of all available Temperature parameters with DegC or Deg.C as unit is shown in the dropdown menu. Make sure that the correct temperature parameter is selected. Only in AiCaP mode.		
Conductivity Sensor Id	ENUM	1	When the DCPS is connected to AiCaP, a list of other available sensors connected to the SmartGuard/SeaGuard Datalogger is shown. This makes it possible to get a correct conductivity input from another sensor through the datalogger[7)] Only in AiCaP mode		
Conductivity Parameter Id	ENUM	1	A list of all available Conductivity parameters with mS/cm as unit is shown in the dropdown menu. Make sure that the correct conductivity parameter is selected. Only in AiCaP mode.		
Heading Sensor Id	ENUM	1	When the DCPS is connected to AiCaP, a list of other available sensors connected to the SmartGuard/SeaGuard Datalogger is shown. This makes it possible to get a correct heading input from another sensor through the datalogger[7)] Only in AiCaP mode		
Heading Parameter Id	ENUM	1	A list of all available Heading parameters with Deg.M as unit is shown in the dropdown menu. Make sure that the correct heading parameter is selected. Only in AiCaP mode.		
Heading Alignment Offset[Deg.M]	Float	1	Offset added to the AiCaP external heading. Only in AiCaP mode.		

1) *The interval is an enumerated type. On Software versions prior to version 8.1.27 this was not enumerated but restricted to the same intervals. The enumerated value for the Interval is shown when sending a Help command to the sensor (10 sec, 20 sec, 30 sec, 1 min, 2 min etc.) On Software version before version 8.1.27 the interval input was only the number of seconds without time unit, i.e 10 was 10 seconds, 60 if 1 minute, 3600 if 1 hour etc.*

[2)] Magnetic declination (variation) is the angle between the magnetic north and the true north. This angle varies depending on the position on the Earth's surface and also varies over time. Declination is positive when magnetic north is east of true north and negative when it is to the west (input angle value ±180°). Magnetic declination at the deployment location can be found for i.e. on NOAA website: [*http://www.ngdc.noaa.gov/geomag-web/*](http://www.ngdc.noaa.gov/geomag-web/)

[3)] The sensor can compensate for variable Temperature, Conductivity and Pressure when installed on a SeaGuardII or SmartGuard Datalogger. If the Datalogger has these sensors connected, the DCPS5400 can be configured to take the input from these sensors to calculate Depth, Salinity, Density and Sound Speed. The calculated depth is also used when surface cell and surface referred columns are enabled. If only some of the sensors are present, the DCPS can also combine sensor inputs and settings to calculate the derived sound speed. See Chapter 5.4 for explanation of Parameter Input when connected to a SeaGuardII or SmartGuard Datalogger.

[4)] The accuracy of the estimated current speeds depends on a correct sound speed setting. The cell positioning also depends on the sound speed. The best way to compensate for variable sound speed is described above in [1)].

[5)] A Pressure/Tide/Wave&Tide sensor which is connected to the same SmartGuard/SeaGuardII can be used as parameter input to the DCPS-sensor to give the calculated depth. If no pressure sensor is available, the Fixed Installation Pressure is used by the sensor if the surface cell or the surface reference is enabled. The Fixed Installation Pressure can be changed while the sensor is running by an external device.

[6)] Even though the user should configure the sensor as upward or downward looking, the sensor detects automatically the orientation when it is in operation. It uses this orientation to calculate the correct North, East and Vertical speeds and also for the calculation of correct compass heading, pitch and roll. If the sensor detects that it is upside down (while configured upward looking and surface referred), the surface cell parameters are set to zero and the parameter status codes returns a "not valid error". If one of the columns is set to surface reference, the column is forced to be instrument referred. If the sensor is configured to be upside down but measures that it is orientated upward looking, both surface cell and surface reference will work if enabled. The 'record status' (in the output data) will indicate in the first bit (32-bit where 32 flags indicates different statuses) with a '1' if there is a mismatch between the upside down setting and the orientation measured by the sensor (binary bits xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx1, where x are the other bits indicating other statuses).

[7)] The fixed heading value here is the angle in degrees between north direction and transducer 1 (clockwise) – Refer Figure 6-2. When viewing the sensor from the front (label side) transducer 1 is to the left on the rear side. If for example transducer 1 is 118° clockwise from north, the fixed heading should be set to 118°. The fixed heading is a value between 0 and 360 (0 and 360 is the same point).

1.10.3 System Configuration

This group is used to control the sensor via properties for configuring communication with logger, sensor setup and parameter enabling and controlling the output from sensor. Some of the properties are only visible depending on the mode selected or if the function is enabled or not. These properties will either be grey or not visible at all. The wave properties are only visible if a license key is set.

Table 1-8: Sensor properties for Doppler Current Profiler Sensor 5400/5400P/5400R/5400PR, 5402/5402R, and 5403/5403R ENUM=Enumeration, INT =Integer, BOOL=Boolean (‘yes’/’no’)

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Mode	ENUM	1	Sets the sensor operation mode (AiCaP, Smart Sensor Terminal and AADI Real-Time). AiCaP is not available on the R-version (5400R) of the sensor. Smart Sensor Terminal is an ASCII output when AADI Real-Time is XML output.		
Enable Sleep	BOOL	1	Enables sleep mode in Smart Sensor Terminal and AADI Real-Time operation to save power (In AiCaP the sensor always tries to sleep when not busy).		
Enable Polled Mode	BOOL	1	Enables polled mode in Smart Sensor Terminal Mode. When set to ‘no’ (non-polled operation) the sensor will sample at the interval given by the *Interval* property. When set to ‘yes’ the sensor will start to do ping measurements at the selected *Polled Pingrate*. A *Do Sample* command triggers the end calculations and output of data. Sensor will calculate with minimum as many ping as set in Ping Number. A *Do Output* command can be sent to repeat the output of the last calculated data.[1)]	SC	No / Low
Polled Pingrate	ENUM	1	Selectable ping rate in Polled mode between 0.1 and 10.0 Hz. The maximum ping rate is limited by the configuration, i.e. large profile with many cells gives lower maximum available pingrate.[1)] Default is 1 Hz.		No / No
Enable Text	BOOL	1	Controls the insertion of descriptive text in Smart Sensor Terminal mode, i.e. parameter names and units. Can be used to reduce message size.		No / Low
Enable Decimalformat	BOOL	1	Controls the use of decimal format in the output string in Smart Sensor Terminal mode. Default is scientific format (exponential format).		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Enable Tilt Compensation	BOOL	1	Tilt compensation is used for correct positioning of the beam cells in each depth cell. It also compensates the Doppler speed measurements for variable tilt to calculate correct speed components (North, East and Vertical). Default enabled.	SC	No / Low
Enable Fixed Heading	BOOL	1	Allows the user to deactivate the internal compass and set a fixed heading value. This can be used if for example the sensor is standing on a fixed platform where the earth magnetic field is disturbed. 2)		
Fixed Heading [Deg.M]	Float	1	The fixed heading value is used if fixed heading is enabled.2)		
Enable Upside Down	BOOL	1	Set to 'No' if used upward looking and 'Yes' if used downward looking. Uses different calibration coefficient set depending on setting. NOTE! Surface Cell and Surface Referred Columns are not possible when sensor is downward looking.3)		
Enable Wave Measurement	BOOL	1	Turns on and of the wave measurements. Only available when Wave software 5729 is enabled with Wave License Key and used in AiCaP mode and at least a pressure sensor are connected to the same bus.		No / No
Wave Integration Time	ENUM	1	Integration time used for wave calculation. 5 min,10 min,15 min,20 min,25 min,30 min. Default is 20min. Only available when Wave software 5729 is enabled with Wave License Key and used in AiCaP mode and at least a pressure sensor are connected to the same bus.		
Wave Sampling Frequency	ENUM	1	Selectable between 2Hz and 4Hz sampling. Default is 4Hz. Only available when Wave software 5729 is enabled with Wave License Key and used in AiCaP mode and at least a pressure sensor are connected to the same bus.		
Significant Wave Height Unit	ENUM	1	Select units for Significant wave height to either Metric (meter) or Imperial (feet). Default setting is Metrics (meter). Only available when Wave software 5729 is enabled with Wave License Key and used in AiCaP mode and at least a pressure sensor are connected to the same bus.		

<table>
<tr><th>Property</th><th>Type</th><th>No of elements</th><th>Use</th><th>Configuration Category</th><th>Access Protection Read/Write</th></tr>
<tr><td>Bandwidth</td><td>ENUM</td><td>1</td><td>Selects between Broadband and Narrowband operation. See Chapter 3.14.8 or 4.10.4 for explanation.</td><td rowspan="8">SC</td><td rowspan="2">No / Low</td></tr>
<tr><td>Enable Ambiguity Lock</td><td>BOOL</td><td>1</td><td>Locks the Broadband algorithm to the speed interval between 0 and 1.2m/s. Should be used if the user knows that the current speeds are always below 1.2m/s.</td></tr>
<tr><td>Ping Number</td><td>ENUM</td><td>1</td><td>The number of ping measurements to be executed in one interval (set by interval property), i.e. the number of ping measurements to be averaged in one recording. Selectable from 10 to 7200. Note that the number of ping needed in broadband is a factor 30 lower compared to narrowband.</td><td rowspan="3">No / No</td></tr>
<tr><td>Enable Burst Mode</td><td>BOOL</td><td>1</td><td>If set to ‘No’, the pings are uniformly spread over the interval. If set to ‘Yes’ the pings are transmitted at the beginning or end of the interval. [4)]</td></tr>
<tr><td>Burst Period Placement</td><td>ENUM</td><td>1</td><td>If set to “Start of Interval” all pings will be transmitted in the beginning of the interval but presented in the end. If set to “End of Interval” it will transmit all pings in the end of the interval close to the read out. Default setting is End of Interval. Only available if Enable Burst Mode is selected.</td></tr>
<tr><td>Enable Surface Cell</td><td>BOOL</td><td>1</td><td>Enables a measurement of the surface layer. This layer I based on the strong reflection from the thin layer between water and air. There will be a strong correlation between wind and speed/surface boundary speed and wind direction / surface boundary direction.</td><td rowspan="3">No / Low</td></tr>
<tr><td>Surface Cell Size</td><td>ENUM</td><td>1</td><td>The surface cell size around the surface layer. The time window where the sensor measures the Doppler is centered at the surface. Selectable from 0.5 to 5 meter. Default setting is 1 meter.</td></tr>
<tr><td>C1 Enable Surface Reference</td><td>BOOL</td><td>1</td><td>Enables surface reference for Column 1. If not selected the column will be instrument referenced. Note! The sensor needs a pressure input to compensate for tidal variations. Cannot be used in combination with downward orientation.</td></tr>
</table>

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
C1 Cell Size	ENUM	1	The Cell size setting for Column 1 in meter. Selectable from 0.5 to 5 meter. Default setting is 1 meter.	SC	No / Low
C1 Distance First Cell Center	ENUM	1	The distance to center of first cell for Column 1 in meter, distance from surface if surface referenced or sensor if not surface referenced. Always sensor referenced if used upside down. Selectable from 1 to 70 meter. Default setting is 3 meter.		
C1 Number Of Cells	ENUM	1	Number of Cells in Column 1, maximum 75 cells. Default setting is 45.		
C1 Cell Center Spacing[m]	ENUM	1	Spacing between two cells for Column 1 in meter. If spacing is equal to cell size the two cells is next to each other. Spacing less than cell size gives overlap and spacing more than cell size gives space between two cells. Selectable from 0.1 to 30 meter. Default setting is 1 meter.		
C2 Enable Column	BOOL	1	Enables Column 2 (Column 1 is always enabled)		
C2 Enable Surface Reference	BOOL	1	Enables surface reference for Column 2. If not selected the column will be instrument referenced. Note! The sensor needs a pressure input to compensate for tidal variations. Cannot be used in combination with downward orientation.		
C2 Cell Size	ENUM	1	The Cell size setting for Column 2 in meter. Selectable from 0.5 to 5 meter. Default setting is 1 meter.		
C2 Distance First Cell Center	ENUM	1	The distance to center of first cell for Column 2 in meter, distance from surface if surface referenced or sensor if not surface referenced. Always sensor referenced if used upside down. Selectable from 1 to 70 meter. Default setting is 3 meter.		
C2 Number Of Cells	ENUM	1	Number of Cells in Column 2, maximum 50 cells. Default setting is 10.		
C2 Cell Center Spacing[m]	ENUM	1	Spacing between two cells for Column 2 in meter. If spacing is equal to cell size the two cells is next to each other. Spacing less than cell size gives overlap and spacing more than cell size gives space between two cells. Selectable from 0.1 to 30 meter. Default setting is 2 meter.		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
C3 Enable Column	BOOL	1	Enables Column 3	SC	No / Low
C3 Enable Surface Reference	BOOL	1	Enables surface reference for Column 3. If not selected the column will be instrument referenced. Note! The sensor needs a pressure input to compensate for tidal variations. Cannot be used in combination with downward orientation.		
C3 Cell Size	ENUM	1	The Cell size setting in Column 3 in meter. Selectable from 0.5 to 5 meter. Default setting is 1 meter.		
C3 Distance First Cell Center	ENUM	1	The distance to center of first cell for Column 3 in meter, distance from surface if surface referenced or sensor if not surface referenced. Always sensor referenced if used upside down. Selectable from 1 to 70 meter. Default setting is 3 meter.		
C3 Number Of Cells	ENUM	1	Number of Cells in Column 3, maximum 25 cells. Default setting is 10.		
C3 Cell Center Spacing[m]	ENUM	1	Spacing between two cells for Column 3 in meter. If spacing is equal to cell size the two cells is next to each other. Spacing less than cell size gives overlap and spacing more than cell size gives space between two cells. Selectable from 0.1 to 30 meter. Default setting is 2 meter.		
Enable Current from Wave Ping	BOOL	1	If enabled data from wave measurement will also be used to calculate current. All current data are presented in Column 4. Only in AiCaP mode and with Wave License Key.		
Wave Mean Direction Output	ENUM	1	Configuration of Wave Mean Dir Output Off, Storage or Output+Storage. Only in AiCaP and with Wave License Key.		
Wave Mean Period Tm02 Output	ENUM	1	Configuration of Wave Mean Period Tm02 Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.		
Wave Energy Period Tm-10 Output	ENUM	1	Configuration of Wave Energy Period Tm-10 Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Energy Spectrum Output	ENUM	1	Configuration of Energy Spectrum Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.	SC	No / Low
Directional Spectrum Output	ENUM	1	Configuration of Directional Spectrum Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.		
Principal Dir Spectrum Output	ENUM	1	Configuration of Principal Dir Spectrum Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.		
Orbital Ratio Spectrum Output	ENUM	1	Configuration of Orbital Ratio Spectrum Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.		
Fourier Coeff Spectrum Output	ENUM	1	Configuration of Fourier Coeff Spectrum Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.		
Wave Depth Cell Output	ENUM	1	Configuration of Wave Depth Cell Output 'Off, Storage or Output+Storage'. Only in AiCaP and with Wave License Key.		
Select Profile Parameters	ENUM	1	Different groups of parameters that will control the output from sensor. If User Specified is selected you may select the individual parameter under User Specified – Profile Parameter. For all other selections the individual setting will be overruled by the group setting. Alternative choices are: Simple Output, Basic Output, Basic + Beam Output, Basic + 3-beam Output, Basic + Beam + 3-beam Output, Full Output, User Specified. See ***Table 3-1*** or ***Table 4-1*** for definition of each group.		
Enable 4-beam Auto Replacement	BOOL	1	Enables automatic replacement of the standard 4-beams calculated result with the best 3-beams if any disturbance in one of the beams.		
NE Speed Output	ENUM	1	Enables/Disables output of calculated North and East speed components.[5)] 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
3-Beam Combination Output	ENUM	1	Enables output of the four 3-Beam combinations. [5)] Each 3-Beam is calculated using only 3-transducers to help detect any obstructions in one of the beams. 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
AutoBeam Output	ENUM	1	Enables output of the autobeam solution; the sensor uses a specific algorithm to define, for each cell and ping, the best beam solution automatically, based on the use of 3 or 4 beams depending on disturbance. 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).	SC	No / Low
AutoBeam Speed Type	ENUM	1	Sets the AutoBeam Speed Type. If AutoBeam Output is selected then AutoBeam Speed Type will select the output format. 'Polar', 'Rectangular 'or 'Polar+Rectangular', See chapter **Error! Reference source not found.** or 3.14.16		
Vertical Speed Output	ENUM	1	Enables output of calculated vertical speed5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Strength Output	ENUM	1	Enables the output of signal strength (Average from all beams). 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Beam Speed Output	ENUM	1	Enables output of speeds for each individual beam (m/s). 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Beam Strength Output	ENUM	1	Enables output of signal strength for each individual beam (dB). 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Std Dev Speed Output	ENUM	1	Enables standard deviation output for horizontal speed calculated in each cell. 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Std Dev Beam Speed Output	ENUM	1	Enables standard deviation output of beam speed for each beam in every cell. 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Cross Difference Output	ENUM	1	Enables cross difference output for all cells. 5) Difference between Doppler shift measured by the transducers on same axis, for each depth the speed in beam 1 - speed beam 3 + speed beam 2 – speed beam 4 should be close to 0. 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Correlation Factor Output	ENUM	1	Enables correlation factor output (only in Broadband). 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).	SC	No / Low
Noise Level Output	ENUM	1	Enables output of noise measurements from the four beams. This is a way to check for disturbance from other acoustic devices or input noise on the cable.5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Heading Output	ENUM	1	Enables output of the compass heading. 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Pitch Roll Output	ENUM	1	Enables output of pitch and roll rotation angles (deg.). 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Abs Tilt Output	ENUM	1	Enables output of the absolute tilt. This is the angle between the sensor plane and the horizontal plane (Deg.). 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Max Tilt Output	ENUM	1	Enables the output of the maximum absolute tilt measured (Deg.) during the recording interval. 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Tilt Direction Output	ENUM	1	Enables the output of the tilt direction of the sensor (Deg.M). 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Std Dev Heading Output	ENUM	1	Enables standard deviation on heading output. The sensor does one heading measurement for each ping. This is the standard deviation of all the heading measurements during a recording interval. 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Std Dev Tilt Output	ENUM	1	Enables standard deviation on tilt output. The sensor does a tilt measurement for each ping. This is the standard deviation of all the absolute tilt measurements during the recording interval. [5)] 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Temperature Output	ENUM	1	Enables the output of Temperature from Temperature sensor 4080 in (Deg.C).Only available if the optional Temperature sensor 4080 is included and calibrated from factory. 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Pressure Output	ENUM	1	Enables the output of Pressure from integrated pressure sensor only for 5400P and 5400PR 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Charge Voltage Output	ENUM	1	Enables output of the charge voltage to the acoustic Tx circuits. This is a way to see if there is something wrong with the charge electronics or the transducers.[5)] 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).	SC	No / Low
Memory Used Output	ENUM	1	Enables output of the used heap memory. [5)] 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Voltage Output	ENUM	1	Enables output of the measured input voltage internally in the sensor. This is a way to see if the input supply voltage starts dropping. [5)] 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Current Output	ENUM	1	Enables output of the measured input current to the sensor. This can indicate if something is wrong in the internal electronics if it suddenly starts to rise. [5)] 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Air Detect Output	ENUM	1	Outputs the value measured by the air detect circuit. This is a circuit which detects if the sensor is in air or water. 5) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).	SC	No / Low
Speed Of Sound Output	ENUM	1	Enables output of the speed of sound. If Derived Sound Speed is enabled, this is the value calculated from the other input settings. (or sensors in AiCaP). If not, it outputs the sound speed setting. 5)6)7) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Depth Output	ENUM	1	Enables depth output. This is the calculated depth, i.e. calculated from other settings (or sensors in AiCaP). 5)6) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Salinity Output	ENUM	1	Enables salinity output. In AiCaP the sensor can get input from a Conductivity, Temperature and Pressure Sensor. This enables the sensor to calculate the salinity. If no sensors are present, it outputs the salinity setting. 5)6) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		
Density Output	ENUM	1	Enables output of calculated density. This is either based on sensor input (in AiCaP) or fixed settings. 5)6) 'Off' or 'Output' (in AiCaP Off, Storage or Output+Storage).		

1) In Polled Mode the sensor uses the Polled Pingrate setting. In non-polled operation the sensor uses the Interval property and the Ping Number property to calculate the ping rate. This is an enumerated value. The selectable ping rate is shown when sending a Help command to the sensor or in the drop-down list shown in Real-Time Collector. The input has to be written as shown with Hz as unit. This value was not enumerated on software versions prior to version 8.1.27. On earlier software versions the values where restricted to the same ping rates (written without unit) but not shown as an enumerated list when sending a Help command or changing the setting in Real-Time Collector.

2) The fixed heading value here is the angle in degrees between north direction and transducer 1 (clockwise) – Refer Figure 6-2. When viewing the sensor from the front (label side) transducer 1 is to the left on the rear side. If for example transducer 1 is 118° clockwise from north, the fixed heading should be set to 118°. The fixed heading is a value between 0 and 360 (0 and 360 is the same point).

3) Even though the user should configure the sensor as upward or downward looking, the sensor detects automatically the orientation when it is in operation. It uses this orientation to calculate the correct North, East and Vertical speeds and also for the calculation of correct compass heading, pitch and roll. If the sensor detects that it is upside down (while configured upward looking and surface referred), the surface cell parameters are set to zero and the parameter status codes returns a "not valid error". If one of the columns is set to surface reference, the column is forced to be instrument referred. If the sensor is configured to be upside down but measures that it is orientated upward looking, both surface cell and surface reference will work if enabled. The 'record status' (in the output data) will indicate in the first bit (32-bit where 32 flags indicates different statuses) with a '1' if there is a mismatch between the upside down setting and the orientation measured by the sensor (binary bits xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx1, where x are the other bits indicating other statuses).
4) The burst mode should be enabled when using a longer interval where the user does not want to average the current over the entire interval. The burst duration for executing all the pings is dependent on the configuration of the sensor (profile size, number of columns, number of cells and number of ping).
5) The enumeration is Off, Output in Smart Sensor Terminal and AADI Real-Time mode. In AiCaP the enumeration is Off, Storage, Output+Storage, where Output+Storage means that the sensor instructs the Datalogger to send out a parameter in real-time in addition to saving the parameter to the SD card and Storage for only saving the data to the SD card.
6) The sensor can compensate for variable Temperature, Conductivity and Pressure when installed on a SeaGuardII or SmartGuard Datalogger. If the Datalogger has these sensors connected, the DCPS5400 can be configured to take the input from these sensors to calculate Depth, Salinity, Density and Sound Speed. The calculated depth is also used when surface cell and surface referred columns are enabled. If only some of the sensors are present, the DCPS can also combine sensor inputs and settings to calculate the derived sound speed. See Chapter 3.13.5 through 3.13.9 for explanation of Parameter Input when connected to a SeaGuardII or SmartGuard Datalogger.
7) The accuracy of the estimated current speeds depends on a correct sound speed setting. The cell positioning also depends on the sound speed. The best way to compensate for variable sound speed is described above in.

1.10.4 User Maintenance

This group contains sensor settings that normally are not altered by the user. To access most of these properties you need to send passkey(1000) or with Real-Time Collector use password: 1000. These properties are used to configure serial port settings, communication to and from sensor. If you got a wave license key you may also enable wave functionality, you may enter temperature coefficients if Temperature sensor is included, set limits for discarding ping if sensor tilt exceeds the limits and property to set the distance from pressure sensor port to center of transducer elements.

Table 1-9: Sensor properties for Doppler Current Profiler Sensor 5400/5400P/5400R/5400PR, 5402/5402R and 5403/5403R ENUM=Enumeration, INT =Integer, BOOL=Boolean ('yes'/'no')

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Node Description	String	31	User text for describing node, placement etc.	UM	No / Low
Owner	String	31	User setting for owner information, company name etc.	UM	No / High
Interface	String	31	Factory use only, RS232 for standard version, RS422 for R-version	UM	High / High
Baudrate	ENUM	1	RS232 baudrate: 4800, 9600, 57600, or 115200. Default baudrate is 115200. The baudrate affects the minimum available Interval setting.	UM	High / High
Flow Control	ENUM	1	RS232/RS422 flow control: 'None' or 'Xon/Xoff'. The Xon/Xoff' characters are also sent for each Doppler ping measurement. To remove the "disturbance" on the receiver, select None. Be aware that this may also lead to missing characters when sending commands to the sensor.	UM	High / High
Enable Comm Indicator	ENUM	1	Enable communication sleep ('%') and communication ready ('!') indicators. After the last communication with the sensor, it normally outputs a '%' when the *Comm Timeout* time is over. When a character is sent to the sensor, it outputs a '!' to indicate that it is ready to communicate.	UM	High / High
Comm TimeOut	BOOL	1	Time communication is active (Always On, 10 s, 20 s, 30 s, 1min, 2 min, 5 min, 10 min). A short time means that the sensor is going to sleep faster after a communication input.	UM	High / High

Property	Type	No of elements	Use	Configuration Category	Access Protection Read/Write
Enable Old Time Setting	BOOL	1	Enables old input in Smart Sensor Terminal mode for Interval and Polled pingrate using seconds instead of seconds, minutes and Hz.	UM	High / High
Acoustic Wave Product Number	String	6	For factory use only.		Read Only
Acoustic Wave Option Key	INT	8	To active the Wave features you need a license key. This key is delivered with the instrument or upgrade kit if wave is ordered. Only available in AiCaP.		High / High
Select Active Wave Cell	INT	1	Select cell 1, 2 or 3 for calculation of wave, Cell 1 is closest to surface, default cell is 1. Only available in AiCaP.		
Enable Fixed Wave Depth Cell	BOOL	1	If enabled you might set the distance from surface to the center of first wave cell in Wave Cell Center Depth. If not set the placement of first cell will be dynamic depending on wave measurement and depth. Only available in AiCaP.		
Wave Cell Center Depth	INT	1	Distance from surface to center of first wave cell. Only available in AiCaP.		
Enable Max Tilt Ping Discard	BOOL	1	If enabled ping with tilt above limit will not be used.		
Max Tilt Limit Ping Discard	INT	1	Set the tilt limit in degrees for when to discard ping. Default value is 60.		
Distance Pressure to Center TRD	INT	1	Set the distance from pressure sensor reference port to center of transducer, this value is used to instrument depth reference to the center of transducer instead of pressure sensor port. Default value is 0.187 meter which correspond to the distance when using pressure sensor 4117, 5217 or 5218. Change value to 0.15 for 5400P or 5400PR.		
Temp Coeffs	INT	6	Only available if Temperature sensor 4080 is installed and calibrated.		
Pressure Coeffs	INT	4	Only available for 5400P and 5400PR.		

CHAPTER 2 **Theory of Operation**

2.1 The Doppler Effect

Acoustic Doppler Current Profilers measure water velocity using a principle of physics discovered by Christian Johann Doppler (1842). The Doppler effect relates to the change in frequency for an observer moving relative to a source of sound or light. Doppler first stated his principle in the article, '*Concerning the colored light of double stars and some other constellations in the heavens*'.

In daily life a common example of the Acoustic Doppler effect or Doppler shift is the siren of an ambulance as it approaches, passes and recedes from an observer. Compared to the emitted frequency, the received frequency is higher during the approach, identical at the instant of passing by, and lower during recession. When the source of the waves is moving towards the observer, each successive wave crest is emitted from a position closer to the observer than the previous wave. Therefore, each wave takes slightly less time to reach the observer than the previous wave. Hence, the time between the arrivals of successive wave crests at the observer is reduced, causing an increase in the frequency (compressed sound waves). Conversely, if the source of waves is moving away from the observer, each wave is emitted from a position farther from the observer than the previous wave, so the arrival time between successive waves is increased, reducing the frequency. The distance between successive wave fronts is then increased (stretched out sound waves). The total Doppler effect result therefore from motion of the source and motion of the observer.

The relationship between the source frequency, f_S and the Doppler shifted frequency, f_D, can be given by:

$$f_D = f_s\left(\frac{c+v_o}{c-v_s}\right) \qquad \textbf{Eq. 2-1}$$

Where c is the speed of sound, v_o is the velocity of the observer and v_S is the velocity of the source.

$$f_D = f_s\left(\frac{c+v_o}{c-v_s}\right)$$

In terms of the corresponding periods

Eq. 2-1 becomes:

$$T_D = T_s\left(\frac{c-v_s}{c+v_o}\right) = T_s\frac{f_S}{f_D} \qquad \textbf{Eq. 2-2}$$

2.2 Doppler shifts using acoustic scatterers

A Doppler current profiler applies the Doppler principle by acting both as source and receiver while bouncing short pulses of acoustic energy off particles/scatterers (e.g. clay, silt, bubbles, phytoplankton, zooplankton) that are always present in natural waters. The scatterers are floating in the water and are assumed to move with the same horizontal and vertical speed as the water. The scatterers will reflect the transmitted sound energy back in all directions and a small amount of the reflected signal is Doppler shifted towards the receiver. Because the instrument both

transmits and receives sound pulse, the Doppler shift is doubled (once on the way to the scatterers and a second time on the way back after reflection).
Assuming that the velocity of the particles (v_O) and the instrument/source (v_S) are much slower than the speed of sound ($v_O << c$ and $v_s << c$), the resulting equation for the Doppler shift becomes:

$$\Delta f = 2 f_S \frac{v_O}{c}$$ **Eq. 2-3**

Example:
With a 600 kHz transmitted sound frequency, 1500m/s speed of sound and scatterers moving at 1 cm/s, the Doppler shift is:

$$\Delta f = 2 \cdot 600kHz \frac{0.01 \ m/s}{1500 \ m/s} = 8 \ Hz$$ **Eq. 2-4**

But what we explained so far only works when sound sources and receivers get closer to or further from one another.

2.2.1 Multiple columns - surface or instrument reference functions

When configuring the instrument it is possible to define up to three 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 (requires pressure sensor).
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. Refer ***Figure 2-1***.

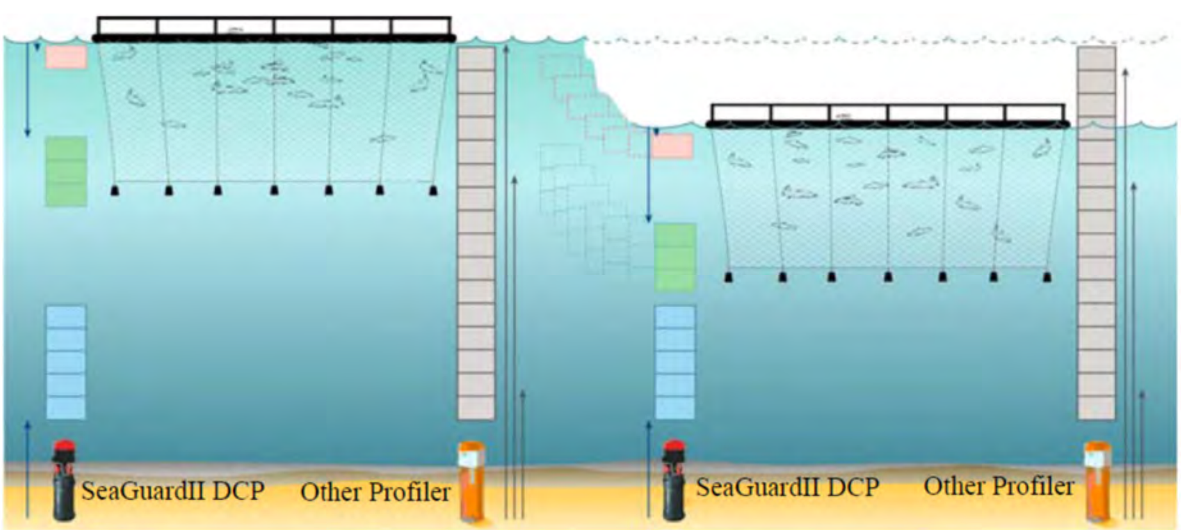


Figure 2-1: Illustration of the multiple columns capability and surface or instrument referred

2.3 Obtaining currents from multiple levels above/below the sensor

The four transducers transmit short pulses (pings) of acoustic energy into the water which are reflected against particles. By systematically clocking these reflections further and further away from the sensor and collecting their doppler shift, currents can be measured at multiple levels, up to 150 (divided over three columns; column 1: max 75 cells, column 2; max 50 cells and column 3 with 25 cells) simultaneously. For more information refer to the DCPS manual TD 304).

An important factor in this context is knowing the speed of sound at the sensor which is obtained from an intergrated temperature sensor and assumed or measured salinity and pressure information. All instruments from Aanderaa have the option for plug-and play addition of smart-sensors for salinity, pressure and other parameters. It is possible to calculate the speed of sound “dynamically” so the sensor sends speed of sound changes based on values obtained from the sensors “continuously” to the DCPS sensor.

In most cases for a sensor like the DCPS that has a maximum range of about 100 m in the best case, it is not important to know the full sound speed profile above/below. A strong stratification with large differences in sound speed could however have implications for at what distance from the instrument the cells are located.

The DCPS sensor is operating at around 600 kHz which gives a typical range of 40-100 m depending on the scatter conditions. In general clear water with a low amount of particles gives shorter range and so do warm water. But also in situations where there is too much particles in the water (above 100 mg/l), like in a turbid river the range will be limited.

For the Doppler current technique to be valid, some assumptions must be fulfilled:

1. The scatterers must drift with the water currents.
2. The water motions must be of a large scale compared to the separation of the beams (horizontal homogenity of the water).
3. The water motions must be of a large scale compared to the length of the transmitted pulse (vertical homogenity of the water).

The first assumption is critical since the movement of the scatterers in the water volume represents the water movement. It is essential that the scatterers do not move by themselves differently from the water current.
The other two assumtions are less critical.

2.4 Parameter Output

Some parameters will always be calculated and presented and cannot be switched off. The rest of the parameters can be configured by the user by selecting the corresponding property. If using AADI Real-Time Collector each property can be selected or deselected in the ***Sensor Configuration*** menu. If using terminal software each parameter can be selected by sending the corresponding property and value to the sensor using a ***set Property(Value)*** command. The alternative for value depends on the mode.

To enable output of ***Strength Output*** we need to send the following command:

In ***AiCaP mode:*** ***set Strength Output (Output + Storage)***

In ***Smart Terminal mode:*** ***set Strength Output (Output)***

and ***AADI Real-Time mode:*** ***set Strength Output (Output)***

CHAPTER 3 **Configuration via Aanderaa Datalogger**

3.1 Introduction

The DCPS can be installed on a SeaGuardII or connected via cable to SmartGuard to configure and collect data. The Sensor needs to be in AiCaP mode before it is connected to the logger. 5400, 5402 and 5403 are covered in the same chapter since except from the depth rating the configuration is identical. 5400P is also covered in the same chapter even though the configuration is a bit different. Most of the screen shot is from SeaGuardII configuration but these will be identical on a SmartGuard.

3.2 Installation of the Sensor to SmartGuard/SeaGuardII

This chapter only describes the software and configuration of sensor. For more information about the SmartGuard refer to TD 293 Operating manual for SmartGuard. For more information about the SeaGuardII refer to TD 303 Manual for SeaGuardII Platform.

3.2.1 Starting up with Real-Time collector

- Connect the DCPS sensor to your SeaGuardII using the sensor foot or SmartGuard using the cable with sensor foot.
- Connect the SeaGuardII/SmartGuard to your PC's USB port using a USB Cable.
- If the logger is connected via a RS-232 real-time connection or via the LAN connection all configurations may also be done using this connection instead of the USB.
- Install and start the AADI Real-Time Collector software on your PC (provided on the memory stick delivered with the instrument). For more information about the AADI Real-Time Collector, refer to TD 268 AADI Real-Time Collector Operating Manual
- Switch on the SeaGuardII/SmartGuard instrument by turning the power button to ***On.*** The startup procedure will take approximately 60 seconds.
- Please note that the SeaGuardII/SmartGuard needs a power reset after connection to find the sensor.
- To be able to control the DCPS via SeaGuardII or SmartGuard the sensor needs to be in AiCaP mode.

3.3 Installation of the DCPS on SeaGuardII

Note! Mount DCPS on the stud and connect the stud in sensor position 1, refer ***Figure 3-1*****.**
Always replace O-rings when connecting a sensor or a sealing plug.

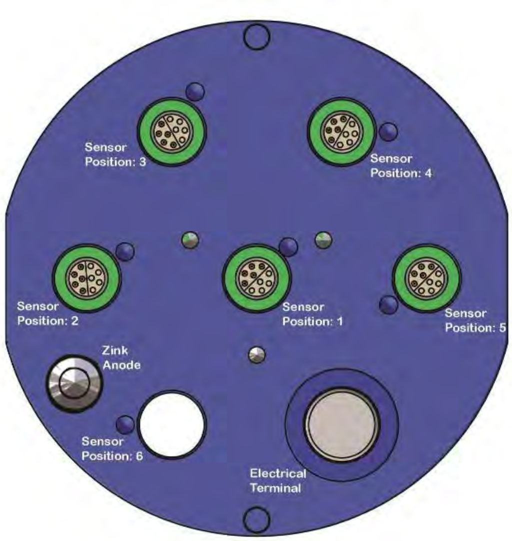


Figure 3-1: SeaGurdII Top End plate

3.4 Establish a new connection to SmartGuard/SeaGuardII

If the AADI Real-Time Collector program is being used for the first time, the connection list will be empty. Click on the ***New*** button in the lower left corner to create a new connection.

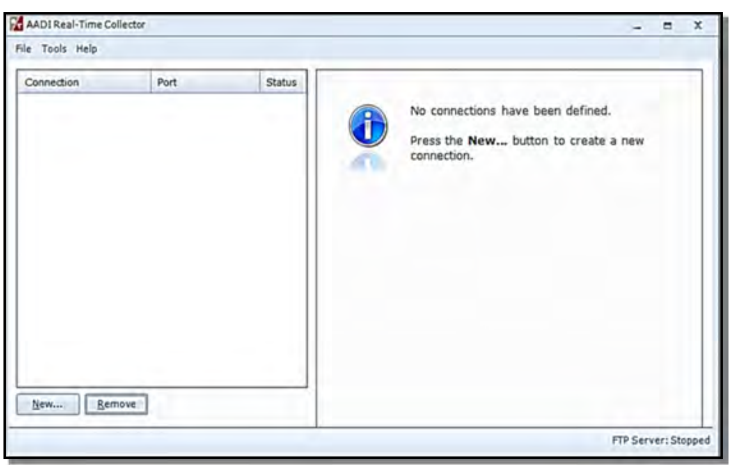


Figure 3-2: AADI Real-Time Collector start up menu

3.5 Windows Mobile Device Center(WMDC) replacement

Since the introduction of SmartGuard and SeaGuardII Aanderaa has used Windows Mobile Device Center for connection between logger and PC. This WMDC has been a part of Windows until Windows 10, and in June 2022 Microsoft removed the software from their download list. Based on this Aanderaa has developed a replacement for WMDC called USB Serial.

This chapter describes the different alternatives for how to configure a SeaGuardII/SmartGuard via our AADI Real-Time Collector software either using the old WMDC if already installed on your PC or using USB Serial if using a newer version of Windows.

You may download the latest version of or software image from our webpage **https://www.aanderaa.com/** or use the link below.

AADI- Real-Time Collector:
https://aanderaa1.xyleminc.com/AADI%20Real-Time%20Collector/

SeaGuardII Image:
https://www.aanderaa.com/media/software/seaguardii-latest-firmware.zip

SmartGuard Image:
https://www.aanderaa.com/media/software/smartguard-latest-firmware.zip

3.6 Installation using a USB connection

The most used connection for configuration of SmartGuard is via the USB port.

For older version of Windows, before Win10 you may use the Windows Mobile Device Center. This software will work fine on Win 10 and 11 as well if it was installed before you upgraded to the newer version.

If you don’t have Windows Mobile Device Center installed, we recommend using the USB Serial connection described in ***chapter 3.6.2.*** To use this connection, you need ***AADI Real-Time Collector Version 7.0.11.0*** or newer and an updated SmartGuard/SeaGuardII image. For SmartGuard/SeaGuardII image upgrade see manual for each logger.

3.6.1 Connection to USB ActiveSync

Windows Mobile Device Center acts as device management and data synchronization between a Windows Mobile-based device and a computer.

Once the USB connection has been established, Windows Mobile Device Center will start automatically:

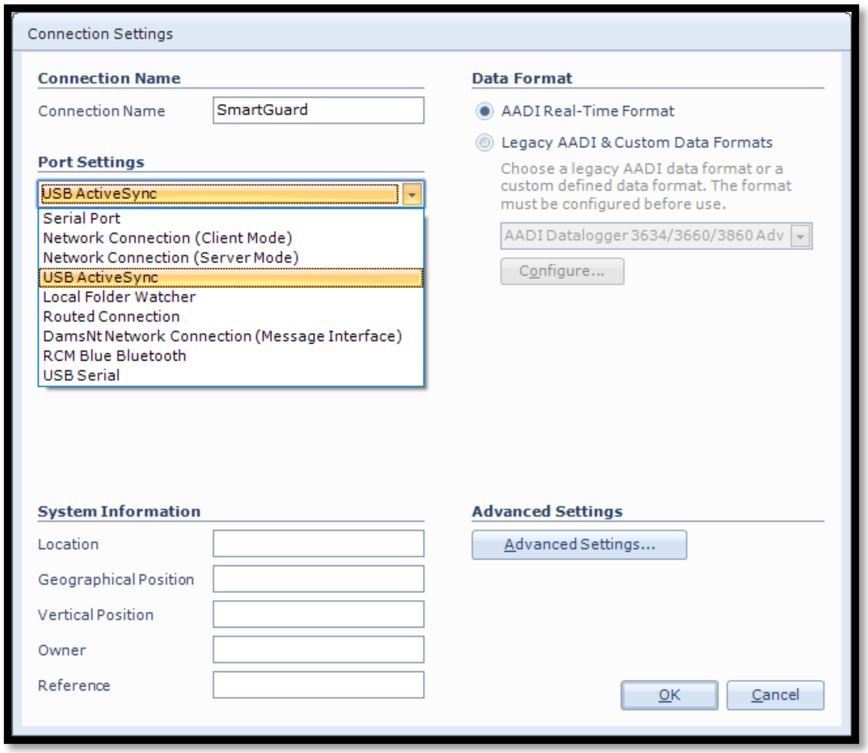


Figure 3-3: AADI Real time Collector connection settings using USB

In the ***Connection Name*** box write a name specific for this connection (e.g. SmartGuard and #serial number).

Select ***USB ActiveSync*** from the ***Port Settings*** drop down menu.

Select ***Serial Port*** if using the serial real-time connection or ***Network Connection*** if using LAN.

Then click on the ***Advanced Settings*** on the lower right side.

If you want to return to this menu later please close the port and then press ***Settings..*** in the main menu.

Figure 3-4: Windows Mobile Device Center

If this SmartGuard has previosly been used with USB serial you need to change the usbfunction setting. Create a text file with name StartupConfig.txt with content usbfunction=activesync and put it on the SD-card. Restart the SmartGuard with this SD-card installed.
Windows Mobile Device Center starts up automaticly if it's installed on your computer. This alternative for switching between USB Active Sync and USB Serial is only for SmartGuard not for SeaGuarII.

3.6.2 Connection to USB Serial Port

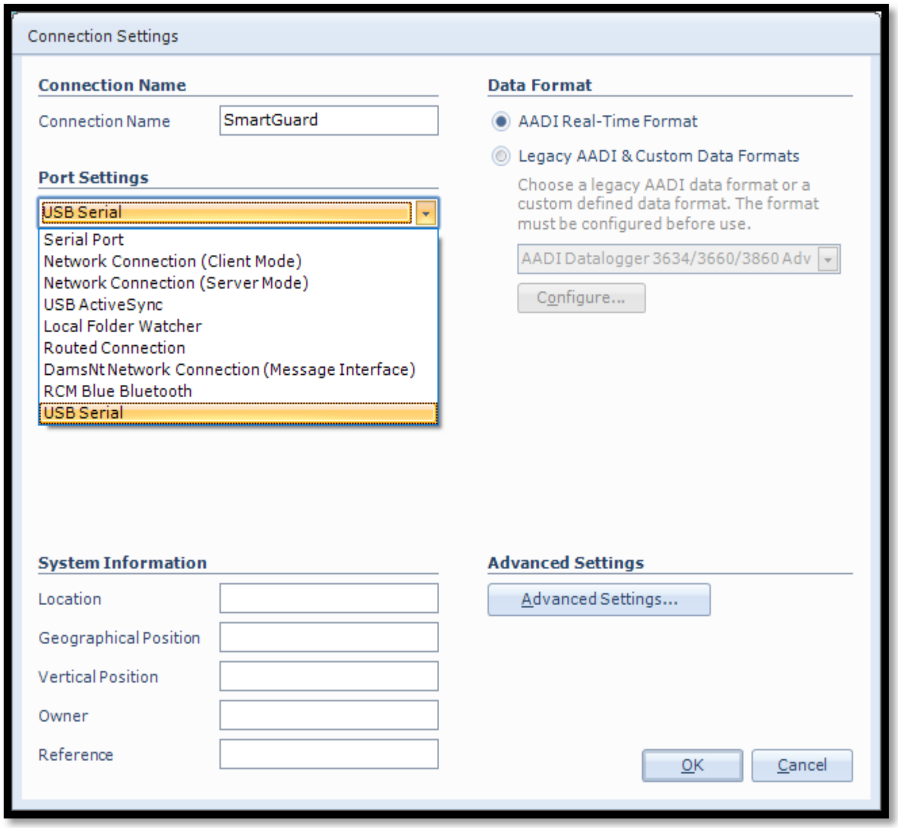


Figure 3-5: AADI Real time Collector connection settings using Using Serial Port

To use this connection, you need ***AADI Real-Time Collector Version 7.0.11.0*** or newer, ***SmartGuard image 2.1.216*** or newer, ***SeaGuardII image 3.0.224*** or newer.

In the ***Connection Name*** box write a name specific for this connection (e.g. SmartGuard and # serial number).

Select ***USB Serial*** from the ***Port Settings*** drop down menu.

Select ***Serial Port*** if using the serial real-time connection or ***Network Connection*** if using LAN.

Then click on the ***Advanced Settings*** on the lower right side.

If this SmartGuard has previosly been used with USB ActiveSync you need to change the usbfunction setting. Create a text file with name StartupConfig.txt with content usbfunction=virtualcomport and put it on the SD-card. Restart the SmartGuard with this SD-card installed.

If you want to return to this menu later please close the port and then press ***Settings..*** in the main menu.

3.7 Advanced Connection Settings

In the ***Advanced Connection Settings*** window select ***Connection*** from the list on the left side.

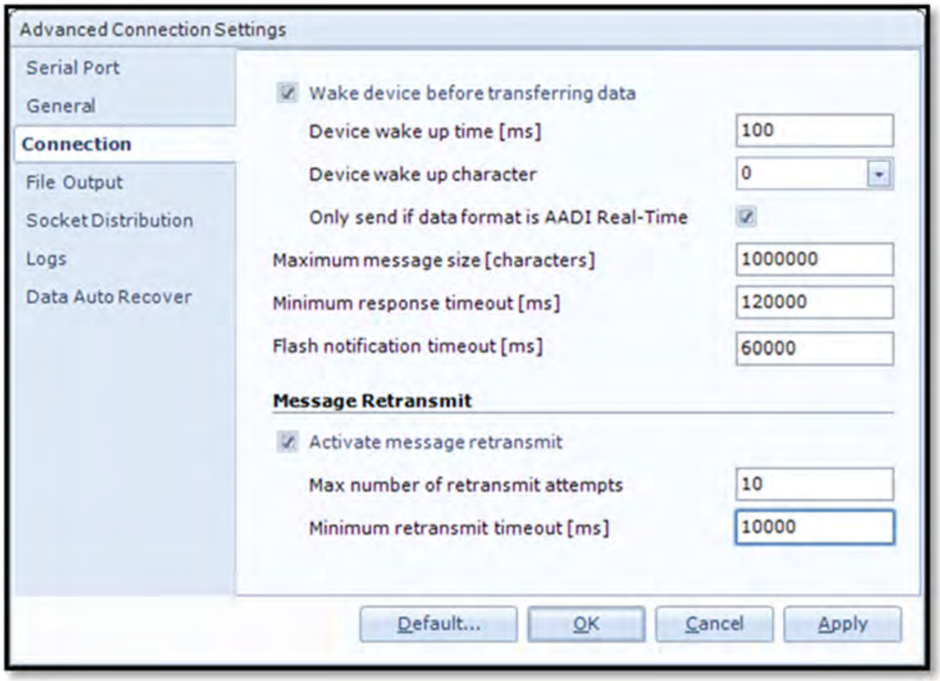


Figure 3-6: Advanced connection setting

AADI Real-Time Collector uses a default setting that fits for most Smart Sensors. However, the DCPS may output a large amount of data and might have longer response time (depending on the configuration) than other smart sensors.

Some of the connection settings might need to be changed. We recommend using the settings as shown in ***Figure 3-6.***

After updating the ***Advanced Connection Settings***, click on ***Apply*** and ***OK*** and then ***OK*** to go back to the start screen.

The ***Advanced Settings*** are only accessible to change when the port is closed. If the settings are grey, then you first need to close the port.

3.8 Connection List

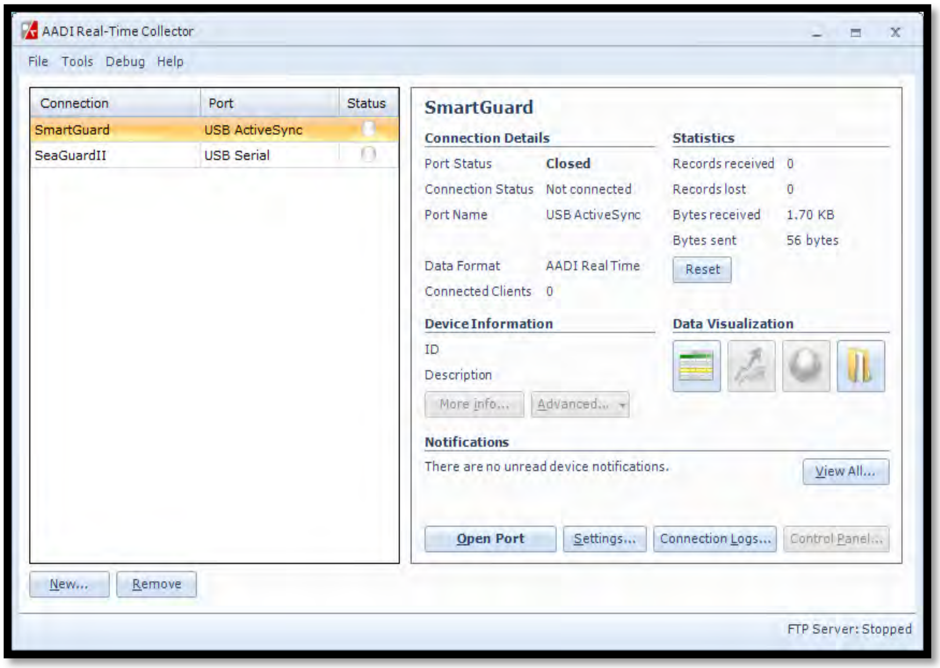


Figure 3-7: Connection list

The new connection is now shown in the AADI Real-Time Collector connection list. Choose the new connection and click on the ***Open Port*** button.

The connection list might contain different connection to other sensors as well. Then highlight your connection to proceed.
NOTE: This procedure only needs to be done once. This connection will be in the connection list at next start-up.

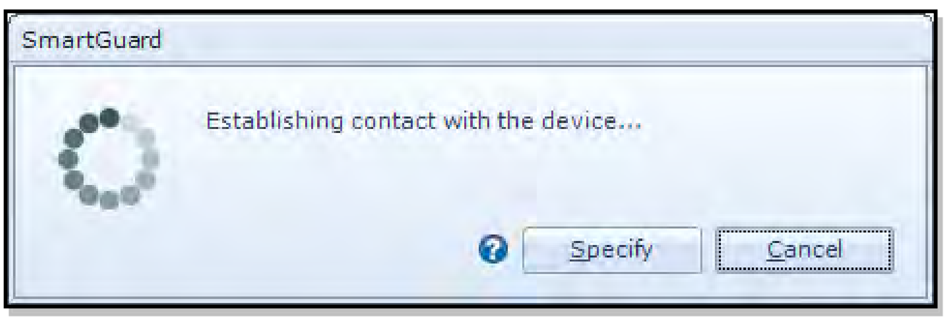


Figure 3-8: Establishing contact

A new window with a turning wheele will then show up waiting for contact. This might take a couple of seconds depending on the instrument configuration.

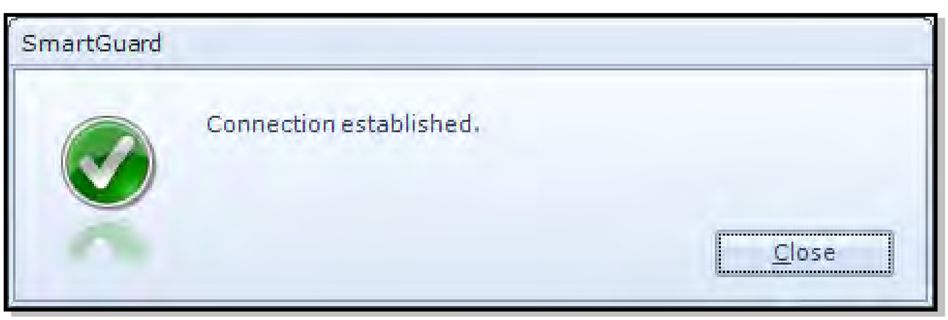


Figure 3-9: Connection established

When connection is established the status light will turn green.

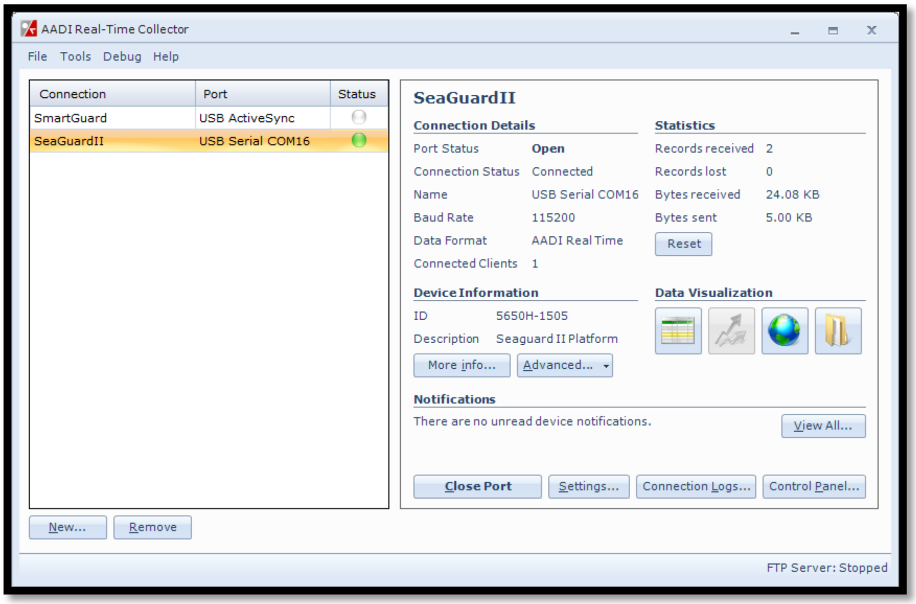


Figure 3-10: AADI Real-Time Collector main menu

The selected connection has now changed to green status.
Press ***Control Panel*** to continue.

3.9 Control Panel

In the ***Control Panel*** window, you will find four tabs, ***Recorder Panel***, ***Device Configuration, Device Layout*** and ***System Status.*** Please note that these tabs are controlling the SmartGuard/SeaGuardII, and the sensor is controlled by the SmartGuard/SeaGuardII together with all other sensors and equipment connected to the same logger. Under ***Recorder Panel*** you can start and stop recordings. If the recorder is running first click on the ***Stop Recorder*** as you are not allowed to configure the sensor when recording. In ***Device Configuration*** you will be able to perform all configurations on the DCPS, SmartGuard/SeaGuardII and all other sensors connected. ***Device Layout*** is used to configure input from Non-Smart Sensors such as analog sensors and to configure output from the SmartGuard/SeaGuardII. DCPS is a smart sensor, and you don't need to configure this under ***Device Layout***, but if you are using an external compass this need to be configured her. ***System Status*** gives information about SmartGuard/SeaGuardII status including battery voltage, SD card status and Memory used. For more information about ***Device Layout*** and ***System Status*** please refer to TD293 Manual for SmartGuard/ TD303 Manual for SeaGuardII Platform.

3.10 Recorder Panel

In the ***Recorder Panel*** you will find 3 groups that are all controlled by the SmartGuard/ SeaGuardII. Each group might have a different recording interval. Each group can contain different kind of sensors with different outputs. Also 3rd party sensors connected to the SmartGuard/ SeaGuardII can be controlled by the logger. Each group can individually be either set to ***Start Now*** or ***Start Delayed***. To check in which group the DCPS sensor is placed or move it to another group select the ***Device Configuration*** folder and then ***Get Current Configuration***, then click on the ***Edit*** button under ***Deployment Setting***, select ***Multi Group Recorder*** under ***Device Nodes*** and then check ***Add/Remove Sensors*** for each group. See TD293 SmartGuard Manual/ TD303 Manual for SeaGuardII Platform for more information about ***Multi Group Recorder*** and how to place sensors in each group. The ***Fixed Interval*** or recording interval can be configured individual for each group either in ***Recorder Panel*** or in the ***Multi Group Recorder*** menu.

Each Sensor will do a calculation based on the configuration for each recording interval.

If Acoustic Wave is enabled then the recording interval for the group containing the DCPS will be the wave measurement period set by ***Wave Integration Time*** in the ***System Configuration*** setting, refer ***chapter 3.14.7*** and the current measurement period.

One recording interval will then consist of a wave measurement period followed by one current measurement period. During the Wave measurement period only a reduced current measurement is calculated refer ***chapter 3.14.13.*** Other sensors in the same group will present one measurement during each recording interval.

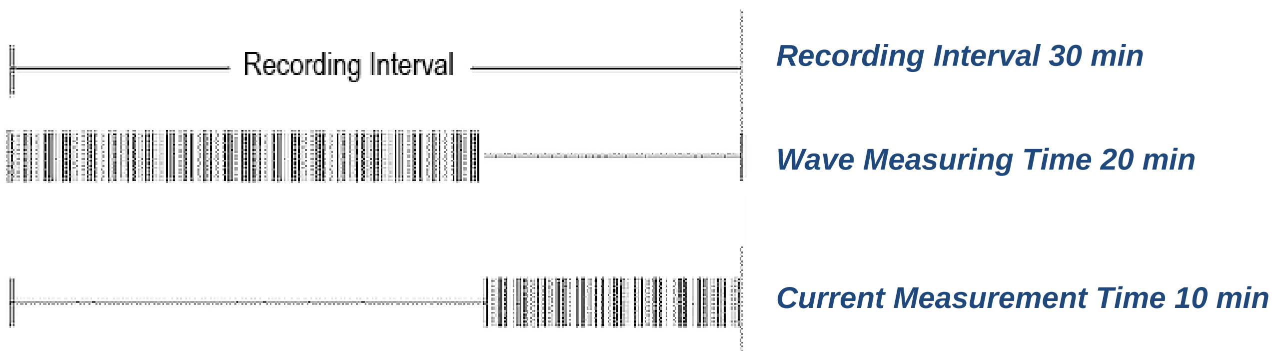
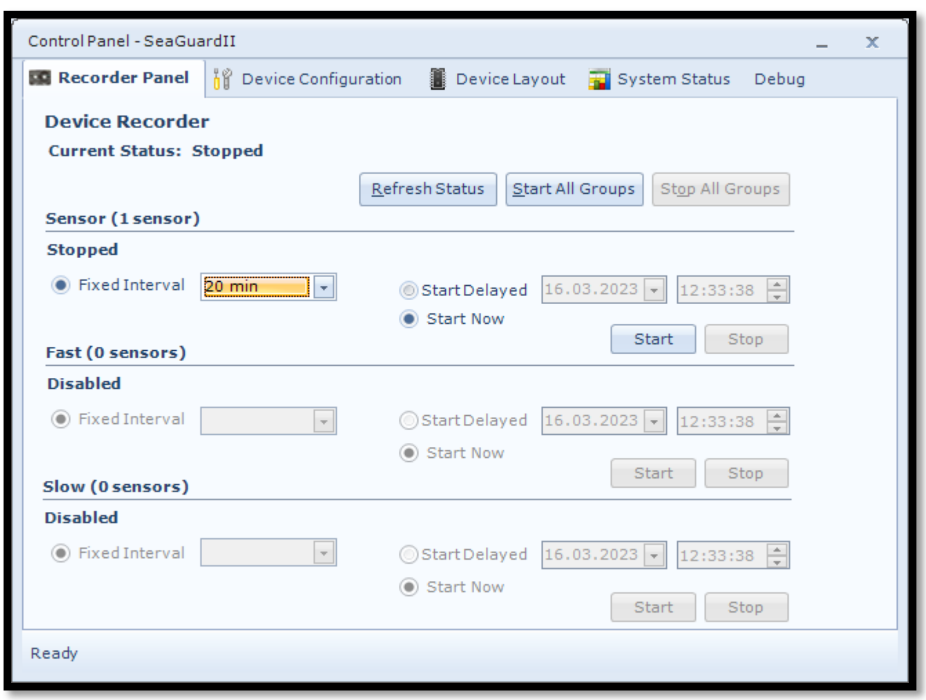


Figure 3-11: Typical Recording Interval Acoustic Wave and Current



Select ***Recorder Panel.*** ***Note!*** *The configuration cannot be changed during a recording session.*

If the instrument is recording, under ***Recorder Panel,*** press ***"Stop All Groups".***

Each recording group may be set to either ***Start Now*** or ***Start Delayed.*** Please note that the recorder panel controls the SmartGuard recording, and each sensor connected are controlled by the SmartGuard/SeaGuardII.

Figure 3-12: Recorder panel

Note! The screen shots might show minor discrepancies compared to screen shots taken from your sensor due to sensor updates.
Note! We recommend that you verify the system settings prior to starting a recording session.

3.11 Changing Values

In the following chapters we will learn more about the DCPS configuration. Sometimes you will need to change the value of a property.

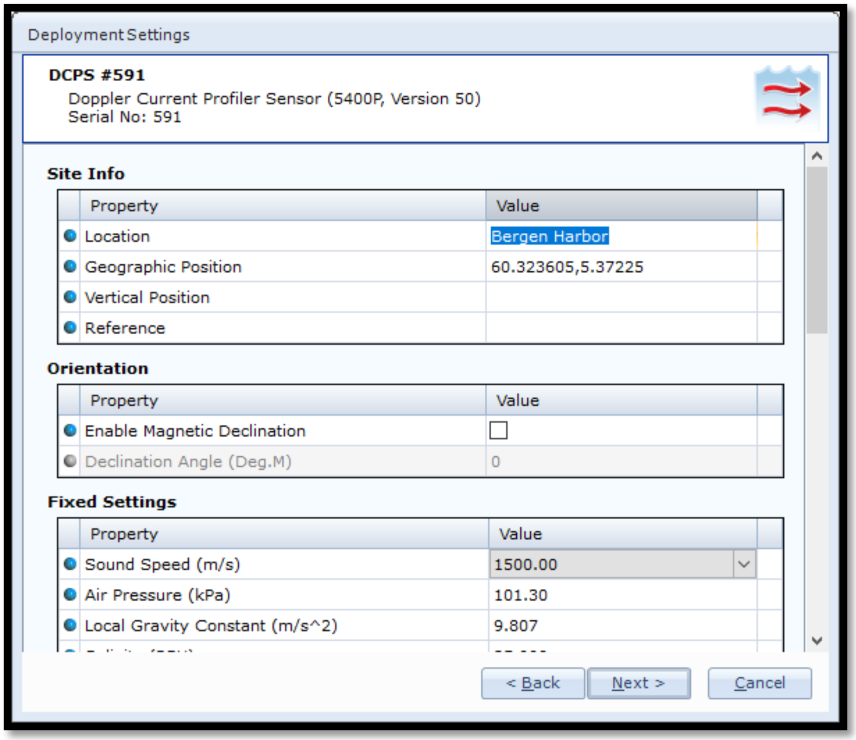


Figure 3-13 Change value

First select the tab where the property is located. In this example: ***Device Configuration***.

Then press ***Get Current Configuration*** and ***Edit,*** located under ***Deployment Setting.***

Select by double clicking on the ***DCPS Sensor*** icon.

Then select the property you want to change by clicking the value box.

To change value enter the new text or number in the value box and press ***Next.***

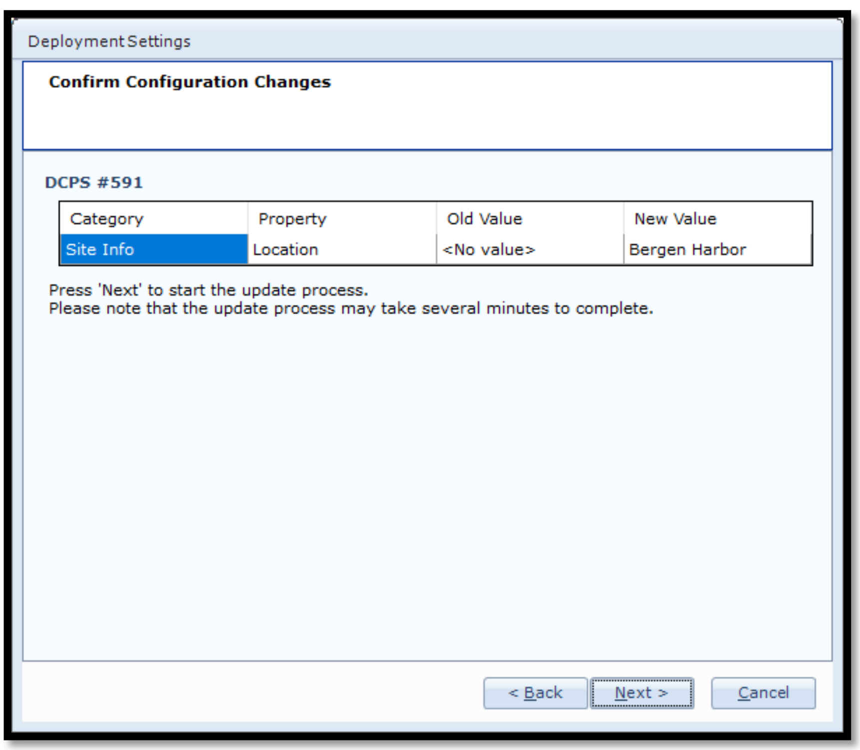


Figure 3-14 Confirm Configuration Changes

Some boxes contain text and others contain numbers. Some of the boxes only accept a specific set of options while other accept free text or any numbers. Check each property in ***chapter 1.10*** about accepted content for each property.

In the next window called ***Confirm Configuration Changes*** you will find a list of all changed properties with old and new values.

If the list of configuration changes is correct press ***Next*** to start the update process.

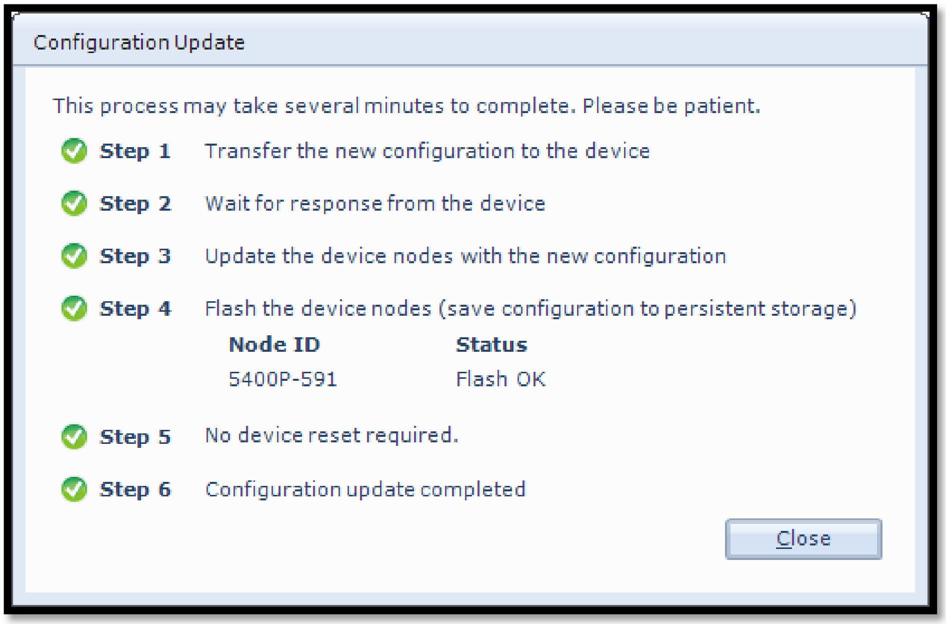


Figure 3-15 Configuration Update

An automatic process will start with 6 steps transferring and storing the new settings in the sensor Flash.

If necessary, a reset will be executed.

Do not switch off before the entire process is completed.

Figure 3-16 Configuration Update Completed

When the updating process is finished a confirmation will show up. Press ***Finish*** to continue.

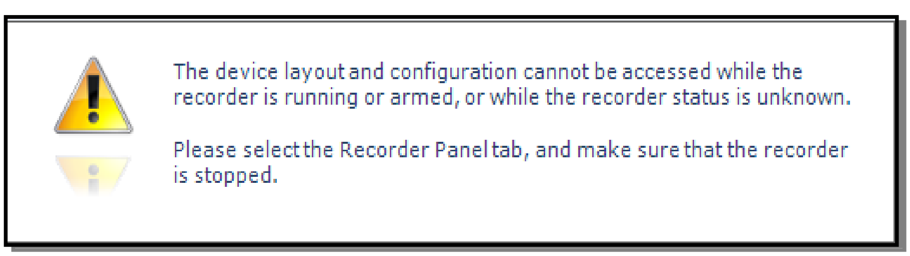


Figure 3-17: Warning after changing values

When you click finish the following warning may show up. Then you need to open the ***Recorder Panel*** and select ***Stop*** or ***Stop All Groups*** and/or press the ***Refresh Status*** button.

3.12 Device Configuration

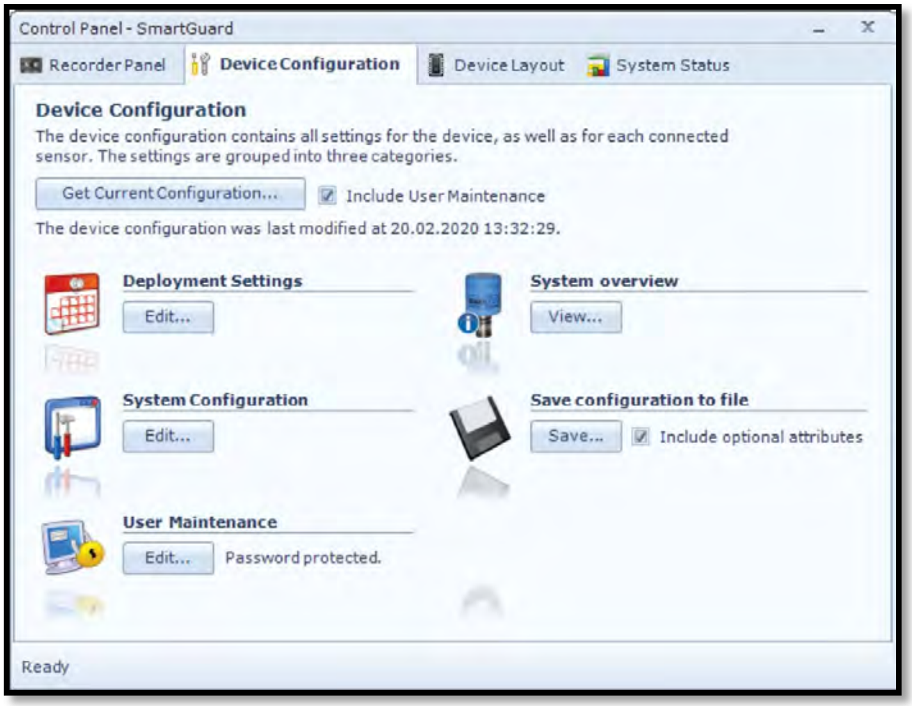


Figure 3-18: Device configuration

Click on the ***Device Configuration*** tab in the top row of the ***Control Panel*** to access the sensor property configuration.

Click on ***Get Current Configuration...***to receive the current configuration from the sensor.

Check ***Include User Maintenance*** before ***Get Current Configuration...*** to view user maintenance settings. This group is password protected. ***The password is 1000***.

The ***Device Configuration*** is separated into five sections:

- ***Deployment settings***
- ***System Configuration***
- ***User Maintenance***
- ***System overview***
- ***Save configuration to file***

User accessible sensor properties that are used to configure the sensor are found in the first three sections. ***Deployment Settings*** are described in ***chapter 3.13***, ***System Configuration*** in ***chapter 3.14***, ***User Maintenance*** in ***chapter 3.15***. ***System Overview*** in ***chapter 3.16*** and ***Save Configuration*** to file in ***chapter 3.17.***

3.13 Deployment Settings

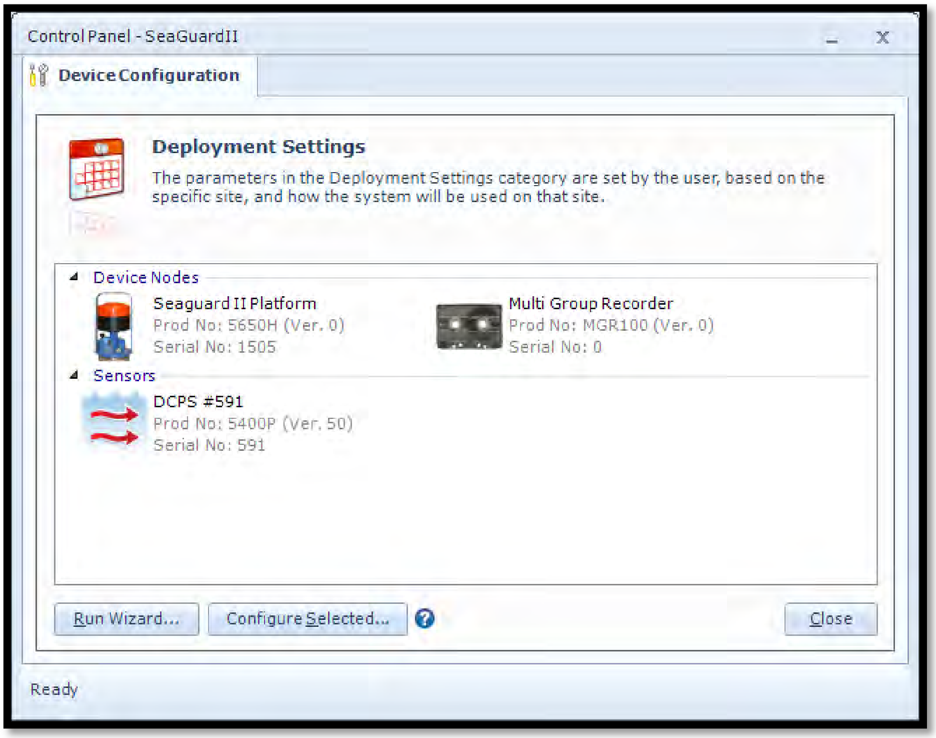


Figure 3-19: Deployment settings main

Select ***Deployment Settings*** by pressing the ***Edit*** button under ***Deployment Settings***

Under the ***Sensors*** section you will find a list of all sensors connected to the logger.

Double-click on the ***DCPS sensor*** icon to select the sensor.

If you don't find the sensor check connection and make sure the sensor is set to ***AiCaP mode***.

If you still can't find the sensor check that the AiCaP termination is as recommended.

Please note that you need a power reset after connecting the sensor.

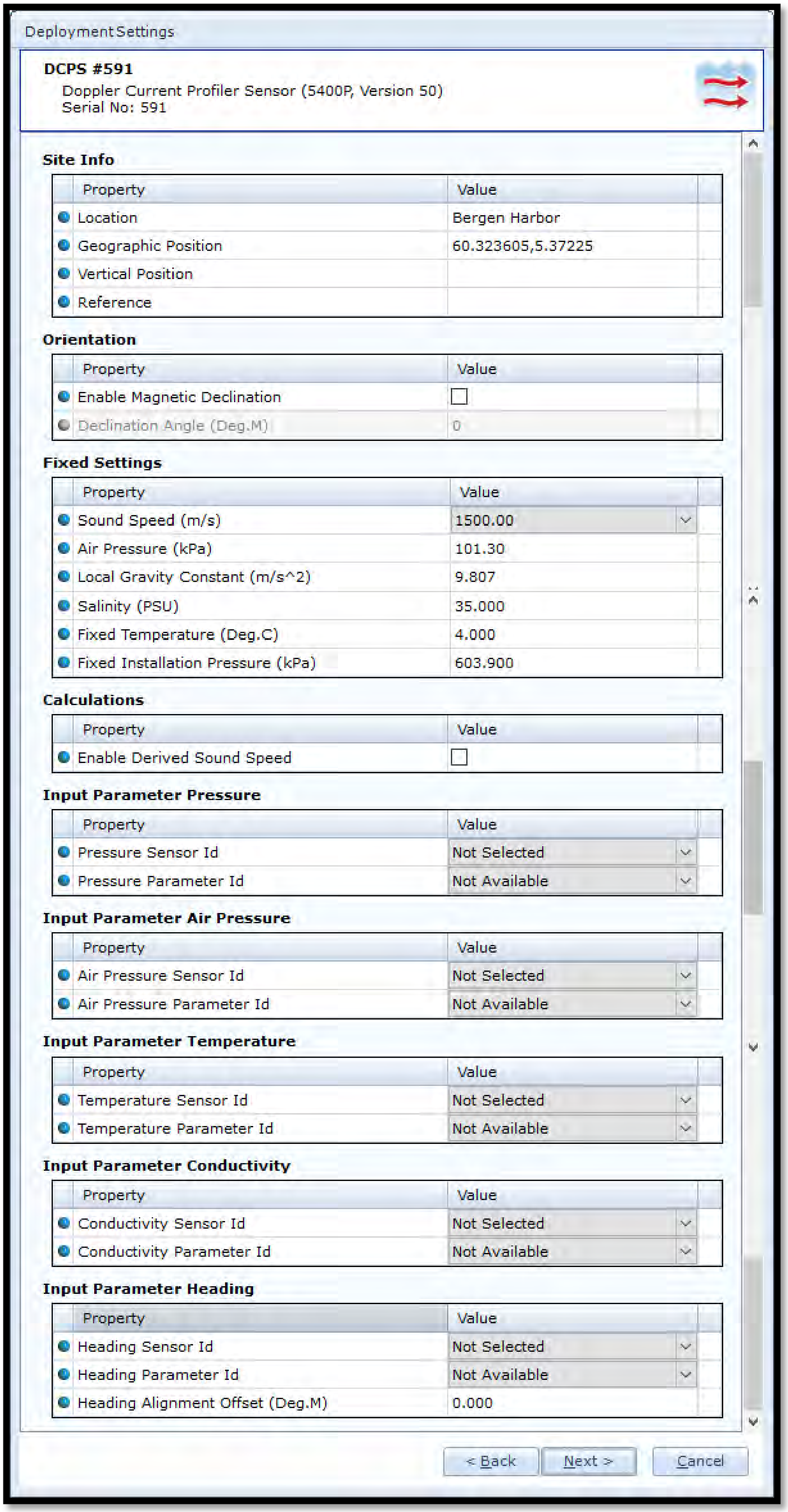


Figure 3-20: DCPS Deployment Settings

The ***Deployment Settings*** is separated in 9 groups. The settings in these groups are mainly used as information or values used in internal calculations.
Refer ***chapter 1.10.2*** for more information on the properties in ***Deployment Settings***

If the surface cell, surface reference or acoustic wave is enabled, we always recommend using a pressure, tide or wave sensor.

An input parameter will be used in calculation if available and selected.

NOTE!
Do not use the DCPS as an external reference, Input Parameter Sensor ID even if it is available in the list.

For more information on each property see ***chapter 3.13.1*** to ***3.13.9.***

3.13.1 Site Info

Site Info

Property	Value
Location	Bergen Harbor
Geographic Position	60.323605,5.37225
Vertical Position	
Reference	

Figure 3-21: Site Info

Site Info containing four properties:

- ***Location:*** Name of location where the instrument is deployed.
- ***Geographic Position:*** GPS potion for deployment format Latitude, Longitude.
- ***Vertical Position:*** Position in water column, e.g. 5 meter depth.
- ***Reference:*** Free text for additional information.

All these settings are optional information where you can enter and store information about the deployment. This can be useful information to store together with a data set. These setting are not used in calculation. ***Geographical Position*** is used to give the map coordinates unless a GPS input is connected to the logger.

3.13.2 Orientation

Orientation

Property	Value
Enable Magnetic Declination	☐
Declination Angle (Deg.M)	0

Figure 3-22:Orientation

Enable Magnetic Declination is normally used when sensor is used close to South Pole or North Pole.

Declination Angle (Deg.M) is a value to correct for the magnetic variation on the site where the sensor is used. This is the angle in degrees between magnetic north and true north. Magnetic declination (variation) is the angle between the magnetic north and the true north. This angle varies depending on the position on the Earth's surface and varies over time. Declination is positive when magnetic north is east of true north and negative when it is to the west (input angle value ±180°). Magnetic declination at the deployment location can be found for i.e. on NOAA website: http://www.ngdc.noaa.gov/geomag-web/

3.13.3 Fixed Settings

Fixed Settings

Property	Value
Sound Speed (m/s)	1500.00
Air Pressure (kPa)	101.30
Local Gravity Constant (m/s^2)	9.807
Salinity (PSU)	35.000
Fixed Temperature (Deg.C)	4.000
Fixed Installation Pressure (kPa)	603.900

Figure 3-23: Fixed Settings

Fixed Settings as shown in **Figure 3-23** are settings used in internal calculation.

***Sound Speed (m/s*)** is the fixed sound speed setting in m/s. This value is used for cell positioning in the profile and for calculation of current speed values. Variable sound speed values can be used while sensor is running. Default value for sea water is 1500.

***Air Pressure (kPa*)** is the barometric pressure in kPa used to compensate for air pressure. The default value is 101.3.

Local Gravity Constant (m/s^2) is the local gravity constant in m/s^2. The default value is 9.81m/s^2.

***Salinity (PSU*)** is the Salinity in PSU used for calculation of density, sound speed and depth. The value can be altered while sensor is running to compensate for variable salinity.

***Fixed Temperature (Deg.C*)** is the temperature in degree centigrade. The value is used for calculation of Salinity, Sound speed and Density. The value can be altered while sensor is running to compensate for variable temperature.

Fixed Installation Pressure (kPa) is the pressure in kPa at the deployment site. The value can be altered while sensor is running to compensate for variable pressure. NOTE! This value is used for calculation of depth and used to position cells referenced to surface if surface cell or surface referenced cell are selected.

3.13.4 Calculations

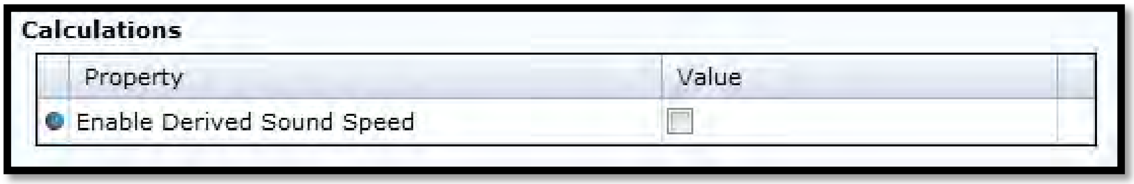


Figure 3-24: Calculations

Under ***Calculations*** you find only one Property.

Enable Derived Sound Speed. If enabled, it will calculate the sound speed from the other available sensors or fixed values. This overrides the Sound Speed setting. If a parameter is available from another sensor it will use this in the calculation, otherwise it will use the fixed value.

3.13.5 Input Parameter Pressure

Figure 3-25: External pressure sensor parameter input

Figure 3-25 gives an example where a AiCaP Wave & Tide sensor is connected to the Datalogger. The Wave and Tide sensor is selected as ***Pressure Sensor Id*** and the Tide Pressure output is selected as ***Pressure Parameter Id***. This enables the DCPS to calculate the depth using this Tide Pressure input. Other AiCaP sensor input such as Pressure Sensor or Tide Sensor can also be used. We recommend using the Tide Pressure as input if available since this gives a reading compensated for wave movements.

3.13.6 Input Parameter Air Pressure

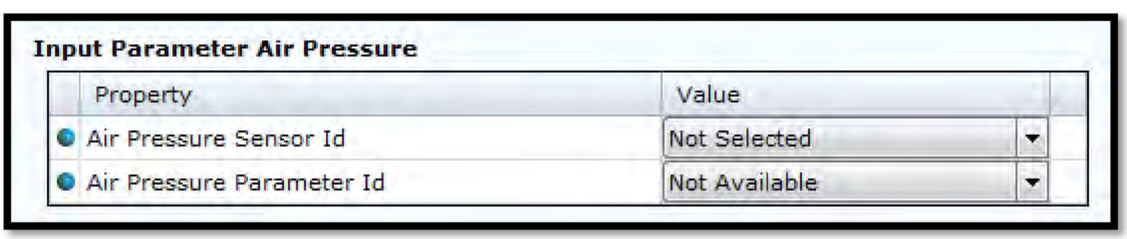
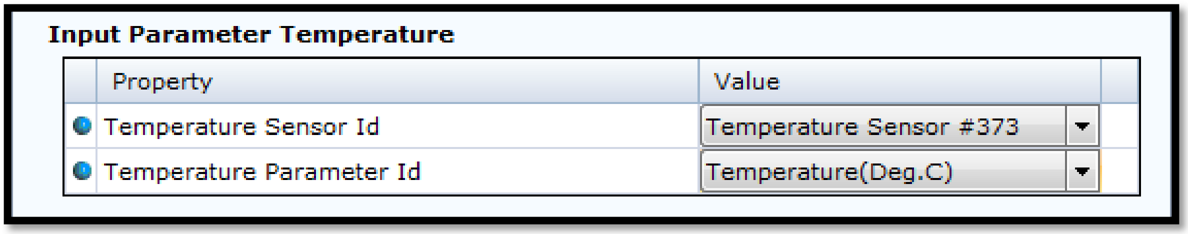


Figure 3-26: External Air Pressure Parameter Input

Air Pressure Sensor Id gives a list of available air pressure sensor if connected. If connected then select the parameter under ***Air Pressure Parameter Id.*** Air Pressure is used to compensate or Air Pressure in calculations like absolute pressure and absolute tide. If no sensor is selected the fixed value will be used.

3.13.7 Input Parameter Temperature



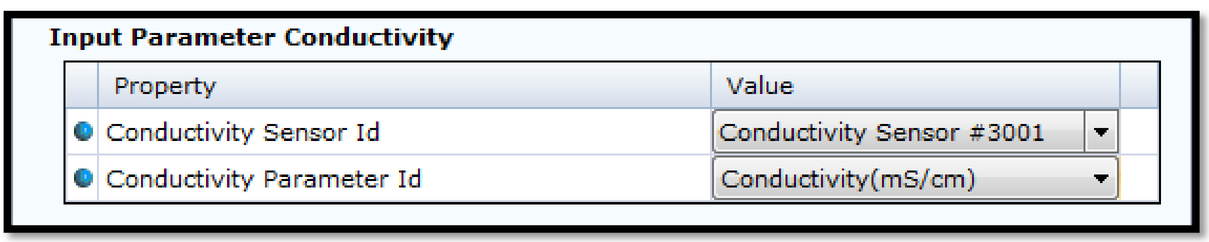
Input Parameter Temperature

Property	Value
Temperature Sensor Id	Temperature Sensor #373
Temperature Parameter Id	Temperature(Deg.C)

Figure 3-27: internal temperature sensor parameter input

Figure 3-27 gives an example of a temperature sensor connected to the Datalogger. The Temperature sensor is selected as ***Temperature Sensor Id*** and the Temperature(Deg.C) is selected as ***Temperature Parameter Id***. The correct temperature is also necessary for calculation of the correct salinity and sound speed. If a temperature sensor is not connected, most of the other smart sensors also has a built-in temperature sensor which can be selected from the drop-down list. We recommend using temperature from the sensor with fastest response time. The DCPS can also be delivered with its own temperature (optional); the temperature input must be disabled here if the built-in temperature is going to be used.
If the DCPS is running in a slow recording group in the multi-group recorder (more information about the multi-group recorder is available in the TD 303 Chapter 3.3.1), it is possible to have the other sensors in a faster group to give more frequent update of input parameters.

3.13.8 Input Parameter Conductivity



Input Parameter Conductivity

Property	Value
Conductivity Sensor Id	Conductivity Sensor #3001
Conductivity Parameter Id	Conductivity(mS/cm)

Figure 3-28: External conductivity sensor parameter input

Figure 3-28 gives an example of a conductivity sensor connected to the same Datalogger as the DCPS. The Conductivity sensor is selected as ***Conductivity Sensor Id*** and the Conductivity(mS/cm) is selected as ***Conductivity Parameter Id***.
When the DCPS receives input from these three sensors via the Datalogger, it can calculate the correct salinity, depth and sound speed. These values are used for correct positioning of cells and the correct conversion from Doppler shift to current speeds.

3.13.9 Input Parameter Heading

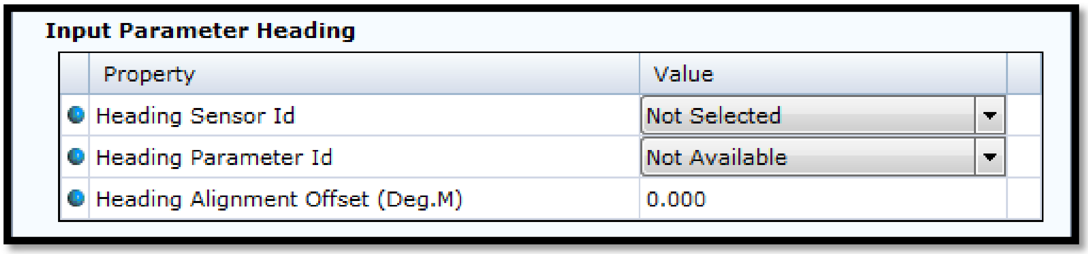
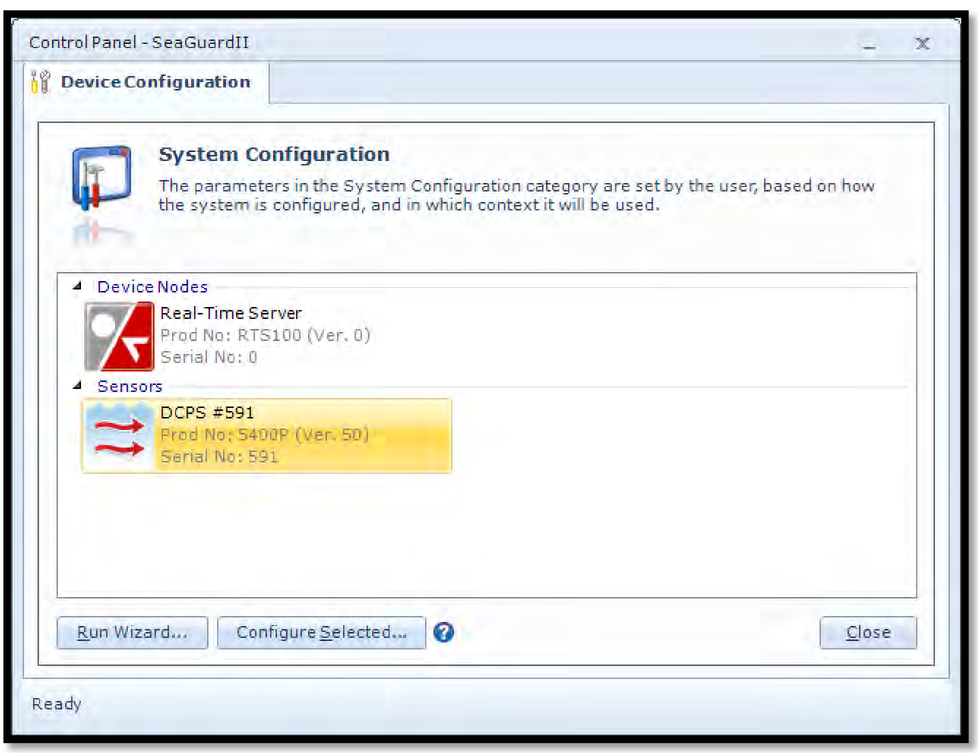


Figure 3-29: External compass sensor input

The sensor can also take an input from an external Compass, like for example the Airmar H2183 Compass. Surface buoys are often made of steel. The magnetic influence from the buoy can give a big error on the compass heading measured by the DCPS. A compass mounted on a mast away from the buoy structure is often a better method which gives a more accurate compass measurement. Select a compass connected to the Logger in the ***Heading Sensor Id*** drop-down menu if available and the heading parameter in ***Heading Parameter Id***. The ***Heading Alignment Offset* (Deg.M)** value can be set to compensate for the misalignment between the compass axes and the axes on the DCPS.
When finished with the configuration, click ***Next*** twice, and wait for the Datalogger to finish the saving of the new configuration.

3.14 System Configuration



Select ***System Configuration*** by pressing the ***Edit*** button under ***System Configuration.***

The different sensors connected to the same Datalogger will show up as selectable items.
Double-click on the ***DCPS Sensor.***

Double-click on the DCPS to start configuring.

Figure 3-30: System configuration main

3.14.1 System Configuration with or without Acoustic wave

System Configuration is separated in 11 groups without Acoustic wave or 14 groups with Acoustic. Some of the settings are only available if Acoustic Wave is enabled. The Acoustic wave module is a licensed option. Older units and units without Acoustic wave can also be upgraded, either by user or at the factory. The license code and enabling of Acoustic wave are done in ***User Maintenance***. After enabling the Acoustic wave, you need to restart the logger.

The settings in ***System Configuration*** are mainly used to configure the sensor and control the output/ storage of data.

Refer ***chapter 1.10.3*** for more information on the properties in ***System Configuration***.

For more information on each property see ***chapter 3.14.6*** to ***3.14.19.***

Output/Storage Settings are controlling the output from the sensor. Except from ***Significant Wave Height*** H_{m0}***, Wave Peak Direction and Wave Peak Period*** that always will be presented all other parameters can either be set to ***Off, Storage*** or ***Storage+Output***.
Where ***Off*** means that the parameter is not calculated, ***Storage*** means that the parameter is stored on SmartGuard/SeaGuardII SD-card and ***Storage+Output*** means that the parameter is both stored and transmitted on the SmartGuard/SeaGuardII output lines.

All parameters are calculated based on data collected the last ***Wave Integration Time.***

NOTE!! ***User Specified – Profile Parameters*** are only valid when ***Select Profile Parameter*** is set to ***User Specified***,

More details on how to enable real-time data output can be found in the TD 303, manual for SeaGuardII platform or TD 293, manual for SmartGuard.

3.14.2 System Configuration without Acoustic Wave part 1

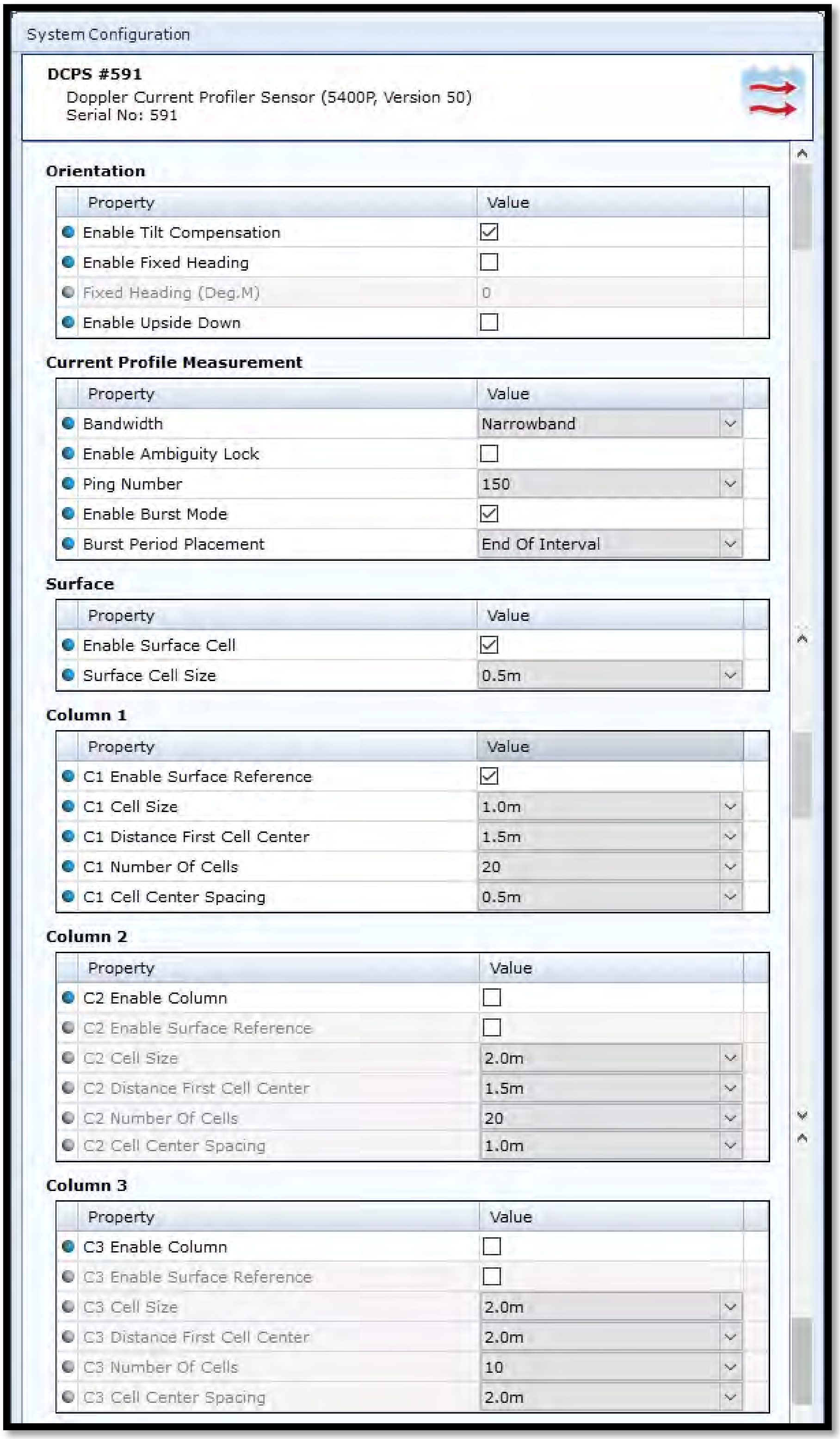


Figure 3-31: System Configuration without Acoustic Wave License part 1

Without ***Acoustic Wave License Key*** set this session contains 11 groups.

Orientation contains settings for controlling the tilt and compass.

Current Profiler Measurement are used to control the ping settings.

Surface is used if you want to measure the surface current, this is based on high reflections from the thin layer between water and air. To use this feature you normally need a pressure sensor.

Column 1 is the first column of 3 and are always on.

Columns 2 and ***3*** are optional extra column if you want to measure bot surface and instrument referenced or columns with different resolutions.

3.14.3 System Configuration without Acoustic Wave part 2

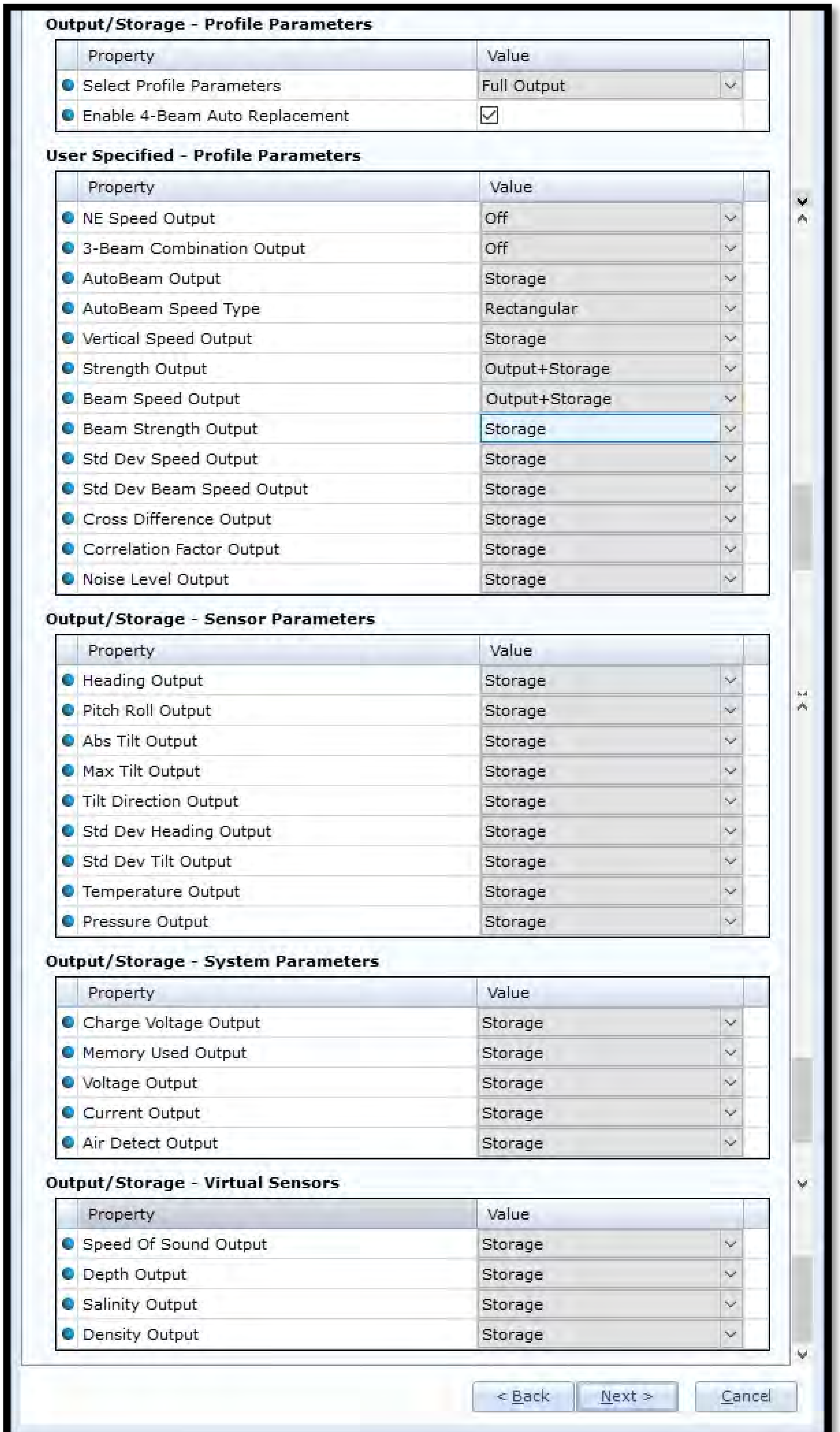


Figure 3-32: System Configuration without Acoustic Wave License part 1

The last 5 groups are used to control the output parameters from the sensor.

Output/Storage – Profile Parameters are used to control the output from some of the other groups.

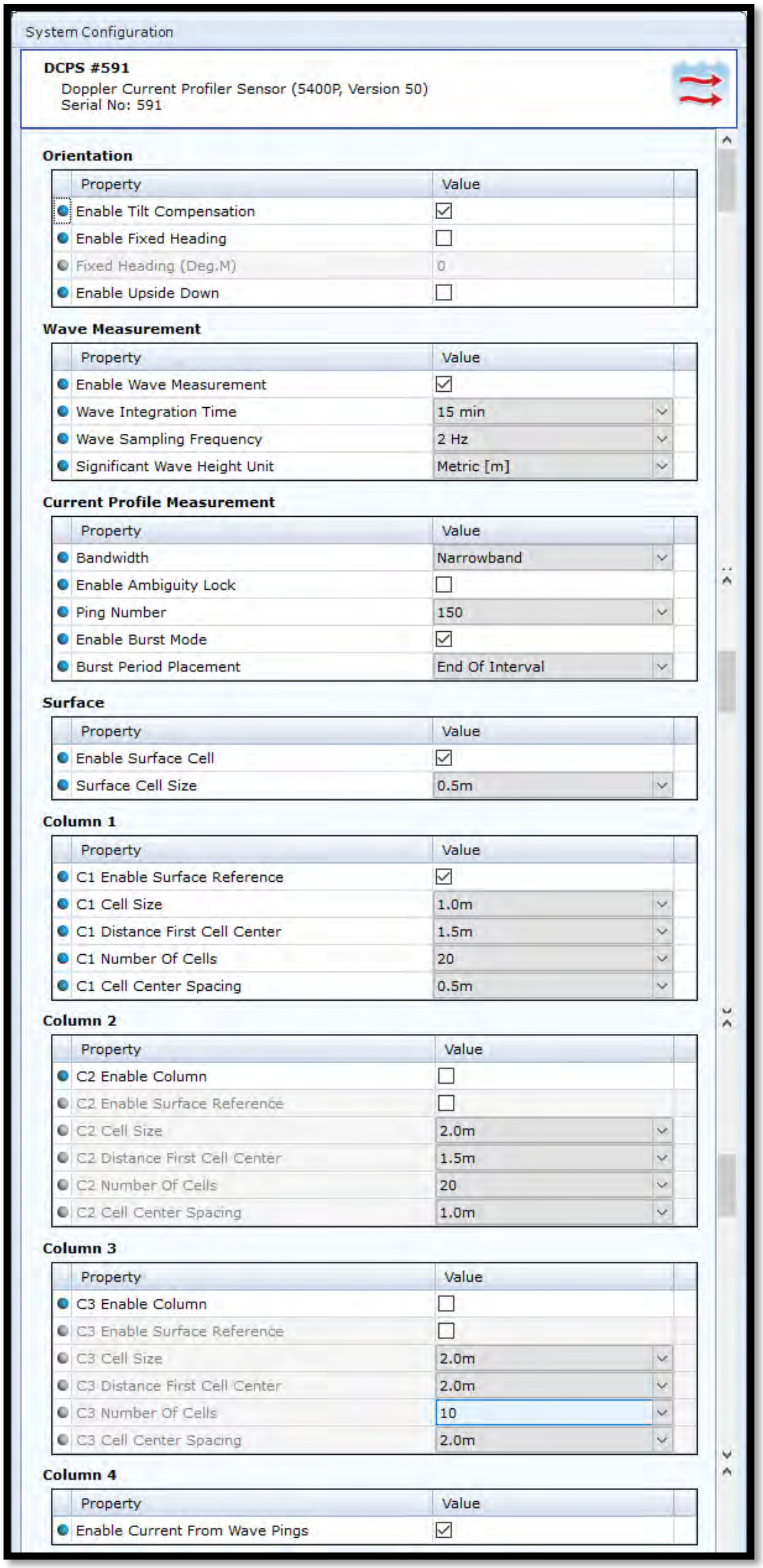
User Specified – Profile Parameters are only used if ***Select Profile Parameters*** above are set to ***User Specified***.

Output/Storage – Sensor Parameters are used to control output from some of the sensors like tilt and Compass. Temperature and Pressure are also selectable if these are ordered with the sensors.

Output/Storage – System Parameters are parameters that give information about the electronics such as voltage and current consumption.

Output/Storage-Virtual Sensors are parameters that either will be calculate using the fixed values from Deployment Setting menu or from the additional sensor connected to the same logger as the DCPS.

3.14.4 System Configuration with Acoustic Wave part 1


System Configuration

DCPS #591
Doppler Current Profiler Sensor (5400P, Version 50)
Serial No: 591

Orientation

Property	Value
Enable Tilt Compensation	☑
Enable Fixed Heading	☐
Fixed Heading (Deg.M)	0
Enable Upside Down	☐

Wave Measurement

Property	Value
Enable Wave Measurement	☑
Wave Integration Time	15 min
Wave Sampling Frequency	2 Hz
Significant Wave Height Unit	Metric [m]

Current Profile Measurement

Property	Value
Bandwidth	Narrowband
Enable Ambiguity Lock	☐
Ping Number	150
Enable Burst Mode	☑
Burst Period Placement	End Of Interval

Surface

Property	Value
Enable Surface Cell	☑
Surface Cell Size	0.5m

Column 1

Property	Value
C1 Enable Surface Reference	☑
C1 Cell Size	1.0m
C1 Distance First Cell Center	1.5m
C1 Number Of Cells	20
C1 Cell Center Spacing	0.5m

Column 2

Property	Value
C2 Enable Column	☐
C2 Enable Surface Reference	☐
C2 Cell Size	2.0m
C2 Distance First Cell Center	1.5m
C2 Number Of Cells	20
C2 Cell Center Spacing	1.0m

Column 3

Property	Value
C3 Enable Column	☐
C3 Enable Surface Reference	☐
C3 Cell Size	2.0m
C3 Distance First Cell Center	2.0m
C3 Number Of Cells	10
C3 Cell Center Spacing	2.0m

Column 4

Property	Value
Enable Current From Wave Pings	☑

Figure 3-33: System Configuration with Acoustic Wave License part 1

With ***Acoustic Wave License Key*** set this session contains 14 groups.

Most of the settings are the some regardless of the ***Acoustic Wave License Code.***

Orientation contains settings for controlling the tilt and compass.

Wave Measurements are used to enable Acoustic wave and controlling the timing.

Current Profiler Measurement are used to control the ping settings.

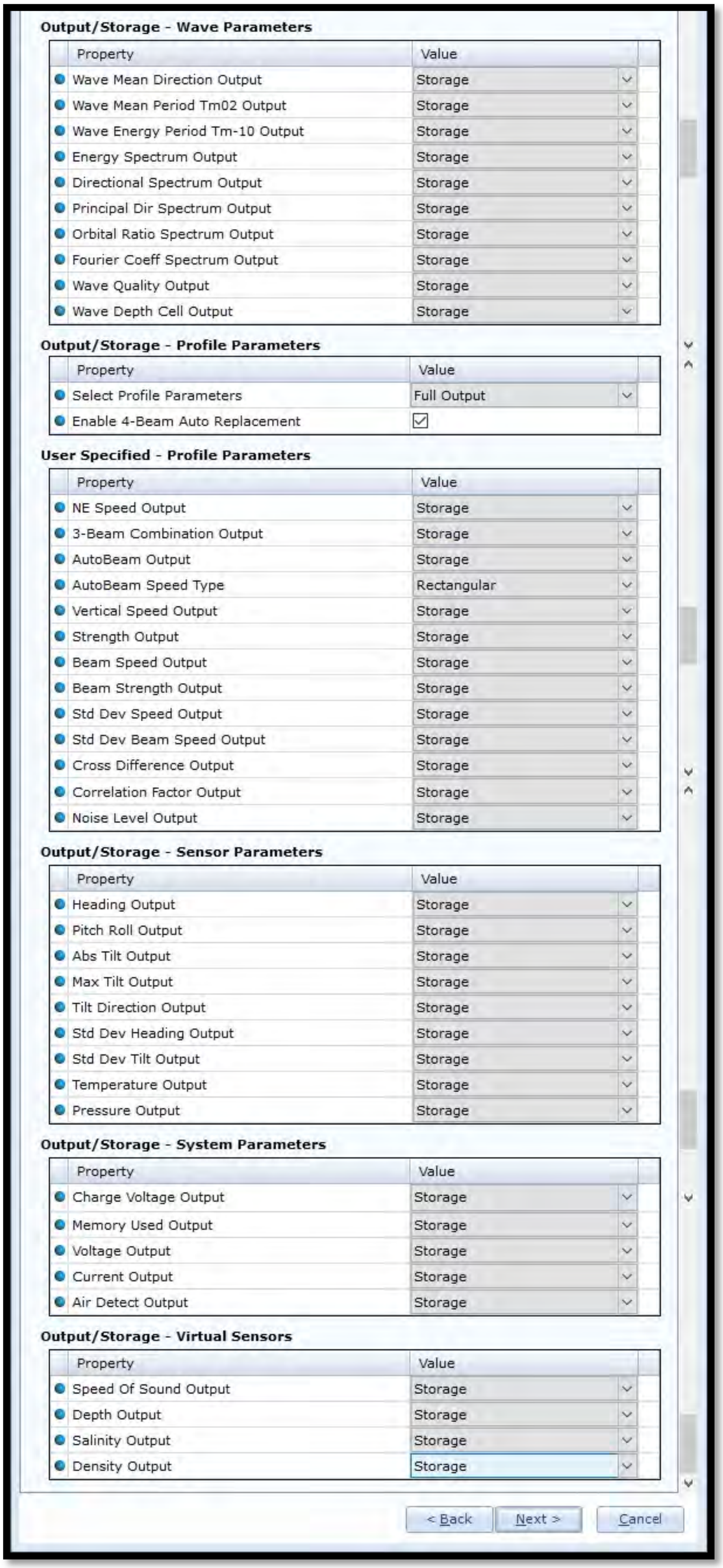
Surface is used if you want to measure the surface current, this is based on high reflections from the thin layer between water and air. To use this feature you normally need a pressure sensor.

Column 1 is the first column of 3 and are always on.

Column 2 and ***3*** are optional extra column if you want to measure bot surface and instrument referenced or columns with different resolutions.

Column 4 are used if you want to also measure Current based on the ping used for Wave measurements. This is a reduced current measurement and are not following the setting set for current measurement.

3.14.5 System Configuration with Acoustic Wave part 2



Output/Storage - Wave Parameters

Property	Value
Wave Mean Direction Output	Storage
Wave Mean Period Tm02 Output	Storage
Wave Energy Period Tm-10 Output	Storage
Energy Spectrum Output	Storage
Directional Spectrum Output	Storage
Principal Dir Spectrum Output	Storage
Orbital Ratio Spectrum Output	Storage
Fourier Coeff Spectrum Output	Storage
Wave Quality Output	Storage
Wave Depth Cell Output	Storage

Output/Storage - Profile Parameters

Property	Value
Select Profile Parameters	Full Output
Enable 4-Beam Auto Replacement	☑

User Specified - Profile Parameters

Property	Value
NE Speed Output	Storage
3-Beam Combination Output	Storage
AutoBeam Output	Storage
AutoBeam Speed Type	Rectangular
Vertical Speed Output	Storage
Strength Output	Storage
Beam Speed Output	Storage
Beam Strength Output	Storage
Std Dev Speed Output	Storage
Std Dev Beam Speed Output	Storage
Cross Difference Output	Storage
Correlation Factor Output	Storage
Noise Level Output	Storage

Output/Storage - Sensor Parameters

Property	Value
Heading Output	Storage
Pitch Roll Output	Storage
Abs Tilt Output	Storage
Max Tilt Output	Storage
Tilt Direction Output	Storage
Std Dev Heading Output	Storage
Std Dev Tilt Output	Storage
Temperature Output	Storage
Pressure Output	Storage

Output/Storage - System Parameters

Property	Value
Charge Voltage Output	Storage
Memory Used Output	Storage
Voltage Output	Storage
Current Output	Storage
Air Detect Output	Storage

Output/Storage - Virtual Sensors

Property	Value
Speed Of Sound Output	Storage
Depth Output	Storage
Salinity Output	Storage
Density Output	Storage

< Back | Next > | Cancel

Figure 3-34: System Configuration with Acoustic Wave License part 2

The last 6 groups are used to control the output parameters from the sensor.

Output/Storage – Wave Parameters are used to control the output from wave calculations.

Output/Storage – Profile Parameters are used to control the output from some of the other groups.

User Specified – Profile Parameters are only used if ***Select Profile Parameters*** above are set to ***User Specified***.

Output/Storage – Sensor Parameters are used to control output from some of the sensors like tilt and Compass. Temperature and Pressure are also selectable if these are ordered with the sensors.

Output/Storage – System Parameters are parameters that give information about the electronics such as voltage and current consumption.

Output/Storage-Virtual Sensors are parameters that either will be calculate using the fixed values from ***Deployment Setting*** menu or from the additional sensor connected to the same logger as the DCPS.

3.14.6 Orientation

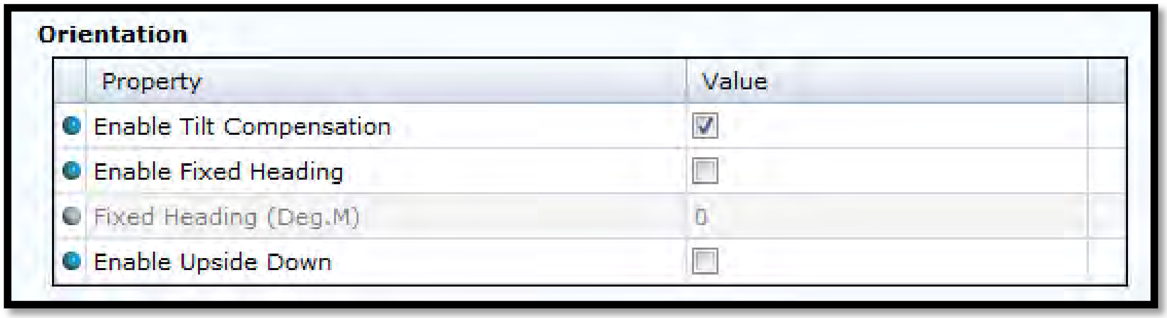


Figure 3-35: Orientation

Enable Tilt Compensation is recommended to set active at all time because then the sensor will automatically compensate for any tilt.

Enable Fixed Heading might be used if there is any magnetic disturbance that might interfere with a compass heading and the instrument has a fix position.

Fixed Heading (Deg.M) can be used to set the offset between the Sensor North direction and the Magnetic North.

Enable Upside Down orientation setting should always be set the same way as the intended use; if the sensor is intended to be deployed upward looking, do not tick the "***Enable Upside Down***". If the sensor is intended to be deployed downward looking, tick the "***Enable Upside Down***". However, the sensor will work even if the orientation setting is defined as the opposite of the used direction; it is able to sense the orientation itself and corrects the calculated current directions, heading etc. accordingly. ***NB! The surface cell and surface reference of columns does not work if the sensor is orientated upside down while running (forced to be sensor referenced instead).*** A status flag in the record status output parameter is also set to indicate that the sensor has been used in the opposite direction to the configured direction.

3.14.7 Wave Measurement only with Acoustic Wave License Key

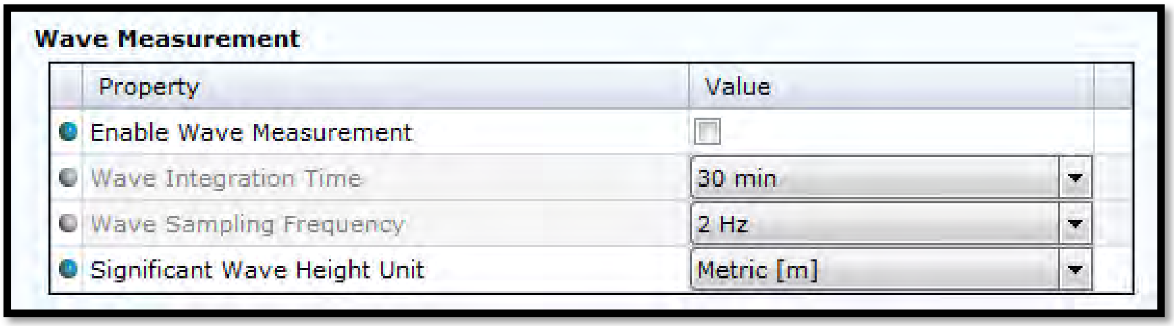


Figure 3-36: Wave Measurement

This menu is only available if Acoustic wave license is enabled. If not available ask factory for upgrade possibilities.

Enable Wave Measurement must be selected to measure acoustic wave.

Wave Integration Time is the integration time used to calculate waves. Number of samples divided by ***Wave Sampling Frequency*** gives the minimum ***Wave Integration Time.***

Wave Sampling Frequency is the ping frequency during wave measurement. Available settings are 2Hz or 4Hz.

Significant Wave Height Unit is the unit used for Significant wave height, Alternative is Metric (m) or Imperial (ft).

3.14.8 Current Profile Measurement

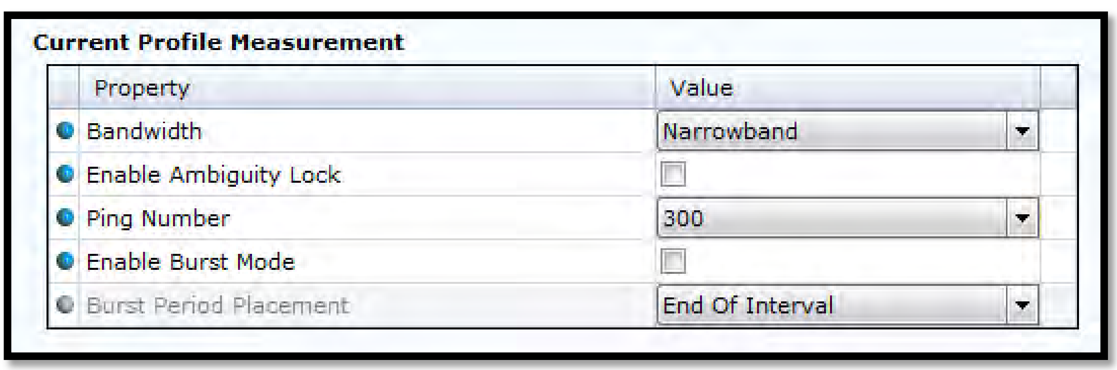


Figure 3-37: Current Profile Measurement

The sensor can select between two ***Bandwidths***, either ***Narrowband*** or ***Broadband*** to find the Doppler shift (and calculate the current parameters); see the DCPS Primer TD 310 for more details.

Each of the two methods have their own advantages:

- ***Broadband*** gives a lower single ping standard deviation which requires fewer ping (lower energy usage) to get a good measurement result. The disadvantage in ***Broadband*** is ambiguity. If the sensor is fixed, for example when deployed in a bottom frame, the ambiguity is not a problem (ambiguity lock disabled). If it is moving and the user knows that the current speeds are always below 1 m/s, enable the ambiguity lock.

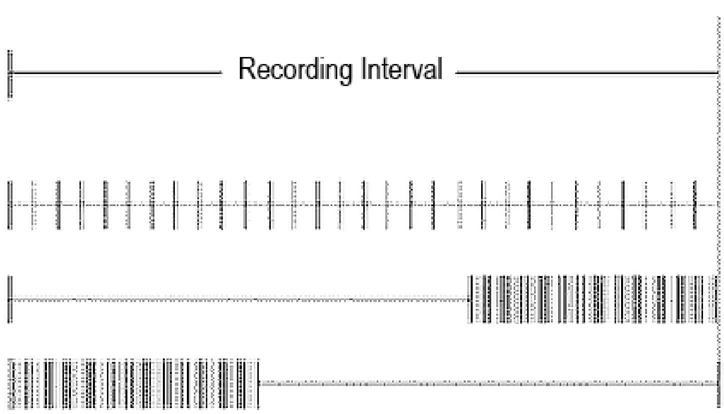
- ***Narrowband*** is recommended to use If the sensor is moving (as under a buoy for example) and if the current speeds are higher than 1m/s. Though ***Narrowband*** is more power consuming than ***Broadband***, the reached measuring range is slightly longer than in ***Broadband*** mode.

Enable Ambiguity Lock is only used with ***Broadband***. In ***Broadband*** the output of the correlation process is a phase value. When the Doppler shift is zero then the phase is also zero. When the Doppler shifts increase, so will the phase. A Doppler shift of approximately 1.25 m/s along the beam corresponds to a phase equal to 360 (360 = 0) which is exactly the same as for zero Doppler shift. For this reason the cross correlation process is not able to distinguish a Doppler shift of 1.5 from a Doppler shift of zero. In fact any Doppler shift outside the 1.25m/s range will be wrongly detected to be within the range 0 – 1.25 m/s. This is called ambiguity and could hamper the correct operation of the instrument if not corrected for. If ambiguity lock is enabled the result will stay in the first loop also between 0 and 1.25 m/s so if you know the current will be below 1.25 m/s you can use ***Ambiguity Lock*** and avoid any error caused by ambiguity,
In case the ambiguity lock is not selected, several stages of ambiguity solving methods are automatically implemented in the DCPS in order to achieve a non-ambiguous solution.

Ping Number is the number of ping transmitted during one recording interval. One ping is a transmitted pulse from all transducers. These four pulses are sent out simultaneously in four directions.

Enable Burst Mode. The sensor can run in burst mode or spread mode. When burst mode is enabled the sensor performs all ping measurements at the beginning or end of the recording interval, dependent on the Burst Period Placement setting.

Burst Period Placement can be set to either ***Start Of Interval*** or ***End Of Interval***. If it is disabled the ping measurements are evenly spread out during the recording interval. The instrument activates sleep mode between each measurement, which reduces the power consumption. Power consumption in spread and burst mode is about the same. Refer **Figure 3-38.**



Spread Mode

Burst Mode – End Of Interval

Burst Mode – Start Of Interval

Figure 3-38: Spread mode and burst mode ping distribution during the recording interval

3.14.9 Surface

Figure 3-39: Surface

Enable Surface Cell will set a cell in the surface layer. The data is set as not valid if the sensor is placed upside down with the surface cell enabled.

Surface Cell Size or the measurement "window" is centered on the surface. At the surface, the impedance difference between the water and air creates an almost perfect reflector, and the acoustic signal is reflected by the surface. Regardless of the cell size used to process the surface cell, this cell will be dominated by the infinitesimal thin layer between water and air. Although the surface cell is infinitesimal small, the cell size used to process the data must be sufficiently large to capture the boundary between air/water defining the surface cell.
The surface cell will reflect the speed of the "boundary condition". Wind will generate capillary waves, and rapidly accelerate the surface boundary. For this reason there will be a strong correlation between wind speed/surface boundary speed and wind direction / surface boundary direction.

NB! Do not use Surface Cell or Surface Reference together with Upside Down enabled, refer chapter 3.14.6.

The surface reference is ignored if the sensor is upside down while it is running (columns forced to be sensor referred).

If instrument is oriented Upside Down the surface cell is ignored and the data is set as non-valid

3.14.10 Column 1

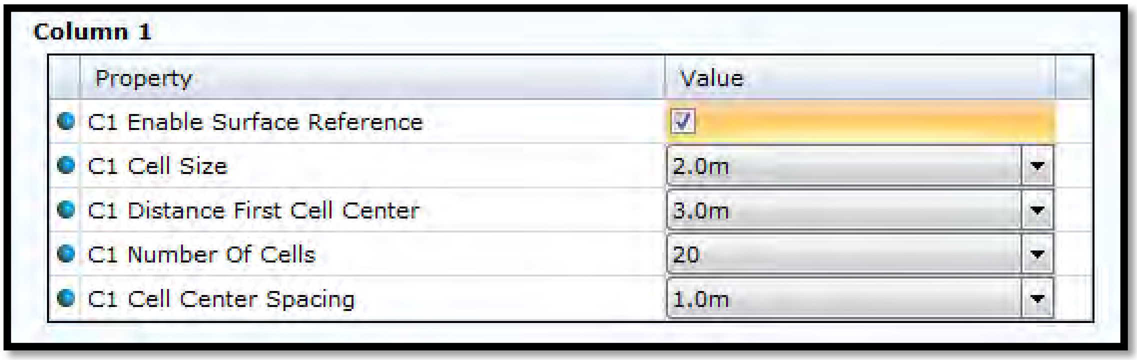


Figure 3-40: Column 1

The sensor does not have any depth measurement itself. Be aware that you must set correct fixed settings under ***Deployment Settings*** if you want to use the ***Surface Cell*** or ***Surface Reference*** of columns. It is possible to update these fixed settings while the sensor is running (not possible through Real-Time Collector without stopping and starting the sensor again). NOTE: this functionality is especially interesting when the deployment location shows some sea level variations as the tide. In this case the column will follow the surface variation but this is dependent on the input of pressure value. If you are using a surface referred column with fixed settings, the results will not reflect the water level changes.
In AiCaP mode when connected to a SmartGuard or SeaGuardII, the sensor can receive input from other sensors connected to the same Datalogger.
Column 1 is always active (not possible to disable). ***Column 1*** can have up to 75 cells. ***Column 2*** can have up to 50 cells and ***Column 3*** can have up to 25 cells (150 cells all together). ***Columns 2*** and 3 must be enabled to be used.

C1 Enable Surface Reference: If set the cells will be referenced to the surface. The surface placement is measured by a pressure sensor prior to start of each recording interval. If not enabled the cells will be referenced to the transducers and located at certain distance from the transducer head.

C1 Cell Size: Whether the instrument is configured in broadband or narrowband, the user needs to configure the cell size (from 0.5 to 5m). The cell could be defined as the volume of water in which the instrument is performing the measurement. By defining the cell size, the number of cells, the cell center spacing and knowing the speed of sound, the instrument determines the time frame when the reflected signal from the corresponding cell will be received.

C1 Distance First Cell Center: available range 1.5 to 70 meter. This will depend on the ***C1 Enable Surface Reference*** setting. If surface referenced it will be the distance from surface to center of first cell. The minimum recommended distance will be the illegible zone, area not measured because of disturbance from side lobes, plus half the cell size. As a thumb of rules the illegible zone where signal is disturbed by side lobes is 10% of the deployment depth due to shorter distance to surface for the side lobs pointing upwards compared to the main lobs and the high reflection from the surface layer. The minimum distance to first cell center should therefore be 10% of deployment depth plus half the cell size. If instrument referenced the minimum distance to first cell should be 1 meter blanking zone for 5400 and 2 meter for 5402 and 5403, plus half the cell size. This blanking zone is due to the fact that the instrument using the same transducers for transmitting the signal as used for receiving. For more information see Chapter 5 of TD 310 DCPS Theoretical Primer.

C1 Number OF Cells: Available from 1 to 75 cells. The instrument can measure multiple cells along the column from instrument to the maximum range given by the scatter condition, or from surface and down to the instrument dependent on the configuration.

C1 Cell Center Spacing is used to either obtain overlap between cells or spacing. If ***Cell Center Spacing*** is set to smaller than cell size the two following cells will overlap each other. This gives you higher resolution for the post processed data and makes it easier to locate special incidents like thermocline layers etc. If spacing is equal to cell size then two following cells will be adjacent to each other. If spacing is greater than cell size then there will be space between two following cells. This is useful if you want to measure only at certain depths for example 5, 15 and 25 meter from surface. To obtain this then set ***Enable Surface Reference*** enable, ***Cell Size*** 2 meter, ***Distance First Cell Center*** 5 meter, ***Number Of Cell*** 3 and ***Cell Center Spacing*** 10 meter.

3.14.11 Column 2

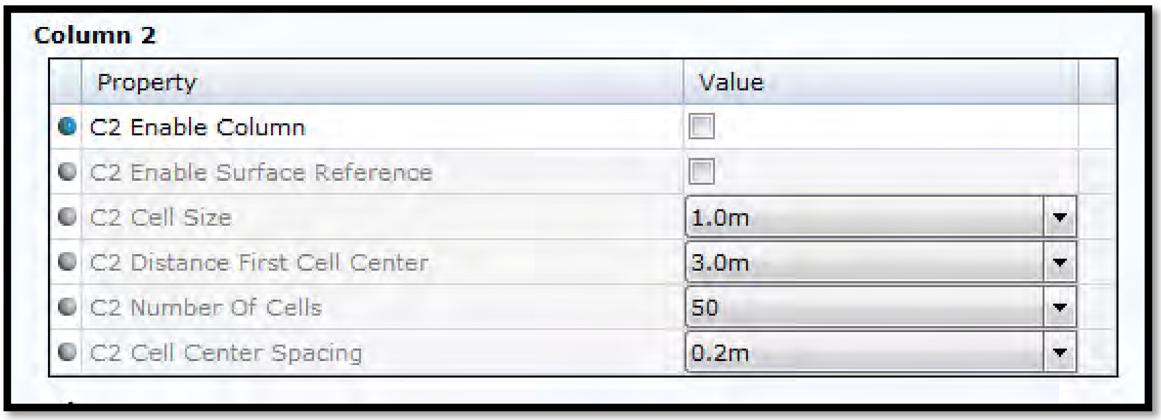


Figure 3-41: Column 2

C2 Enable Column: If you want more columns. The columns can be different, mix of both reference and configuration. Typical combination is one column covering the whole water column, one surface referenced with high resolution near surface and one instrument reference near bottom.

C2 Enable Surface Reference: Same as for C1 see ***chapter* 3.14.10**

C2 Cell Size: Same as for C1 see chapter **3.14.10**

C2 Distance First Cell Center: Same as for C1 see ***chapter* 3.14.10**

C2 Number OF Cells: Available from 1 to 50 cells. The instrument can measure multiple cells along the column from instrument to the maximum range given by the scatter condition, or from surface and down to the instrument dependent on the configuration.

C2 Cell Center Spacing: Same as for C1 see ***chapter* 3.14.10**

3.14.12 Column 3

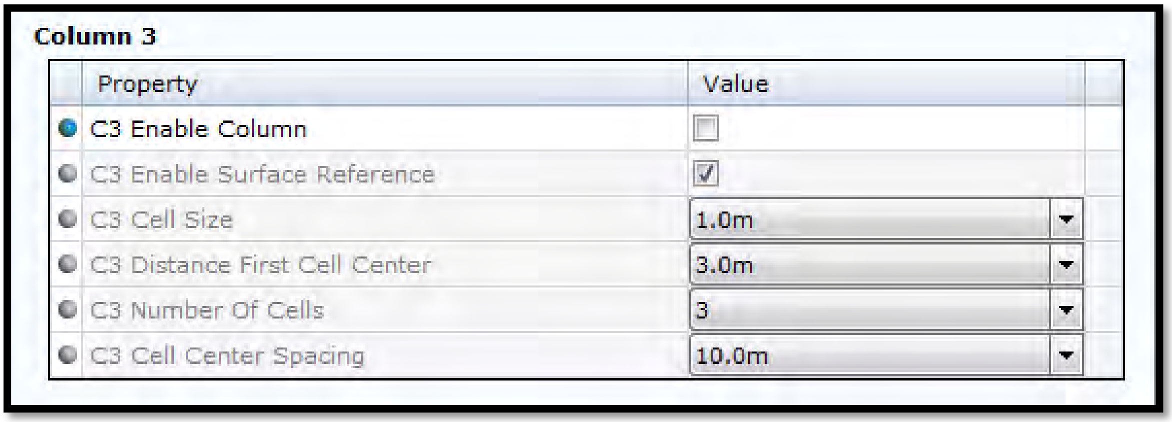


Figure 3-42: Column 3

C3 Enable Column: Same as for C2 see ***chapter* 3.14.11**

C3 Enable Surface Reference: Same as for C1 see ***chapter* 3.14.10**

C3 Cell Size: Same as for C1 see ***chapter* 3.14.10**

C3 Distance First Cell Center: Same as for C1 see ***chapter* 3.14.10**

C3 Number OF Cells: Available from 1 to 25 cells. The instrument can measure multiple cells along the column from instrument to the maximum range given by the scatter condition, or from surface and down to the instrument dependent on the configuration.

C3 Cell Center Spacing: Same as for C1 see ***chapter* 3.14.10**

3.14.13 Column 4 only with Acoustic Wave License Key

Figure 3-43: Column 4

Enable Current From Wave Pings. A profiler are normally not able to measure Acoustic Wave and Current simultaneously because the sensor using the same transducer for both operations. However with the DCPS you might set the ***Enable Current From Wave Ping*** which make it possible to use the data from Wave measurement pings to also calculate a reduced column with current. This is presented in ***Column 4*** when enabled. This column is limited to only measure in 3 different cells and these cells are controlled by the setting under ***User Maintenance*** and ***Wave Measurement,*** refer ***chapter 3.15.8.***

3.14.14 Output/Storage Wave Parameters only with Acoustic Wave License Key

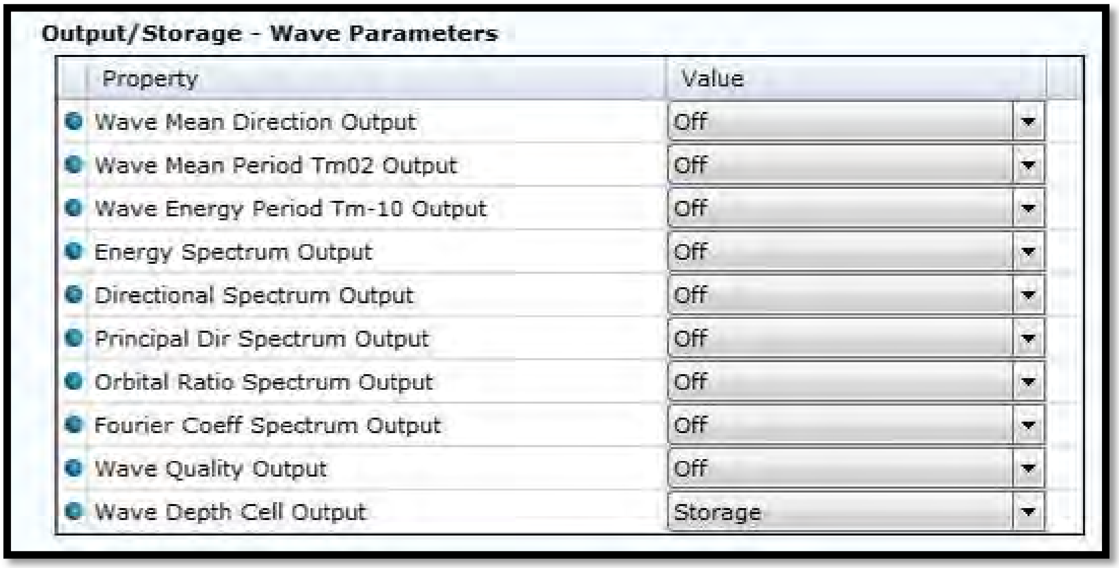


Figure 3-44: Output/Storage - Wave Parameters

The Wave output parameters can be controlled by the user. Alternative options for each parameter are Off, Storage or Output+Storage where Off means the parameter is not calculated. Storage means that the parameter is only stored on the SD-card and Output+Storage means the parameter will be transmitted on the Real-Time output in addition to storage on the SD-card.

Significant Wave Height H_{m0} and ***Significant Wave Height $H_{1/3}$*** is always both output and stored while the other parameters can be selected as desired by the operator, The following parameters are available for selection. See chapter ***12.3*** for a description of each parameter calculation.

Wave Mean Direction Output

Wave Mean Period T_{m02} Output

Wave Energy Period T_{m-10} Output

Energy Spectrum Output

Directional Spectrum Output

Principal Dir Spectrum Output

Orbital Ratio Spectrum Output

Fourier Coeff Spectrum Output

Wave Quality Output

Wave Depth Cell Output

3.14.15 Output/Storage Profile Parameters

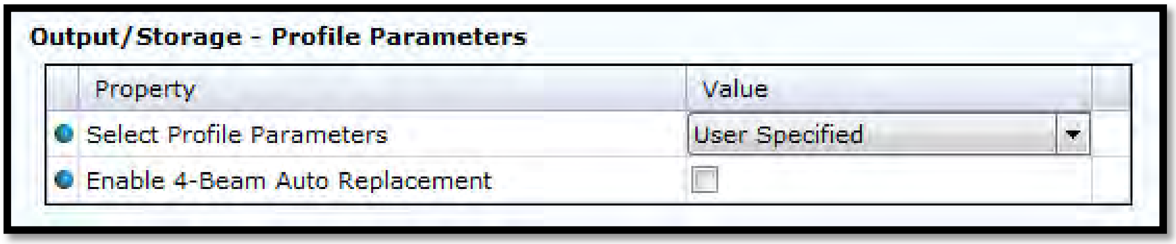


Figure 3-45: Output/Storage - Profile Parameters

While configuring the sensor, it is possible to define which parameters should be calculated and sent from the sensor.

Select Profile Parameters gives the user the choice to either select one of the predefined groups of ***Profile Parameter*** or you might select your own selection in ***User Specified – Profile Parameters*** refer chapter ***3.14.16***, by selecting ***User Specified***. The sensor always outputs the ***Cell State1 and Cell Stat 2***, ***Horizontal Speed*** and ***Direction*** for all the cells (not possible to disable). Available settings for ***Select Profile Parameters*** are:

- ***Simple Output***
- ***Basic Output***
- ***Basic + Beam Output***
- ***Basic + 3-Beam Output***
- ***Basic + Beam + 3-Beam Output***
- ***Full Output***
- ***User Specified***

Refer ***Table 3-1*** for parameters included in each group.

Refer to ***Table 1-8*** for definition of the parameters.

NOTE: Enabling more data also means larger data messages and more time to transfer data.

All profile parameters are an average of each ping data from the last measurement interval.

Enable 4-Beam Auto Replacement. If selected all 4-beam parameters will automatically be replaced with the best 3-beam solution if a disturbance is detected in one of the beam.

Table 3-1: Profile Parameter additional parameters for each group

Profile parameter	Parameter name	Simple Output	Basic Output	Basic + Beam Output	Basic + 3-Beam Output	Basic + Beam + 3-Beam Output	Full Output
	Cell State 1	x	x	x	x	x	x
	Cell State 2	x	x	x	x	x	x
	Horizontal Speed	x	x	x	x	x	x
	Direction	x	x	x	x	x	x
NE Speed Output	North Speed		x	x	x	x	x
	East Speed		x	x	x	x	x
Vertical Speed Output	Vertical Speed		x	x	x	x	x
Std Dev Speed Output	SP Stdev Horizontal		x	x	x	x	x
Strength Output	Strength		x	x	x	x	x
Cross Difference Output	Cross Difference		x	x	x	x	x
Beam Speed Output	Beam1 Speed			x		x	x
	Beam2 Speed			x		x	x
	Beam3 Speed			x		x	x
	Beam4 Speed			x		x	x
Beam Strength Output	Beam1 Strength			x		x	x
	Beam2 Strength			x		x	x
	Beam3 Strength			x		x	x
	Beam4 Strength			x		x	x
Std Dev Beam Speed Output	Beam1 Stdev			x		x	x
	Beam2 Stdev			x		x	x
	Beam3 Stdev			x		x	x
	Beam4 Stdev			x		x	x
Correlation Factor Output	Beam1 Correlation Factor			x		x	x
	Beam2 Correlation Factor			x		x	x
	Beam3 Correlation Factor			x		x	x
	Beam4 Correlation Factor			x		x	x

Profile parameter	Parameter name	Simple Output	Basic Output	Basic + Beam Output	Basic + 3-Beam Output	Basic + Beam + 3-Beam Output	Full Output
3-Beam Combination Output	SP Stdev Beam123				x	x	x
	SP Stdev Beam124				x	x	x
	SP Stdev Beam134				x	x	x
	SP Stdev Beam234				x	x	x
	North Beam123				x	x	x
	North Beam124				x	x	x
	North Beam134				x	x	x
	North Beam234				x	x	x
	East Beam123				x	x	x
	East Beam124				x	x	x
	East Beam134				x	x	x
	East Beam234				x	x	x
3-Beam Combination Output (continue)	Vertical Beam123				x	x	x
	Vertical Beam124				x	x	x
	Vertical Beam134				x	x	x
	Vertical Beam234				x	x	x
AutoBeam Output	SP Stdev AutoBeam						x
	Horizontal Speed AutoBeam						x
	Direction AutoBeam						x
	North AutoBeam						x
	East AutoBeam						x
	Vertical AutoBeam						x
	Point Parameters						
Noise Level Output	Noise Peak Level B1						x
	Noise Peak Level B2						x
	Noise Peak Level B3						x
	Noise Peak Level B4						x
	Noise Average Level B1						x
	Noise Average Level B2						x
	Noise Average Level B3						x
	Noise Average Level B4						x

3.14.16 User Specified – Profile Parameters

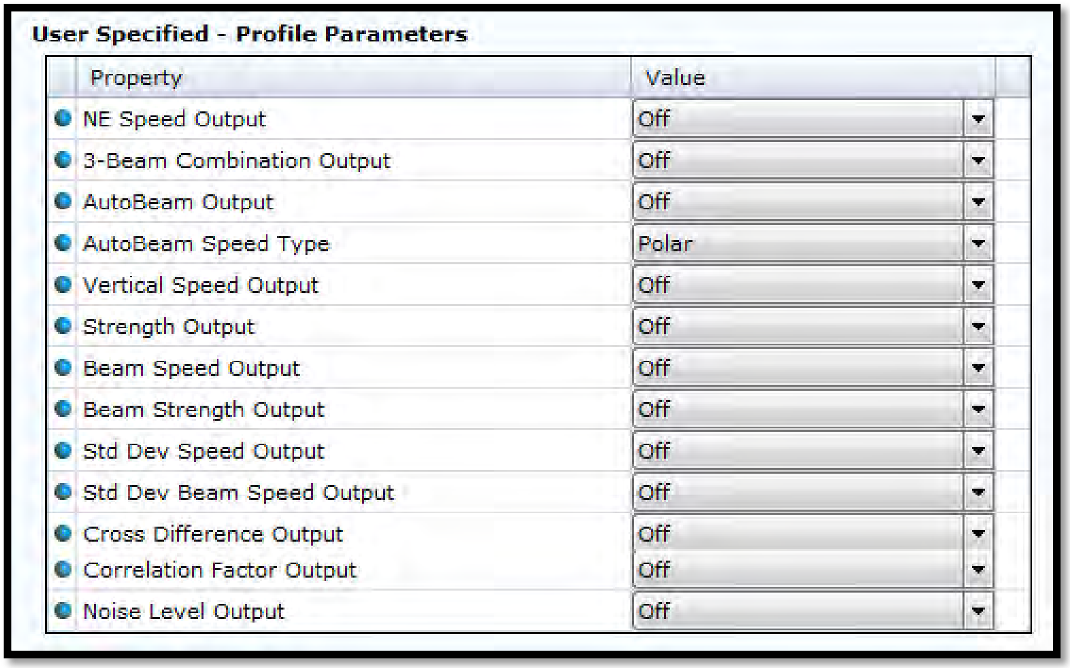


Figure 3-46: User Specified - Profile Parameters

User Specified Profile Parameters settings are setting that only are in use if ***User Specified*** is selected under ***Select Profile Parameters.*** For all other settings the group content displayed in ***Table 3-1*** will overrule the selection and all are stored.
In AiCaP mode the alternatives are ***Off, Storage*** or ***Output + Storage***

NE Speed Output outputs the calculated values for ***North Speed*** and ***East Speed*** where speed in north and east direction gives a positive value and speed in South and West direction gives a negative value.

3-Beam Combination Output outputs the four 3-Beam solutions, Beam 123, Beam 134, Beam 124 and Beam 234 for each of the four parameters, ***SP Stdev Beam*** (Single Ping Standard Deviation Beam), ***North Beam, East Beam*** and ***Vertical Beam***. These information is useful if there are an obstruction in one of the beams but also important as quality control to decide that there are now disturbance in one or more beams.

AutoBeam Output outputs ***SP Stdev AutoBeam*** (Single Ping Standard Deviation AutoBeam), ***Horizontal Speed, Direction, North, East*** and ***Vertical Speed*** which for each parameter is the automatically selected best combination of either one of the 3-beam solutions or the 4-beam solution. If all five solutions is identical or close to identical the sensor will always select the 4-beam solutions because this has more pings and therefore better standard deviation.

AutoBeam Speed Type. If ***AutoBeam Output*** is selected then ***AutoBeam Speed Type*** will set the output type for these parameters. Alternative type is ***Rectangular, Polar*** or ***Rectangular + Polar***.

Vertical Speed Output outputs the measured ***Vertical Speed*** based on the four beams. Alternatively 3 beams if ***Enable 4-Beam Auto Replacement*** is selected

Strength Output outputs an average of signal strength from the four transducers. Alternatively 3 transducers if ***Enable 4-Beam Auto Replacement*** is selected

Beam Speed Output outputs the individual speed measurements from each of the four beams

Beam Strength Output outputs the individual signal strength from each of the four beams.

Std Dev Speed Output outputs a calculated ***SP Stdev Horizontal*** (Single Ping Standard Deviation Horizontal Speed) based on measurements from the four beams. Alternatively three beams if ***Enable 4-Beam Auto Replacement*** is selected.

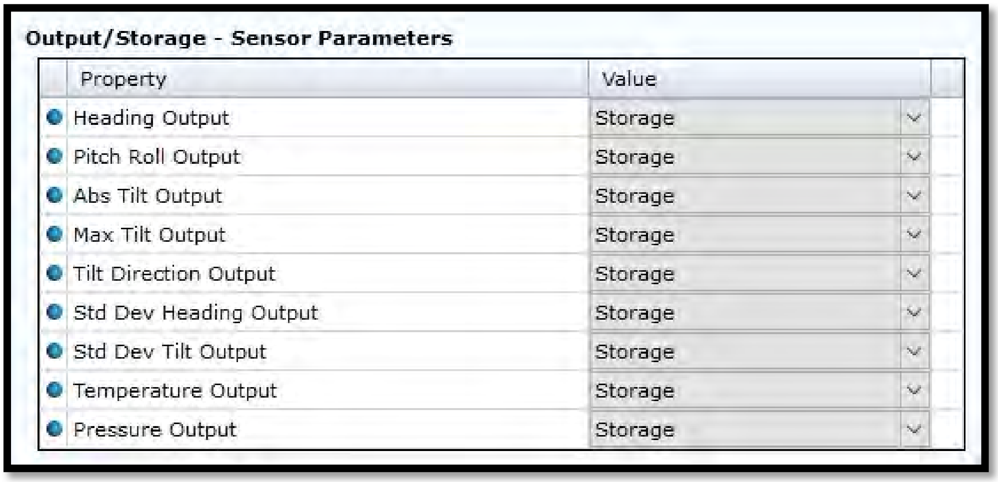
Std Dev Beam Speed Output outputs individual standard deviation for each beam.

Cross Difference Output outputs the Cross Difference which is the difference in Doppler shift from transducers on the same axis, for each depth the speed in beam 1 - speed beam 3 + speed beam 2 – speed beam 4 should be close to 0.

Correlation Factor Output outputs the correlation factor for each beam. The result should be close to 0.5. Only for use in Broadband mode.

Noise Level Output outputs the ***Noise Peak Level*** and ***Noise Average Level*** for each of the four transducers. The noise level is a measurement done before the ping measurement where the sensor is only listening to the signal received by the transducers. ***Noise Peak Level*** outputs the highest signal level detected and this gives a good indication on nearby noise sources in the water (other current meters, echo sounders etc.)

3.14.17 Output/Storage - Sensor Parameters



Output/Storage - Sensor Parameters

Property	Value
Heading Output	Storage
Pitch Roll Output	Storage
Abs Tilt Output	Storage
Max Tilt Output	Storage
Tilt Direction Output	Storage
Std Dev Heading Output	Storage
Std Dev Tilt Output	Storage
Temperature Output	Storage
Pressure Output	Storage

Figure 3-47: Output/Storage - Sensor Parameters

In this section sensor parameters related to the compass/tilt measurement are enabled or disabled.

In AiCaP mode the alternatives are either ***Off***, ***Storage*** or ***Output+Storage***

A compass/tilt measurement is taken for each ping measurement (current speed measurement). One ping consists of one ping from each transducer. The given value is an average of all single measurements from the last measurement interval.

Heading Output is the angle in degrees between transducer 1 and magnetic north. Turning the sensor clockwise gives an increasing angle. When looking at the sensor from the label side, transducer 1 is the transducer back to the left (refer to Chapter ***CHAPTER 10***). When looking at the sensor from the label side with the sensor upside down, transducer 1 is the transducer back to the right.
The tilt is converted to rotational angles, ***Pitch*** and ***Roll***. The rotational angles are used internally when calculating correct heading from the 3D magnetic field vector and correct current speed components from the acoustic beam vectors in each cell. ***Pitch*** and ***Roll*** output is an average from all measurements in the last measurement interval.
The ***Heading Output*** is the average compass reading referenced to north during one measurement interval.

Pitch Roll Outputs individually outputs ***Pitch*** and ***Roll*** as an average for one measurement interval.

Abs Tilt Output (Absolute tilt) is the tilt between the horizontal plane and the sensor's plane. When upside down, the Abs tilt is varying around 180 degree. This is different from the Aanderaa RDCP (previous profiler generation). The new profiler is able to sense if it is upside down or not, and the absolute tilt indicates the actual direction of the sensor when it is running.

Max Tilt Output (Maximum tilt is the maximum tilt in any direction measured by the sensor during one measurement interval.

Tilt Direction Output is the average of all tilt direction measurement during one measurement interval.

Std Dev Heading Output (Standard Deviation Heading Output). The sensor does one heading measurement for each ping. This is the standard deviation of all the heading measurements during a recording interval.

Std Dev Tilt Output (Standard Deviation Tilt Output). The sensor does one tilt measurement for each ping. This is the standard deviation of all the absolute tilt measurements during a recording interval.

Temperature Output. If a temperature sensor 4080 is installed and calibrated this will output the measured temperature

Pressure Output. Only for 5400P. This will output the measured pressure from the integrated pressure sensor.

3.14.18 Output/Storage System Parameters

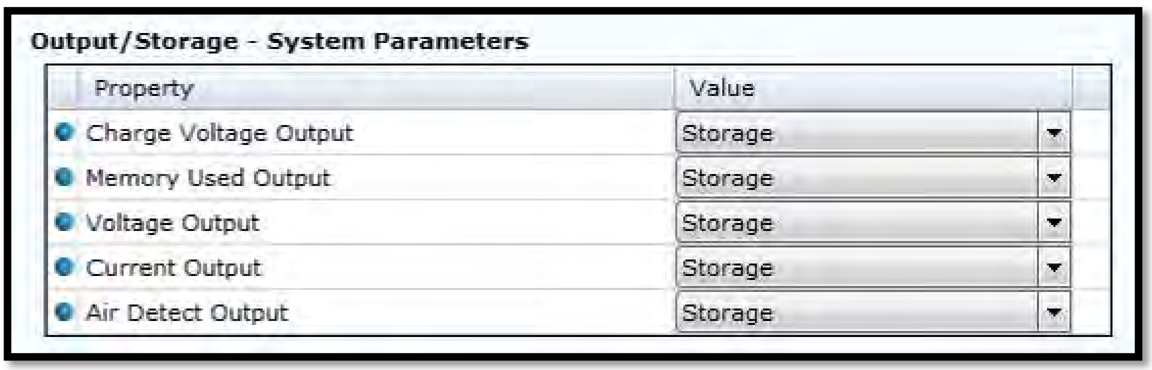


Figure 3-48: Output/Storage - System Parameters

The sensor can also output different system parameters like voltage, current draw while awake, and voltage to the acoustic transmitter circuits etc. that could be necessary during the QA&QC of data.

Charge Voltage Output is the charge voltage to the acoustic Tx circuits. Important information to see if there is something wrong with the charge electronics or the transducers. Used for troubleshooting.

Memory Used Output gives a number for the used heap memory. Used for troubleshooting.

Voltage Output gives the measured input voltage internally in the sensor. This is a way to see if the input supply voltage starts dropping and used to check power consumption. Value is dependent on type of battery or if external power is used.

Current Output is the measured input current to the sensor. This can indicate if something is wrong in the internal electronics if it suddenly starts to rise.

Air Detect Output is the value measured by the air detects circuit. This is a circuit which detects if the sensor is in air or water.

3.14.19 Output/Storage Virtual Sensor

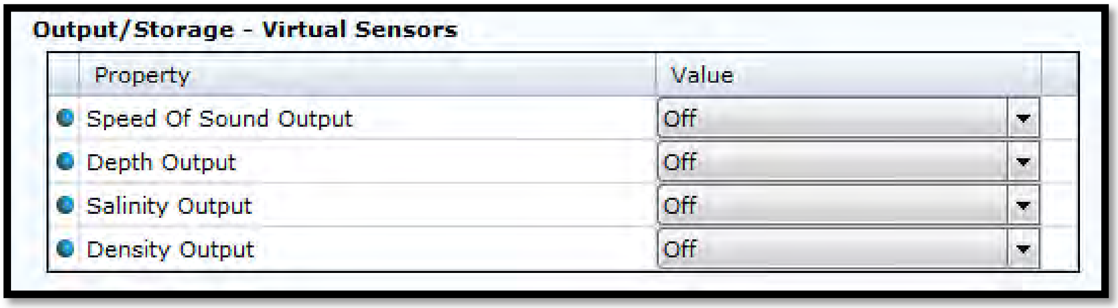


Figure 3-49: Output/Storage - Virtual Sensor

The sensor can also calculate some virtual parameters. These are more interesting when the sensor is used on a Datalogger where the sensor can receive external sensor input via the Datalogger.

Speed Of Sound Output is the fixed Sound Of Speed setting or calculated from available inputs.

Depth Output is the calculated depth based on fixed settings or calculated from available inputs.

Salinity Output is the calculated salinity based on fixed settings or calculated from available inputs.

Density Output is the calculated density based on fixed settings or calculated from available inputs.

3.15 User Maintenance

In ***User Maintenance*** you will find properties that are password protected and are normally set / altered by a trained user. It is not recommended to change properties unless instructed.

To access this menu check the ***"Include User Maintenance"*** box in the ***Device Configuration*** before clicking on the ***"Get Current Configuration…"*** button. The password is: **1000**.

Then click on the ***Edit*** button under ***User Maintenance*** and double click on the ***Wave Sensor*** icon in the sensor list.

3.15.1 User Maintenance without Acoustic Wave License

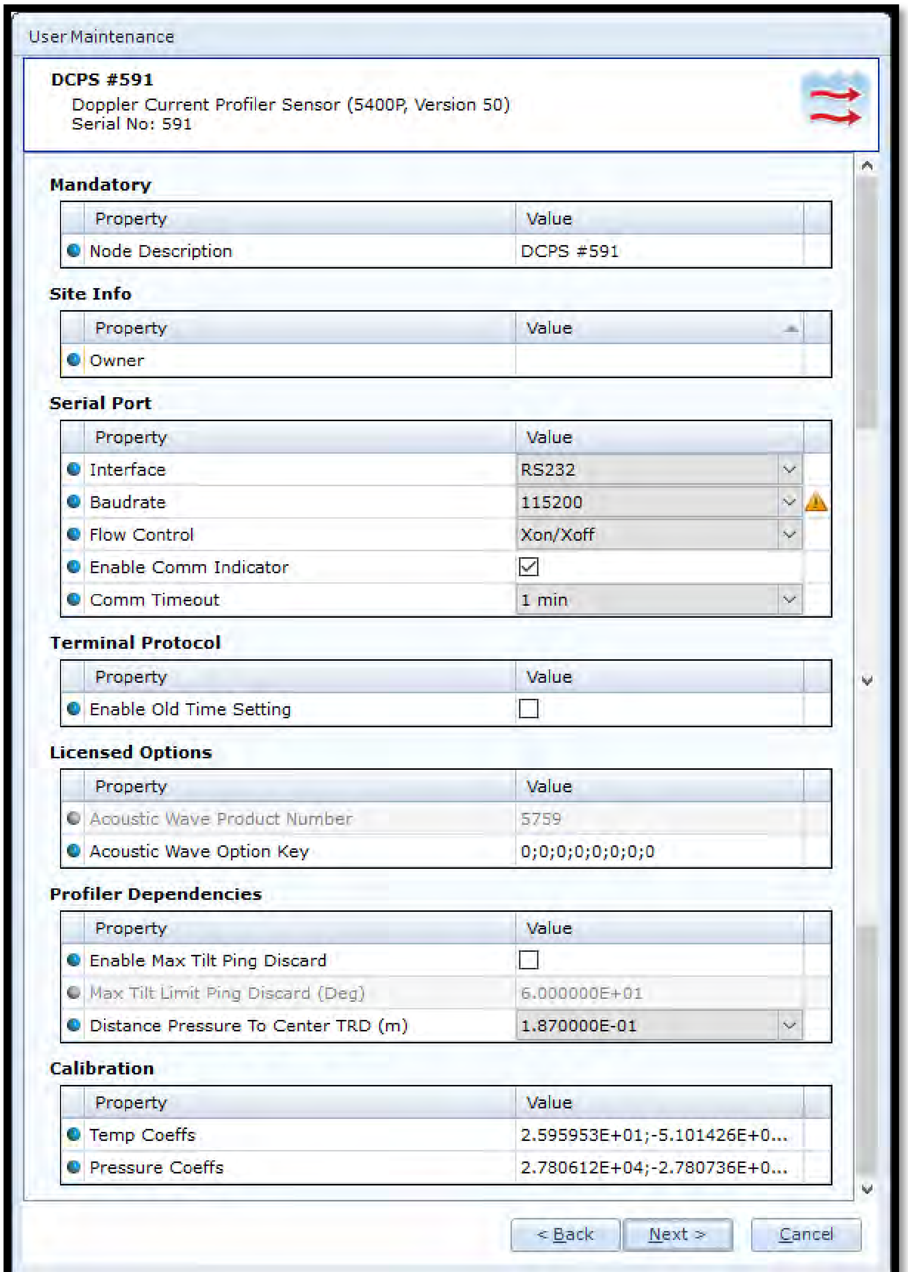


Figure 3-50: User Maintenance without Wave Direction License

User Maintenance holds 6 different sections:

- ***Mandatory***
- ***Site Info***
- ***Serial Port***
- ***Licensed Options***
- ***Profiler Dependencies***
- ***Calibration***

3.15.2 User Maintenance with Acoustic Wave License

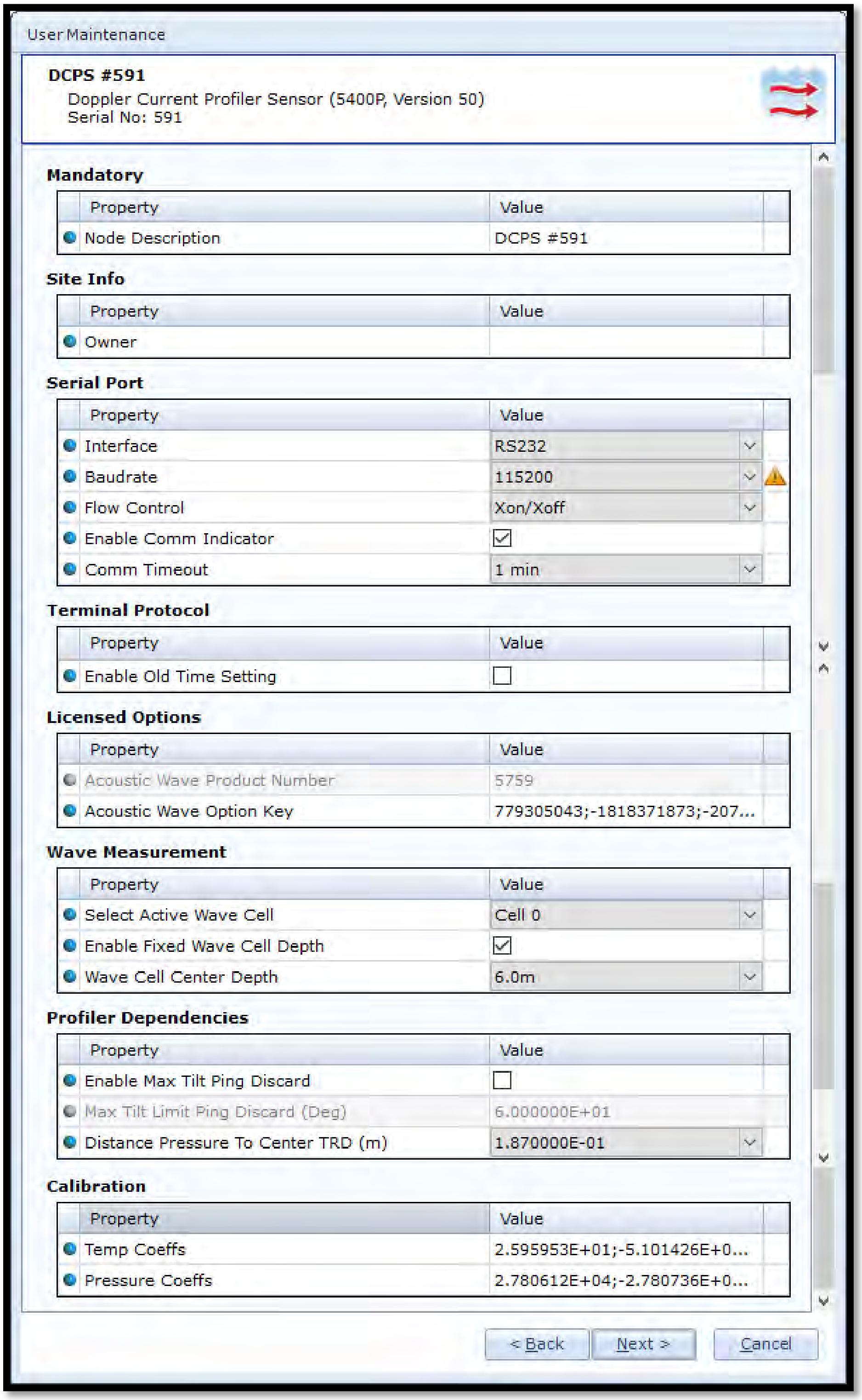


Figure 3-51: User Maintenance with Wave Direction License

User Maintenance holds 8 different sections:

- ***Mandatory***
- ***Site Info***
- ***Serial Port***
- ***Terminal Protocol***
- ***Licensed Options***
- ***Wave Measurement***
- ***Profile Dependencies***
- ***Calibration***

Please note that Acoustic Wave is only available when the sensor is connected to a Aanderaa logger and set to AiCaP mode.

See ***chapter 3.15.3*** through *Error! Reference source not found.****3.15.10*** for a description of each parameter in each sections.

.

3.15.3 Mandatory

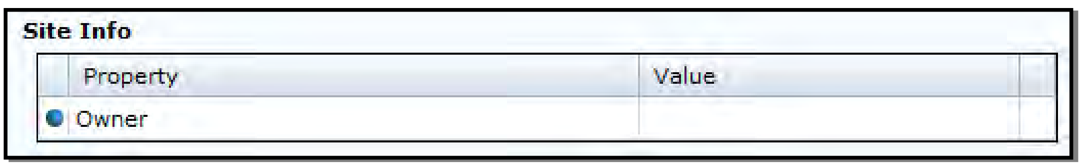

Mandatory

Property	Value
Node Description	DCPS #591

Figure 3-52: Mandatory in User Maintenance

All sensors are given a ***Node Description*** text like ***DCPS #xxx*** (where xxx is the serial number of the sensor). The user can modify this node description text if required. Be aware that the node description changes to ****Corrupt Configuration*** if it has lost the configuration in flash. Contact the factory if this happens. The configuration is saved in two sectors in flash memory. A flash sector can be corrupted if the power is lost during the saving of new configuration. The double flash sector saving ensures that it does not lose the configuration. If one of the sectors is corrupted, the other sector is used and saved to the corrupt sector.

3.15.4 Site Info


Site Info

Property	Value
Owner	

Figure 3-53; Site Info in User Maintenance

Site Info is optional information to be entered to store information about the ***Owner***. This setting is not used in calculation.

3.15.5 Serial Port

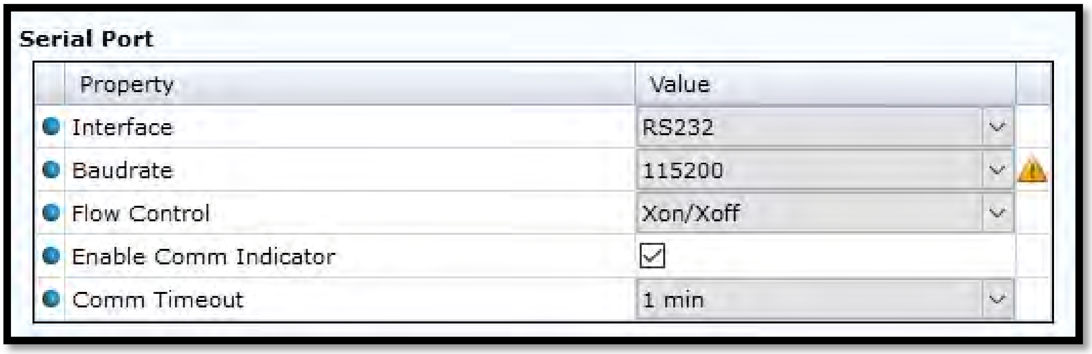


Figure 3-54: Serial Port settings in User Maintenance

The ***Serial Port*** group contains setting that deals with the serial port setting.

Interface is only available as RS-232 for 5400, 5400P, 5402 and 5403 and as RS-422 for 5400R, 5400PR, 5402R and 5403R.

Baudrate need to be set to the same value as for your logger or terminal software. Default setting is 115200 but you may also select a lower baudrate. Please note that this will slow down the communication but on the other hand it will be able to rune the sensor on longer cables.

3.15.6 Licensed Option without Acoustic Wave License

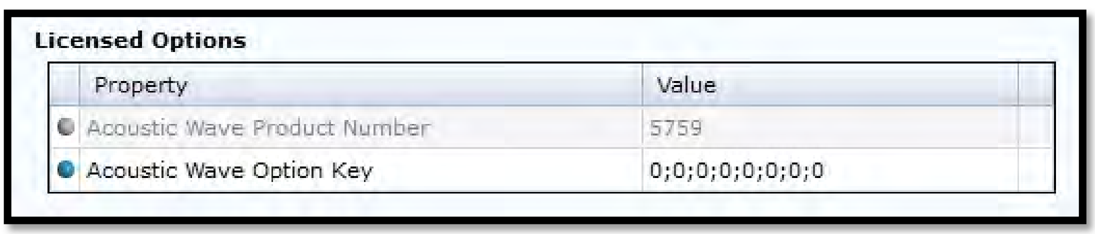


Figure 3-55: Licenced Options without Wave Direction License

Acoustic Wave Product Number is a fixed setting and cannot be changed by the user.
If no Acoustic Wave option is ordered, then the numbers in ***Acoustic Wave Option Key*** will all be zero. If you want to upgrade to also measure wave a unique set of numbers for this specific sensor can be ordered from the factory or one of our dealers. The key is generated based on product number and serial number.
Acoustic Wave Option Key is only available with newer software versions and there might also be some hardware limitations if you want to upgrade an older version of the sensor to include Acoustic Wave.

3.15.7 Licensed Option with Acoustic Wave License

Licensed Options

Property	Value
Acoustic Wave Product Number	5759
Acoustic Wave Option Key	779305043;-1818371873;-207...

Figure 3-56: Licenced Options with Acoustic Wave License

Acoustic Wave Product Number is a fixed setting and cannot be changed by the user.
If Acoustic Wave is ordered, then a unique set of numbers will be stored in ***Acoustic Wave Option Key***. Each sensor has a unique Key generated based on product number and serial number.
Acoustic Wave Option Key is only available with newer software versions and there might also be some hardware limitations if you want to upgrade an older version of the sensor to include Acoustic Wave.

3.15.8 Wave Measurement only with Acoustic Wave License

Wave Measurement

Property	Value
Select Active Wave Cell	Cell 0
Enable Fixed Wave Cell Depth	☑
Wave Cell Center Depth	6.0m

Figure 3-57: Wave Measurement in User Maintenance

The settings in this section are only available if Acoustic Wave Option Key is installed.

Select Active Wave Cell gives you the possibility to select which cell to be used for wave calculation. Available cells are 1,2 and 3 where Cell 1 is closest to the surface. The position of each cell depends on the setting selected for the two other properties in this group.

Enable Fixed Wave Cell Depth is used to either set a static position of cell 1, enabled or dynamic if disabled.

If enabled, then the distance to center of first cell is set by ***Wave Cell Center Depth***. If disabled, the placement of first cell will depend on wave measurement and depth.

3.15.9 Profiler Dependencies

Profiler Dependencies

Property	Value
Enable Max Tilt Ping Discard	☐
Max Tilt Limit Ping Discard (Deg)	6.000000E+01
Distance Pressure To Center TRD (m)	1.870000E-01

Figure 3-58: Profiler Dependencies in User Maintenance

Enable Max Tilt Ping Discard. If this setting is enabled, then if tilts exceed the ***Max Tilt Limit Ping Discard (Deg)***value the ping will not be used. This is used to avoid bad data from ping when the sensor is tilting too much.

Max Tilt Limit Ping Discard (Deg) is the value used to discard ping if ***Enable Max Ping Discard*** is enabled.

Distance Pressure To Center TRD (m) is used to set the distance from pressure sensor inlet port (the reference level for the pressure sensor) to the center of the DCPS transducers. Default value when used mounted on SeaGuardII top-end plate is 0.187 meter. Value for 5400P is 1.50 which is the distance from pressure sensor reference level to center of DCPS transducers.

3.15.10 Calibration

Calibration

Property	Value
Temp Coeffs	2.595953E+01;-5.101426E+0...
Pressure Coeffs	2.780612E+04;-2.780736E+0...

Figure 3-59: Calibration in User Maintenance

Temp Coeffs is only used if a 4080 Temperature Sensor installed from factory. This property holds 4 coefficients if the sensor is calibrated at factory. The calibration coefficients are available from the calibration certificate.

Pressure Coeffs are only used for 5400P versions. This property holds 4 coefficients obtained during a calibration process at factory. The calibration coefficients are available from the calibration certificate.

3.16 System Overview

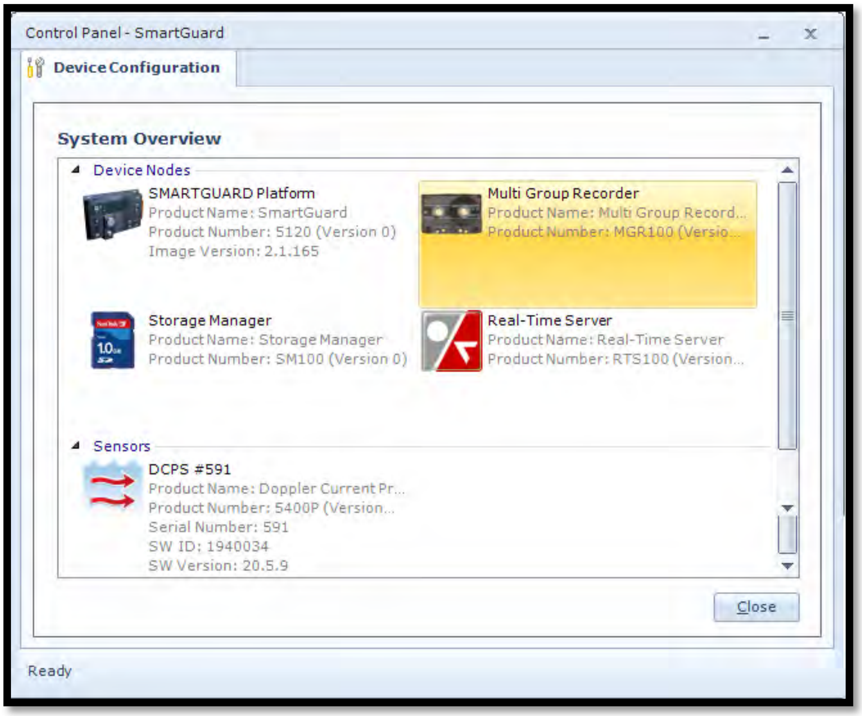


Figure 3-60: System Overview

When you select ***System Overview*** under the ***Device Configuration*** tab you will get a short list of the SmartGuard Device Nodes with info like ***Product Name, Product Number*** and ***Image Version***. If you scroll down using the bar on the right side you will also see a list of all connected sensors with ***Product Name, Product Number, Serial Number*** and ***Software Version***.

3.17 Save Configuration to file.

The example below shows a small excerpt of a saved configuration. All information and settings related to both SmartGuard and all connected sensor are found in the full file.


```xml
  <?xml version="1.0" encoding="UTF-8"?>
- <Config xmlns="http://www.aadi.no/RTConfigSchema" ID="5120-488-2020-04-24T07:39:27Z" Time="2020-04-24T07:39:27.982Z">
  - <NodeConfig ID="5120-488" ProdName="SMARTGUARD" Descr="SMARTGUARD Platform" ProdNo="5120" SerialNo="488" ConfigVer="0
    - <ConfigCategory ID="0" Descr="Factory Maintenance">
      - <PropertyCategory ID="0" Descr="Mandatory">
          <Property ID="0" Descr="Product Name" Type="VT_BSTR" Access="R1">SMARTGUARD</Property>
          <Property ID="1" Descr="Product Number" Type="VT_BSTR" Access="R1">5120</Property>
        </PropertyCategory>
      - <PropertyCategory ID="1" Descr="Mainboard">
          <Property ID="0" Descr="Product Number" Type="VT_BSTR" Access="R1">3969691</Property>
          <Property ID="1" Descr="Serial Number" Type="VT_I2" Access="R1">488</Property>
          <Property ID="2" Descr="Version" Type="VT_BSTR" Access="R1">8</Property>
          <Property ID="3" Descr="Last Service" Type="VT_BSTR" Access="R1W4"/>
        </PropertyCategory>
      - <PropertyCategory ID="3" Descr="SR10VR22 Logger">
          <Property ID="0" Descr="Product Number" Type="VT_BSTR" Access="R1">3969047A</Property>
          <Property ID="1" Descr="Serial Number" Type="VT_I2" Access="R1">381</Property>
          <Property ID="2" Descr="Version" Type="VT_BSTR" Access="R1">D</Property>
          <Property ID="3" Descr="Last Service" Type="VT_BSTR" Access="R1W4"/>
        </PropertyCategory>
      - <PropertyCategory ID="4" Descr="Software">
          <Property ID="0" Descr="Image Name" Type="VT_BSTR" Access="R1">SSH20</Property>
          <Property ID="1" Descr="Image Version" Type="VT_ARRAY | VT_I2" Access="R1">2;1;165</Property>
        </PropertyCategory>
      </ConfigCategory>
    - <ConfigCategory ID="1" Descr="User Maintenance">
      - <PropertyCategory ID="0" Descr="Mandatory">
          <Property ID="0" Descr="Node Description" Type="VT_BSTR" Access="R1W3">SMARTGUARD Platform</Property>
```


Figure 3-61: Example of saved .xml

CHAPTER 4 **Configuration with AADI Real-Time collector**

4.1 DCPS configuration

This chapter describes the sensor configuration using AADI Real-Time Collector when the sensor is used stand-alone with serial communication via the PC COM-port. All sensor versions are covered in the same chapter since except from the Pressure and Temperature Parameter they are identical. The sensor might be set to any mode when configured using AADI Real-Time Collector but if you want to use the included real-time display function then the sensor needs to be in AADI Real-Time mode, refer ***chapter 4.10.1*** for changing the mode. The menus shown here are slightly different from the menus shown when the sensor is set to AiCaP mode and configured either stand-alone or through a SmartGuard Datalogger (described in *Error! Reference source not found.*).

See ***chapter*** *Error! Reference source not found.* for sensor connection and ***chapter*** *Error! Reference source not found.* for available cables between sensor and PC. Please note that the sensor needs a steady power supply with 6-14VDC. Our standard stand-alone cables are normally supplied with a 9 pin D-sub plug for connection to PC. If your PC has no Serial Port we recommend to use FTDI Serial to USB adapter, see ***Figure 4-1***: This adapter can also be ordered from Aanderaa. After the sensor is connected and power are supplied then install and start the AADI Real-Time Collector software on your PC (license and software delivered on memory stick with the sensor). For more info refer TD 268 AADI Real-Time Collector Operation Manual.

Figure 4-1: FTDI serial-USB adapter

4.2 Establishing a new connection

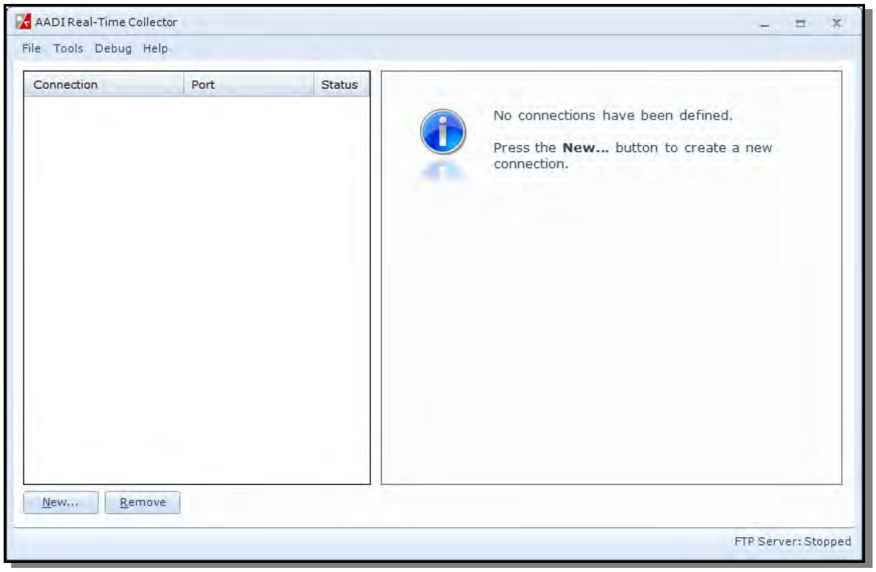


Figure 4-2: AADI Real-Time Collector start up menu

If the AADI Real-Time Collector program is being used for the first time, the connection list will be empty. Click on the ***New*** button in the lower left corner to create a new connection.

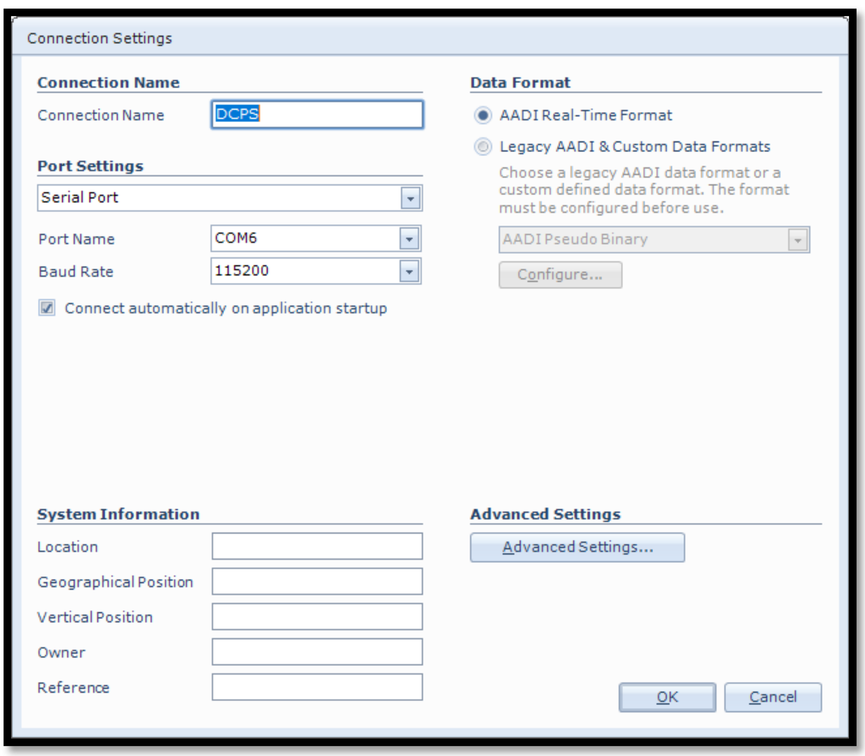


Figure 4-3: AADI Real Time Collector connection settings

Type a descriptive name in the ***Connection Name*** box (e.g. DCPS and #serial number).

Select ***Serial Port*** as ***Port Settings*** even if you use the serial to USB adapter**,** selects the correct ***COM#*** as ***Port Name*** and ***115200*** as ***Baud Rate***. This is the default baud rate set at factory on all DCPS sensors. ***Baud rate*** needs to be the same as set in sensor to obtain connection.

Then click on the ***Advanced Settings*** on the lower right side and in the ***Advanced Connection Settings*** window select ***Connection*** in the list on the left side, refer ***Figure 4-4.***

If you want to return to this menu later please close the port and then press ***Settings..*** in the main menu.

If ***Connect automatically on application startup*** is selected then this connection will automatically open every time you start AADI Real-Time Connector.

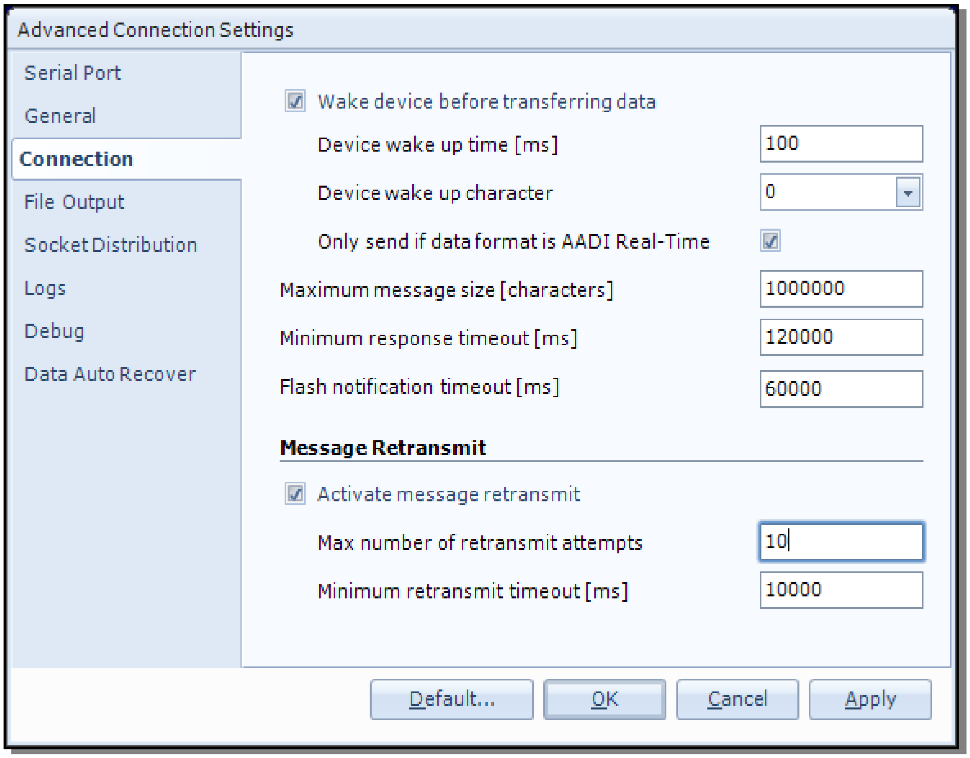


Figure 4-4: Advanced connection settings

AADI Real-Time Collector uses a default setting that fits for most Smart Sensors.

However the DCPS may output a large amount of data and therefor much longer response time (depending on the configuration) than other smart sensors.

Some of the connection settings might need to be changed. We recommend using the settings as shown in ***Figure 4-4.*** screen.

After updating the ***Advanced Connection Settings***, click on ***Apply*** and ***OK*** and then ***OK*** to go back to the start.

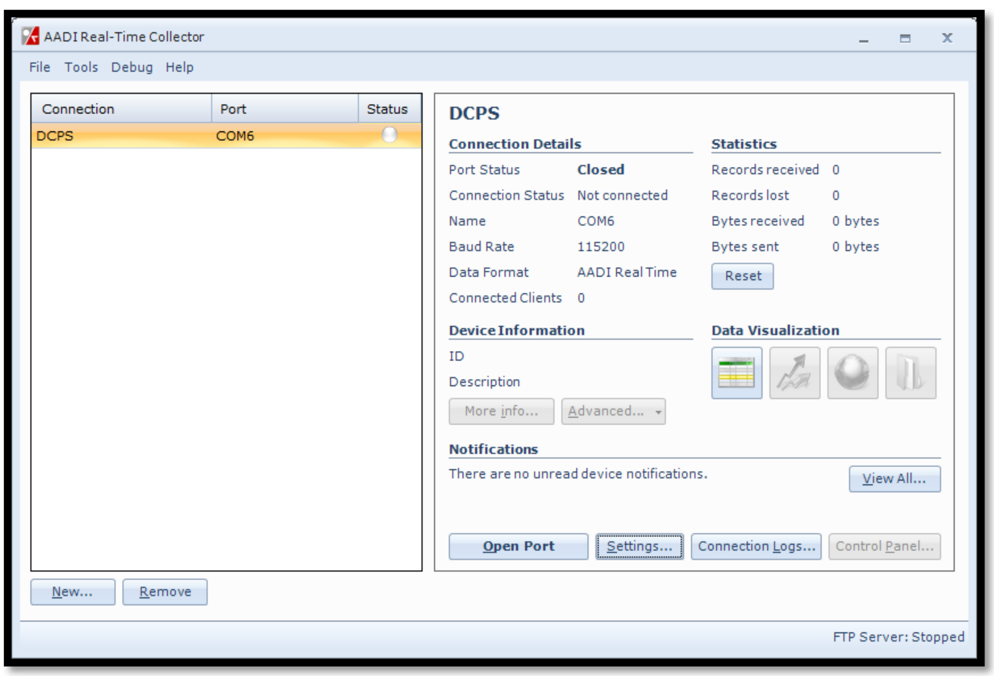


Figure 4-5: Connection list

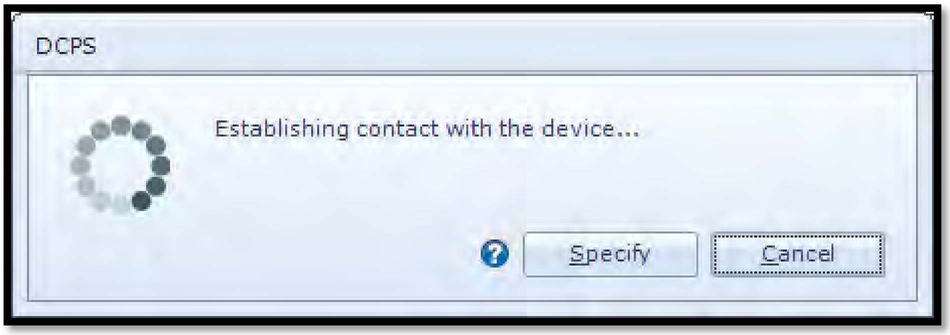
The ***Advanced Settings*** are only accessible to change when the port is closed. If the settings are grey then you first need to close the port, refer ***Figure 4-5*** and press ***Close Port.***

The new connection is now shown in the AADI Real-Time Collector connection list. Choose the new connection and click on the ***Open Port*** button.

The connection list might contain different connections to other sensors as well.

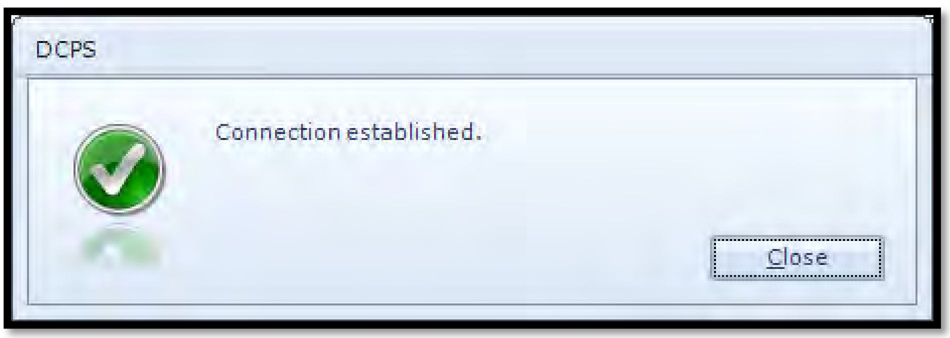
Then highlight the DCPS connection before pressing the ***Open Port*** button.

NOTE: This procedure only needs to be done once. This connection will be in the connection list at next start-up.



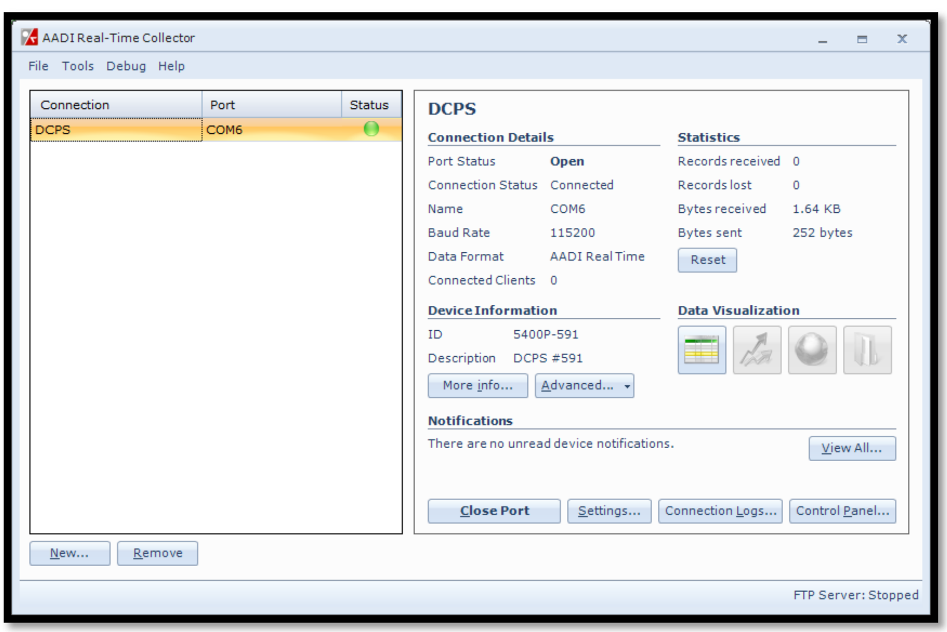
A new window with a turning wheele will then show up waiting for contact. This might take a couple of seconds depending on the sensor configuration.

Figure 4-6: Establishing contact



When connection is established the status light will turn green

Figure 4-7: Connection established



The selected connection has now changed to green status.

Press Control Panel in the right lower corner to continue.

Figure 4-8: AADI Real-Time Collector main menu

4.3 Control Panel

In the ***Control Panel*** window you will find three tabs***, Recorder Panel, Device Configuration*** and ***System Status.*** In ***Recorder Panel*** you can start and stop recordings if the sensor is set to AADI Real-Time mode. If the recorder is running first click on the ***Stop Recorder*** as you are not allowed to configure the sensor when recording. In ***Device Configuration*** you will be able to perform all configurations of the ***DCPS***. ***System Status*** gives information about

4.4 Recorder Panel

In the recorder panel you will be able to start and stop the recorder as long as the sensor is set to AADI Real-Time mode. If the sensor is set to another mode the sensor will not be controlled by the ***Recorder Panel*** and therefore all setting will be grey and not selectable. In AiCaP mode you need an Aanderaa logger to control the sensor. In all other mode the sensor will either start at power up in non-polled mode or when a ***do sample*** message is sent to the sensor in polled mode.

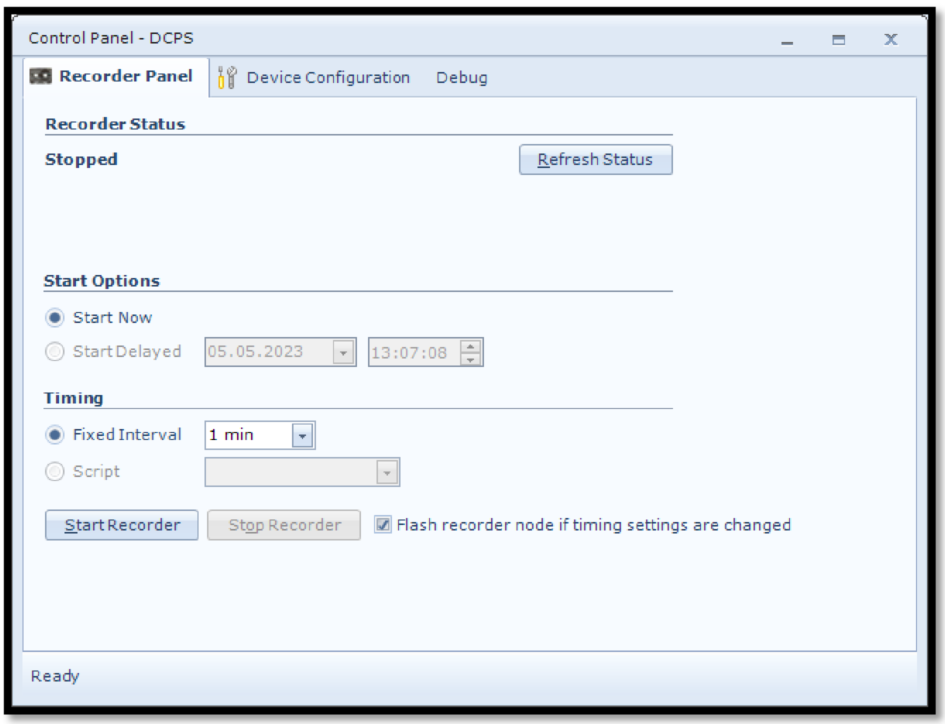


Figure 4-9: Control Panel for the DCPS

Select ***Recorder Panel.***

This is only applicable if sensor is in AADI Real-Time mode. For all other modes the alternatives will be grey.

Click on the ***Stop Recorder*** button if the sensor is running as you are not allowed to configure the sensor when recording.

Under ***Start Option*** the only selectable choice is ***Start Now***.

Under ***Timing*** the only selectable choice is ***Fixed Interval*** where you might set the recording interval. This setting is also available in the ***Deployment Setting*** menu as ***interval(s)***, refer ***chapter 4.7.***

4.5 Changing Values

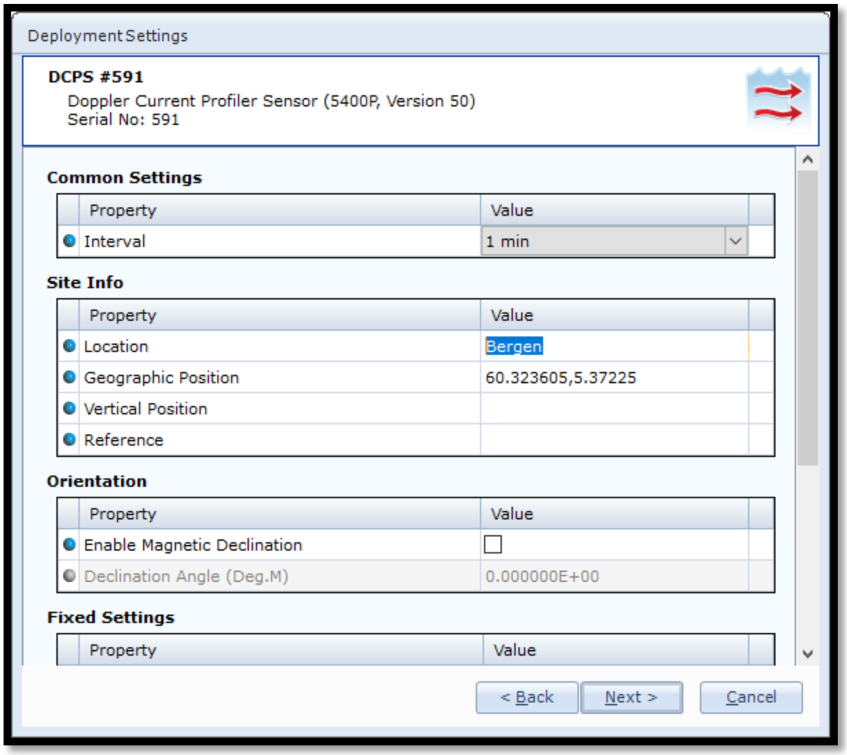


Figure 4-10: Change value

In the following chapters we will learn more about the DCPS configuration. Sometimes you will need to change the value of a property.

First select the tab where the property is located. In this example: ***Device Configuration***.

Then press ***Get Current Configuration*** and ***Edit,*** located under ***Deployment Setting.***

Select by double clicking on the ***DCPS Sensor*** icon.

Then select the property you want to change by clicking in the value box.

To change values enter the text or number in the value box and press ***Next.***

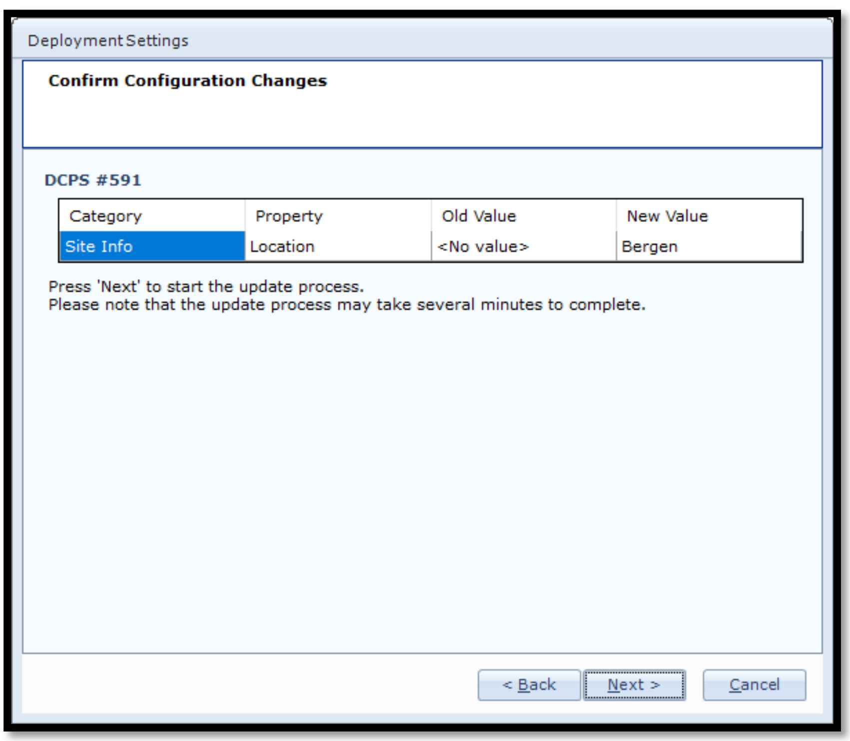
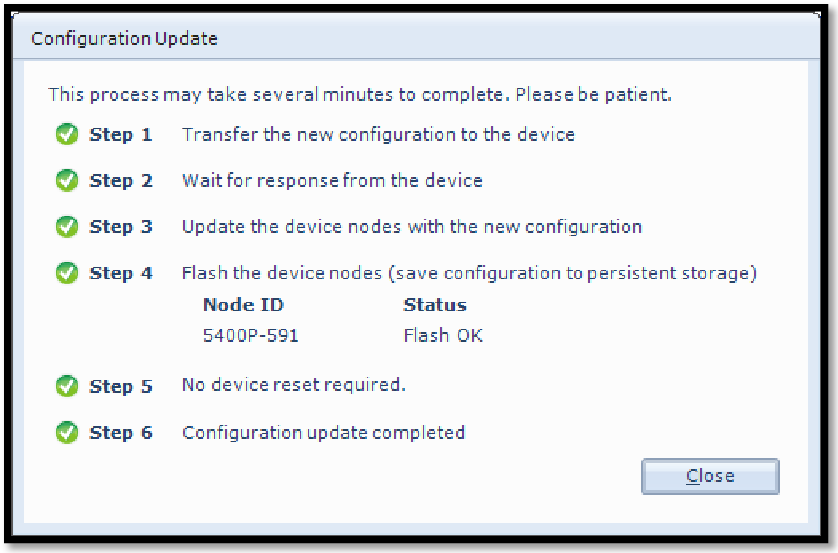


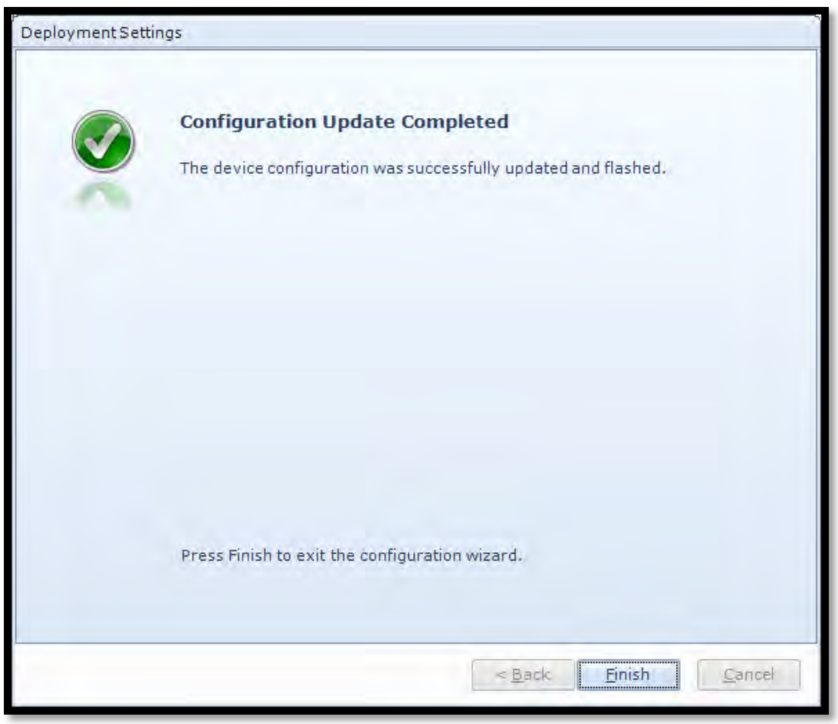
Figure 4-11 Confirm Configuration Changes

In the next window called ***Confirm Configuration Changes*** you will find a list of all changed properties with old and new values.
If the list of configuration changes is correct press ***Next*** to start the update process.



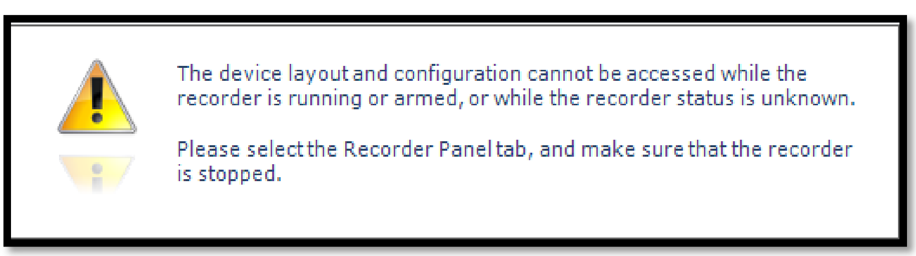
An automatic process will start with 6 steps transferring and storing the new information/setting in the sensor Flash. If necessary a reset will be executed. Do not switch off before the entire process is completed.

Figure 4-12 Configuration Update



When the updating process is finished a confirmation will show up. Press ***Finish*** to continue.

Figure 4-13 Configuration Update Completed



When you click ***Finish*** the following warning may show up. Then you need to open the ***Recorder Panel*** and select ***Stop Recorder*** and/or press the ***Refresh Status*** button.

Figure 4-14: Warning after changing values

4.6 Device Configuration

Click on the ***Device Configuration*** tab in the top row of the ***Control Panel*** to access the sensor property configuration.

Click on ***Get Current Configuration...***to receive the current configuration from the sensor. Check ***Include User Maintenance*** to view user maintenance settings. This group is password protected. ***The password is 1000***.

Figure 4-15: Device Configuration

The ***Device Configuration*** is separated into five sections:

- ***Deployment Settings***
- ***System Configuration***
- ***User Maintenance***
- ***System overview***
- ***Save configuration to file***

User accessible sensor properties that are used to configure the sensor are found in the first three sections. ***Deployment Settings*** are described in ***chapter 4.7***, ***System Configuration*** in ***chapter 4.9***, ***User Maintenance*** in ***chapter 4.11***. ***System overview*** in ***chapter 4.12*** and ***Save configuration to file*** in ***chapter*** *Error! Reference source not found.*.

4.7 Deployment Settings

Select the ***Deployment Settings*** by pressing the ***"Edit…"*** button ***under Deployment Settings,*** see ***Figure 4-15.***

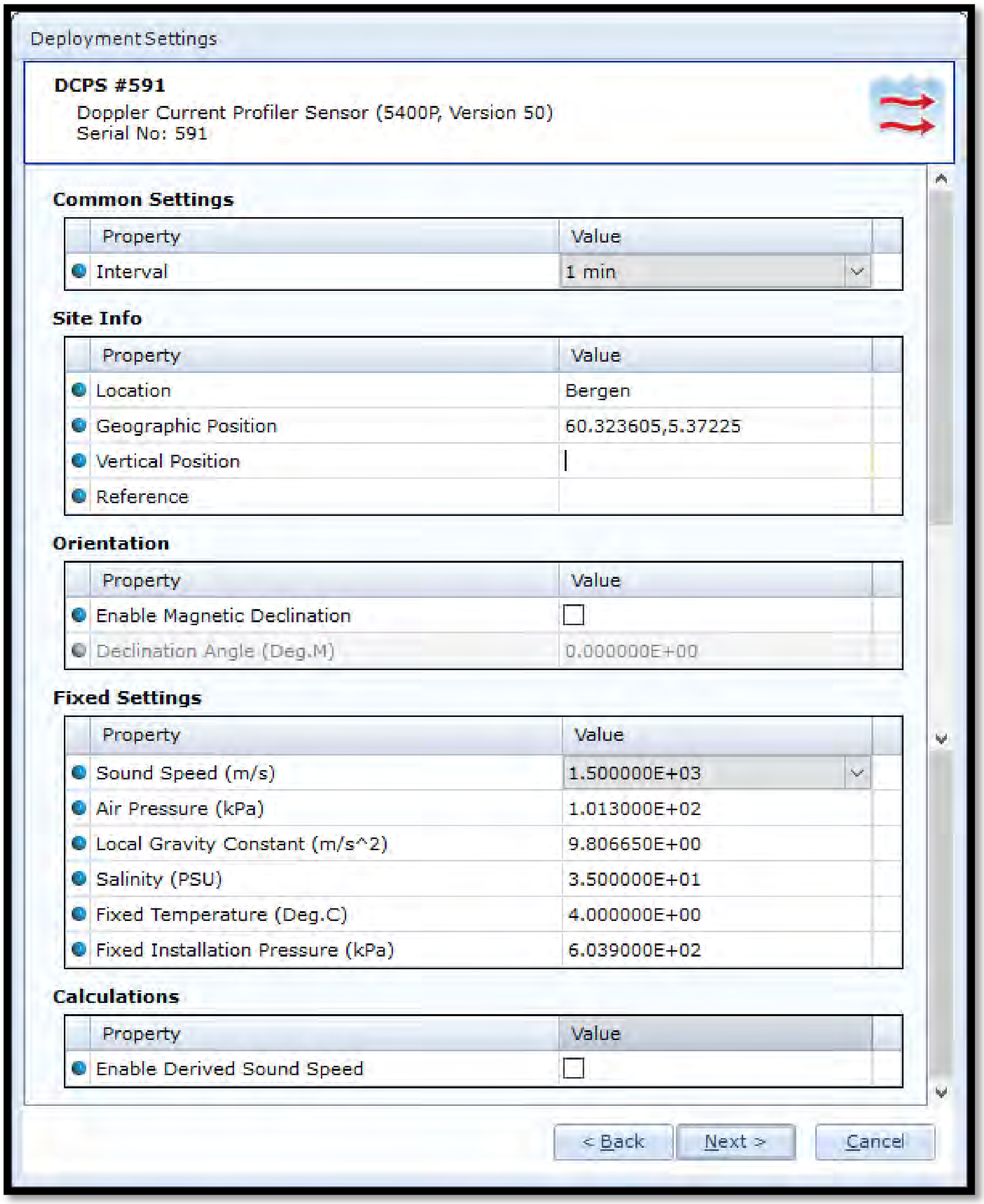


Figure 4-16: Deployment Settings

This menu holds five different sections,

- ***Common Settings***
- ***Site Info***
- ***Orientation***
- ***Fixed Settings***
- ***Calculations***

For detail on each property refer to ***chapter 4.7.1*** through ***4.7.5.***

4.7.1 Common settings

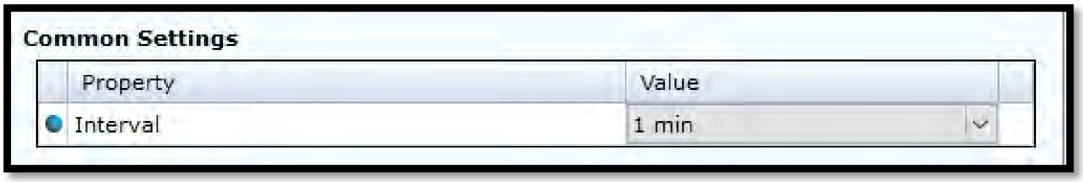


Figure 4-17: Common Settings in Deployment Settings

Interval is used to control the sensors recording interval, the number of seconds or minutes between each output. Please note that this setting will act different depending on mode.

The interval may also be set from ***Recorder Panel*** if sensor is set to ***AADI Real-Time*** mode. The last entered value will be the valid one if properly is stored to flash.

4.7.2 Site Info

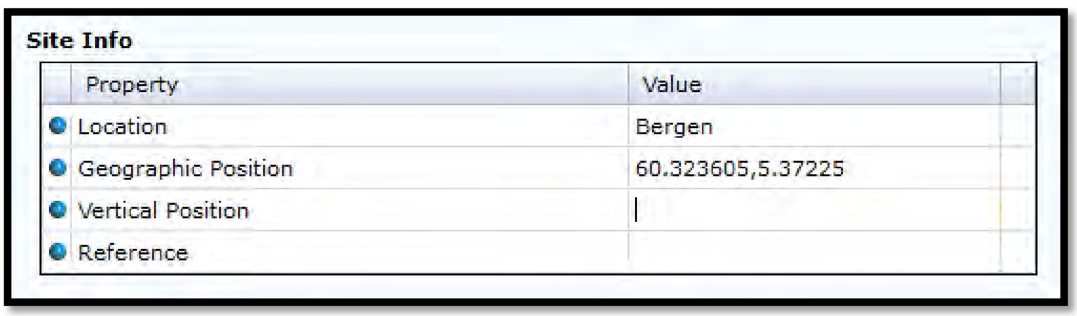


Figure 4-18: Site Info

Site Info containing four properties:

- ***Location:*** Name of location where the instrument is deployed.
- ***Geographic Position:*** GPS potion for deployment format Latitude, Longitude.
- ***Vertical Position:*** Position in water column, e.g. 5 meter depth.
- ***Reference:*** Free text for additional information.

All these settings are optional information where you may enter and store information about the deployment. These setting are not used in calculation. ***Geographical Position*** can be used to give the map coordinates either under the Data Visualization using AADI Real-Time collector and sensor in AADI Real-Time mode or it can be used in a display software to display position of sensor.

4.7.3 Orientation

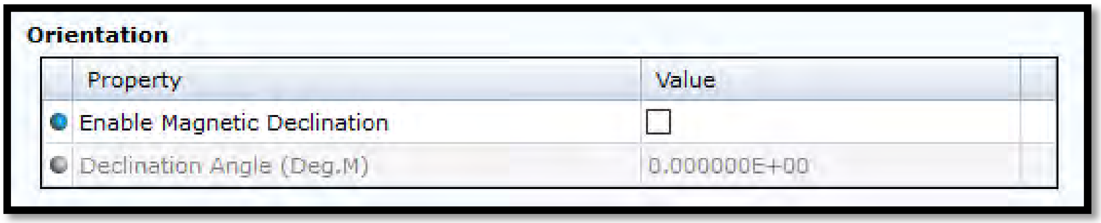


Figure 4-19: Orientation

Enable Magnetic Declination is normally used when sensor is used close to South Pole or North Pole.

Declination Angle (Deg.M) is a value to correct for the magnetic variation on the site where the sensor is used. This is the angle in degrees between magnetic north and true north. Magnetic declination (variation) is the angle between the magnetic north and the true north. This angle varies depending on the position on the Earth's surface and varies over time. Declination is positive when magnetic north is east of true north and negative when it is to the west (input angle value ±180°). Magnetic declination at the deployment location can be found for i.e. on NOAA website: http://www.ngdc.noaa.gov/geomag-web/

4.7.4 Fixed Settings

Fixed Settings

Property	Value
Sound Speed (m/s)	1.500000E+03
Air Pressure (kPa)	1.013000E+02
Local Gravity Constant (m/s^2)	9.806650E+00
Salinity (PSU)	3.500000E+01
Fixed Temperature (Deg.C)	4.000000E+00
Fixed Installation Pressure (kPa)	6.039000E+02

Figure 4-20: Fixed Settings

Fixed Settings as shown in ***Figure 4-20*** are settings used in internal calculation.

Sound Speed (m/s**)** is the fixed sound speed setting in m/s. This value is used for cell positioning in the profile and for calculation of current speed values. Variable sound speed values can be used while sensor is running. Default value for sea water is 1500.

Air Pressure (kPa**)** is the barometric pressure in kPa used to compensate for air pressure. The default value is 101.3.

Local Gravity Constant (m/s^2) is the local gravity constant in m/s^2. The default value is 9.81m/s^2.

Salinity (PSU**)** is the Salinity in PSU used for calculation of density, sound speed and depth. The value can be altered while sensor is running to compensate for variable salinity.

Fixed Temperature (Deg.C**)** is the temperature in degree centigrade. The value is used for calculation of Salinity, Sound speed and Density. The value can be altered while sensor is running to compensate for variable temperature.

Fixed Installation Pressure (kPa) is the pressure in kPa at the deployment site. The value can be altered while sensor is running to compensate for variable pressure. NOTE! This value is used for calculation of depth and used to position cells referenced to surface if surface cell or surface referenced cell are selected.

4.7.5 Calculations

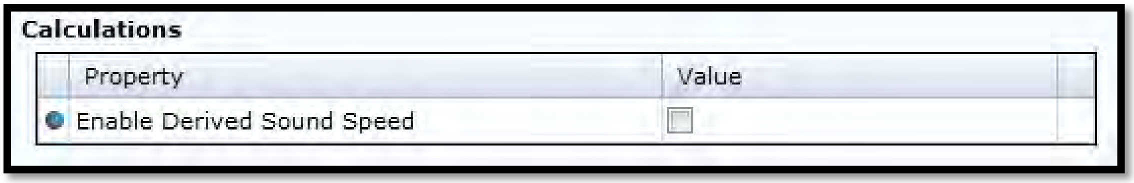


Figure 4-21: Calculations

Under ***Calculations*** you find only one Property.

Enable Derived Sound Speed. If enabled, it will calculate the sound speed from the other available sensors or fixed values. This overrides the Sound Speed setting. If a parameter is available from another sensor it will use this in the calculation, otherwise it will use the fixed value.

4.8 System Configuration

Select the ***Systen Configuration*** by pressing the ***"Edit…"*** button ***under System Configuration,*** see ***Figure 4-15***

System Configuration is separated in 13 groups. Some of the settings are only available if Acoustic Wave is enabled.

The settings in ***System Configuration*** are mainly used to configure the sensor and control the output of data.

Refer chapter **Error! Reference source not found.** for more information on the properties in ***System Configuration***.

For more information on each property see chapter ***3.14.6*** to ***3.14.19.***

Off/Output Settings are controlling the output from the sensor. Except from ***Record State, Cell Index, Cell State1, Cell State 2, Horizontal Speed(cm/s), Direction (Deg.M)*** and for 5400P also ***Raw Pressure*** that always will be presented all other parameters can either be set to ***Off*** or ***Output***.
Where ***Off*** means that the parameter is not calculated, ***Output*** means that the parameter is transmitted on the output lines.

All parameters are calculated based on data collected the last ***Interval.***

NOTE!! ***User Specified – Profile Parameters*** are only valid when ***Select Profile Parameter*** is set to ***User Specified***.

4.9 System Configuration part 1

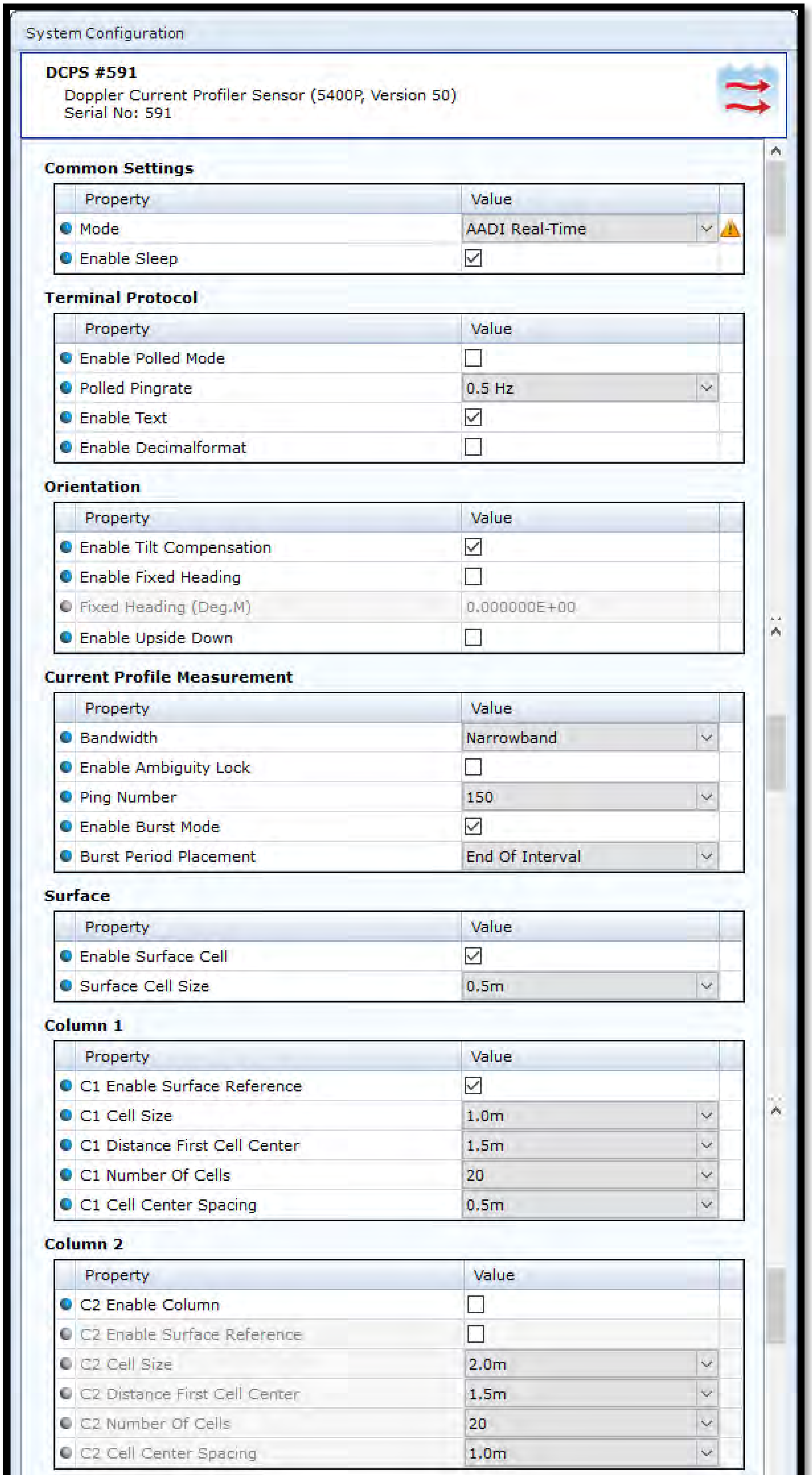


Figure 4-22: System Configuration part 1

System Configurations holds fourteen different sections that are mainly controlling the output from the sensor. The sections are:

Common Settings are used to set the ***mode*** and to save power by allowing the sensor to go to sleep between measurements.

Terminal Protocol contains settings for Polled/Non-polled mode and output controls for Smart Sensor Terminal mode.

Orientation contains settings for controlling the tilt and compass.

Current Profiler Measurement are used to control the ping settings.

Surface is used if you want to measure the surface current, this is based on high reflections from the thin layer between water and air. To use this feature you normally need a pressure sensor.

Column 1 is the first column of 3 and are always on.

Columns 2 are optional extra column if you want to measure bot surface and instrument referenced or columns with different resolutions.

4.10 System Configuration part 2

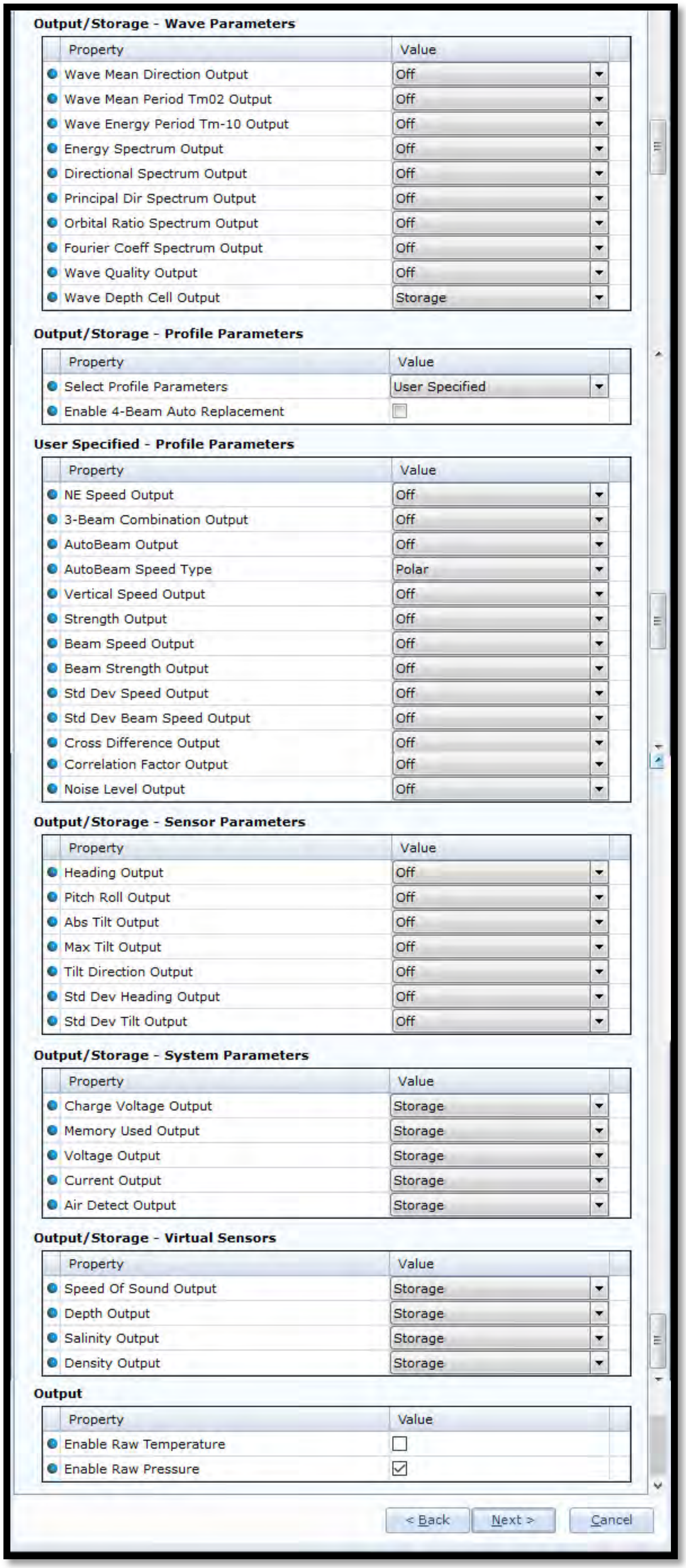


Figure 4-23: System Configuration part 2

Columns 3 are optional extra column if you want to measure bot surface and instrument referenced or columns with different resolutions.

Output – Profile Parameters are used to control the output from some of the other groups.
See ***Table 3-1*** for more information.

User Specified – Profile Parameters are only used if Select Profile Parameters above are set to User Specified.

Output – Sensor Parameters are used to control output from some of the sensors like tilt and Compass. Temperature and Pressure are also selectable if these are ordered with the sensors.

Output – System Parameters are parameters that give information about the electronics such as voltage and current consumption.

Output – Virtual Sensors are parameters that either will be calculate using the fixed values from Deployment Setting menu or from the additional sensor connected to the same logger as the DCPS.

For configuration details, refer to ***chapter 4.10.1*** through *Error! Reference source not found.*.

4.10.1 Common settings

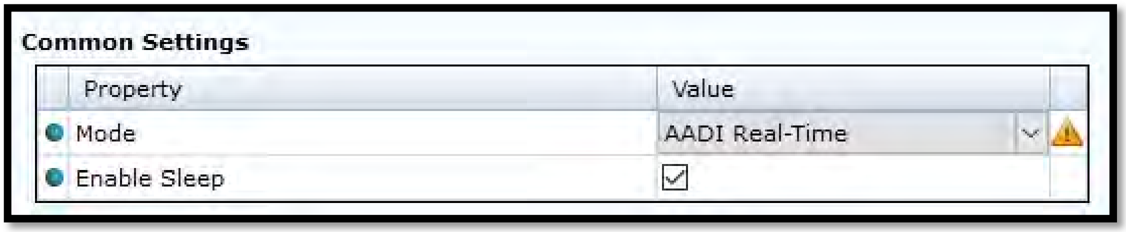


Figure 4-24: Common Settings in System Configuration

Mode: The communication protocol needs to be defined under "***Mode*".** There are three different choices:

- ***AADI Real-Time*** is the correct mode (protocol) when used together with Real-Time Collector. This is an xml based protocol which includes more metadata in the data messages.

- The ***Smart Sensor Terminal*** protocol is a simplified ASCII protocol which is easier to use together with a PC terminal program. This protocol is described more detailed in CHAPTER 9 . It is possible to configure the sensor even if it is set to AiCaP or Smart Sensor Terminal mode when it is connected via RS-232 to the PC, but it is not possible to run and log data with Real-Time Collector unless the sensor is set to AADI Real-Time. Notice that the sensor always must be reset when the protocol/mode has been changed.

- If the sensor is going to be used with an Aanderaa logger such as SmartGuard, the mode must be changed to ***AiCaP*** mode first and saved before connecting it to the logger.

Enable Sleep: This setting gives lower power consumption in AADI Real-Time and Smart Sensor Terminal mode when the sensor is able to go to sleep between measurements. In AiCaP mode this is controlled by the logger.

4.10.2 Terminal Protocol settings

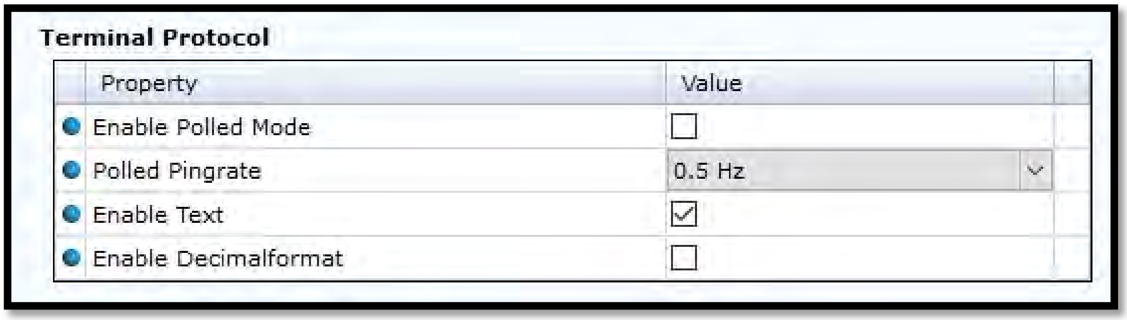


Figure 4-25: Terminal Protocol settings in System Configuration

The ***Terminal Protocol*** settings are only used if the sensor is set to Smart Sensor Terminal protocol. See CHAPTER 6 for more details.

This protocol opens for an ***Enable Polled Mode*** where the sensor outputs data when the user/system polls for data (***Do Sample ()*** command). The calculation will start when sensor has performed number of pings set in ***Ping Number***. ***Do Sample*** will trigger a calculation using all ping since last ***Do Sample***. A ***Do Sample*** command will reset the ***Ping Count*** and start over again. ***Ping Count*** will show how many pings used in each calculation.

Enable Text control the output string in Smart Sensor Terminal. When enabled the sensor will output a string with parameter name together with each reading, refer Figure 6-5 for an example where this command is toggled.

Enable Decimalformat toggle between decimal format like 0.10 and Engineering format like 1.000E-01.

4.10.3 Processing Dependencies

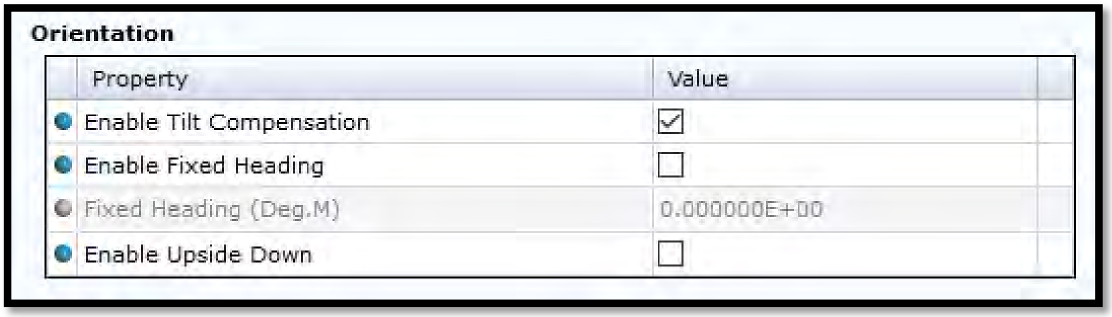


Figure 4-26: Orientation in System Configuration

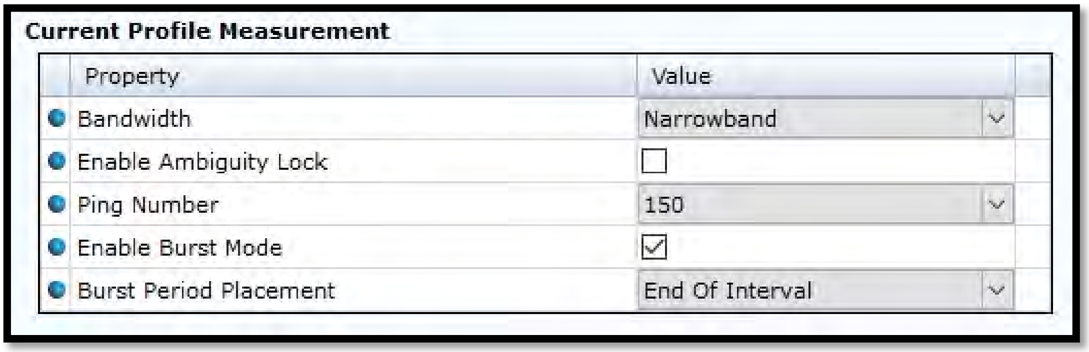
Enable Tilt Compensation is recommended to set active at all times because then the sensor will automatically compensate for any tilt.

Enable Fixed Heading might be used if there is any magnetic disturbance that might interfere with a compass heading and the instrument has a fix position.

Fixed Heading (Deg.M) can be used to set the offset between the Sensor North direction and the Magnetic North.

Enable Upside Down orientation setting should always be set the same way as the intended use; if the sensor is intended to be deployed upward looking, do not tick the "***Enable Upside Down***". If the sensor is intended to be deployed downward looking, tick the "***Enable Upside Down***". However, the sensor will work even if the orientation setting is defined as the opposite of the used direction; it is able to sense the orientation itself and corrects the calculated current directions, heading etc. accordingly. ***NB! The surface cell and surface reference of columns does not work if the sensor is orientated upside down while running (forced to be sensor referenced instead).*** A status flag in the record status output parameter is also set to indicate that the sensor has been used in the opposite direction to the configured direction.

4.10.4 Current Profile Measurement


Current Profile Measurement

Property	Value
Bandwidth	Narrowband
Enable Ambiguity Lock	☐
Ping Number	150
Enable Burst Mode	☑
Burst Period Placement	End Of Interval

Figure 4-27: Current Profile Measurement in System Configuration

The sensor can select between two ***Bandwidths***, either ***Narrowband*** or ***Broadband*** to find the Doppler shift (and calculate the current parameters); see the DCPS Primer TD 310 for more details.

Each of the two methods have their own advantages:

- ***Broadband*** gives a lower single ping standard deviation which requires fewer ping (lower energy usage) to get a good measurement result. The disadvantage in ***Broadband*** is ambiguity. If the sensor is fixed, for example when deployed in a bottom frame, the ambiguity is not a problem (ambiguity lock disabled). If it is moving and the user knows that the current speeds are always below 1 m/s, enable the ambiguity lock.

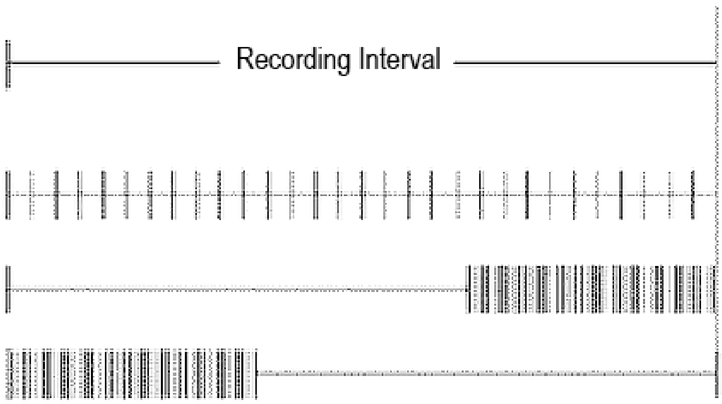
- ***Narrowband*** is recommended to use If the sensor is moving (as under a buoy for example) and if the current speeds are higher than 1m/s. Though ***Narrowband*** is more power consuming than ***Broadband***, the reached measuring range is slightly longer than in ***Broadband*** mode.

Enable Ambiguity Lock is only used with ***Broadband***. In ***Broadband*** the output of the correlation process is a phase value. When the Doppler shift is zero then the phase is also zero. When the Doppler shifts increase, so will the phase. A Doppler shift of approximately 1.25 m/s along the beam corresponds to a phase equal to 360 (360 = 0) which is the same as for zero Doppler shift. For this reason the cross correlation process is not able to distinguish a Doppler shift of 1.5 from a Doppler shift of zero. In fact any Doppler shift outside the 1.25m/s range will be wrongly detected to be within the range 0 – 1.25 m/s. This is called ambiguity and could hamper the correct operation of the instrument if not corrected for. If ambiguity lock is enabled the result will stay in the first loop also between 0 and 1.25 m/s so if you know the current will be below 1.25 m/s you can use ***Ambiguity Lock*** and avoid any error caused by ambiguity,
In case the ambiguity lock is not selected, several stages of ambiguity solving methods are automatically implemented in the DCPS to achieve a non-ambiguous solution.

Ping Number is the number of pings transmitted during one recording interval. One ping is a transmitted pulse from all transducers. These four pulses are sent out simultaneously in four directions.

Enable Burst Mode. The sensor can run in burst mode or spread mode. When burst mode is enabled the sensor performs all ping measurements at the beginning or end of the recording interval, dependent on the Burst Period Placement setting.

Burst Period Placement can be set to either ***Start Of Interval*** or ***End Of Interval***. If it is disabled the ping measurements are evenly spread out during the recording interval. The instrument activates sleep mode between each measurement, which reduces the power consumption. Power consumption in spread and burst mode is about the same. Refer **Figure 3-38.**



Spread Mode

Burst Mode – End Of Interval

Burst Mode – Start Of Interval

Figure 4-28: Spread mode and burst mode ping distribution during the recording interval

4.10.5 Surface

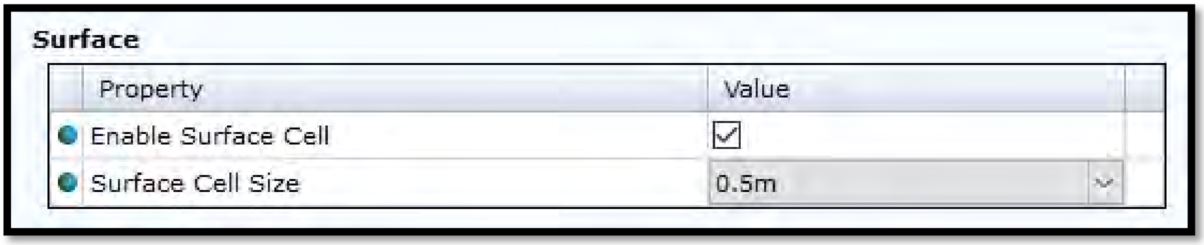


Figure 4-29: Surface in System Configuration

Enable Surface Cell will set a cell in the surface layer. The data is set as not valid if the sensor is placed upside down with the surface cell enabled.

Surface Cell Size or the measurement “window” is centered on the surface. At the surface, the impedance difference between the water and air creates an almost perfect reflector, and the acoustic signal is reflected by the surface. Regardless of the cell size used to process the surface cell, this cell will be dominated by the infinitesimal thin layer between water and air. Although the surface cell is infinitesimal small, the cell size used to process the data must be sufficiently large to capture the boundary between air/water defining the surface cell.
The surface cell will reflect the speed of the “boundary condition”. Wind will generate capillary waves, and rapidly accelerate the surface boundary. For this reason there will be a strong correlation between wind speed/surface boundary speed and wind direction / surface boundary direction.

NB! Do not use Surface Cell or Surface Reference together with Upside Down enabled, refer chapter 3.6.1.

The surface reference is ignored if the sensor is upside down while it is running (columns forced to be sensor referred).

If instrument is oriented **Upside Down** *the surface cell is ignored and the data is set as non-valid.*

4.10.6 Column 1

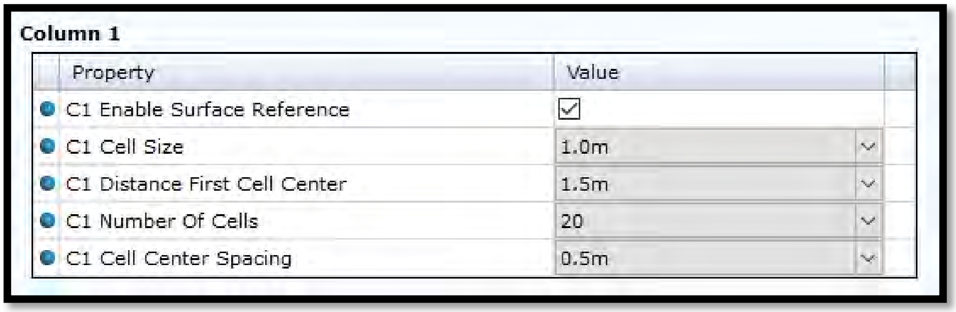


Figure 4-30: Column 1

Only version 5400P has a depth measurement itself. Be aware that you must set correct fixed settings under Deployment settings if you want to use the Surface Cell or Surface Reference of columns without a pressure sensor.

NOTE: this functionality is especially interesting when the deployment location shows some sea level variations as the tide. In this case the column will follow the surface variation but this is dependent on the input of pressure value. If you are using a surface referred column with fixed settings, the results will not reflect the water level changes.

Column 1 is always active (not possible to disable). Column 1 can have up to 75 cells. Column 2 can have up to 50 cells and Column 3 can have up to 25 cells (150 cells all together). Columns 2 and 3 must be enabled to be used.

C1 Enable Surface Reference: If set the cells will be referenced to the surface. The surface placement is measured by a pressure sensor prior to start of each recording interval. If not enabled the cells will be referenced to the transducers and located at certain distance from the transducer head.

C1 Cell Size: Whether the instrument is configured in broadband or narrowband, the user needs to configure the cell size (from 0.5 to 5m). The cell could be defined as the volume of water in which the instrument is performing the measurement. By defining the cell size, the number of cells, the cell center spacing and knowing the speed of sound, the instrument determines the time frame when the reflected signal from the corresponding cell will be received.

C1 Distance First Cell Center: available range 1.5 to 70 meter. This will depend on the ***C1 Enable Surface Reference*** setting. If surface referenced it will be the distance from surface to center of first cell. The minimum recommended distance will be the illegible zone, area not measured because of disturbance from side lobes, plus half the cell size. As a thumb of rules the illegible zone where signal is disturbed by side lobes is 10% of the deployment depth due to shorter distance to surface for the side lobs pointing upwards compared to the main lobs and the high reflection from the surface layer. The minimum distance to first cell center should therefore be 10% of deployment depth plus half the cell size. If instrument referenced the minimum distance to first cell should be 1 meter blanking zone for 5400 and 2 meter for 5402 and 5403, plus half the cell size.
This blanking zone is due to the fact that the instrument using the same transducers for transmitting the signal as used for receiving. For more information see Chapter 5 of TD 310 DCPS Theoretical Primer.

C1 Number OF Cells: Available from 1 to 75 cells. The instrument can measure multiple cells along the column from instrument to the maximum range given by the scatter condition, or from surface and down to the instrument dependent on the configuration.

C1 Cell Center Spacing is used to either obtain overlap between cells or spacing. If ***Cell Center Spacing*** is set to smaller than cell size the two following cells will overlap each other. This gives you higher resolution for the post processed data and makes it easier to locate special incidents like thermocline layers etc. If spacing is equal to cell size then two following cells will be adjacent to each other. If spacing is greater than cell size then there will be space between two following cells. This is useful if you want to measure only at certain depths for example 5, 15 and 25 meter from surface. To obtain this then set ***Enable Surface Reference*** enable, ***Cell Size*** 2 meter, ***Distance First Cell Center*** 5 meter, ***Number Of Cell*** 3 and ***Cell Center Spacing*** 10 meter.

4.10.7 Column 2

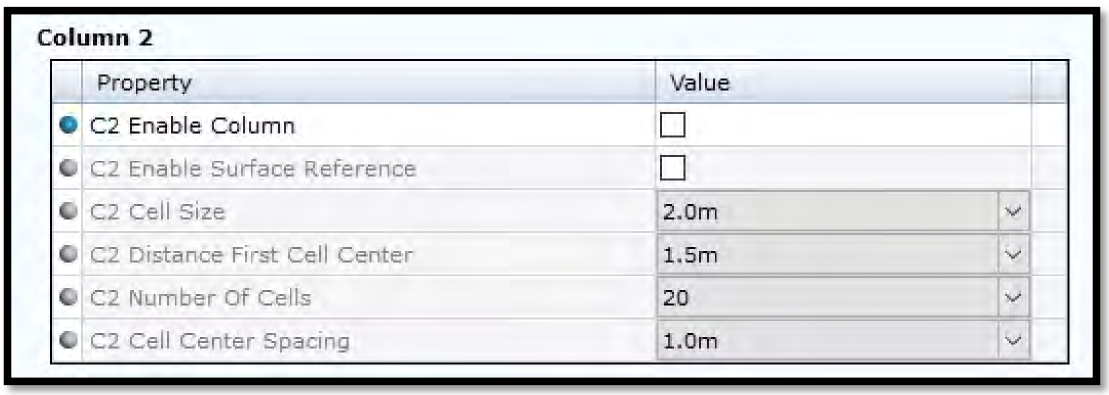


Figure 4-31: Column 2

C2 Enable Column: If you want more columns. The columns can be different, mix of both reference and configuration. Typical combination is one column covering the whole water column, one surface referenced with high resolution near surface and one instrument reference near bottom.

C2 Enable Surface Reference: Same as for C1 see ***chapter 4.10.6.***

C2 Cell Size: Same as for C1 see ***chapter 4.10.6.***

C2 Distance First Cell Center: Same as for C1 see ***chapter 4.10.6*.**
C2 Number OF Cells: Available from 1 to 50 cells. The instrument can measure multiple cells along the column from instrument to the maximum range given by the scatter condition, or from surface and down to the instrument dependent on the configuration.

C2 Cell Center Spacing: Same as for C1 see ***chapter 4.10.6.***

4.10.8 Column 3

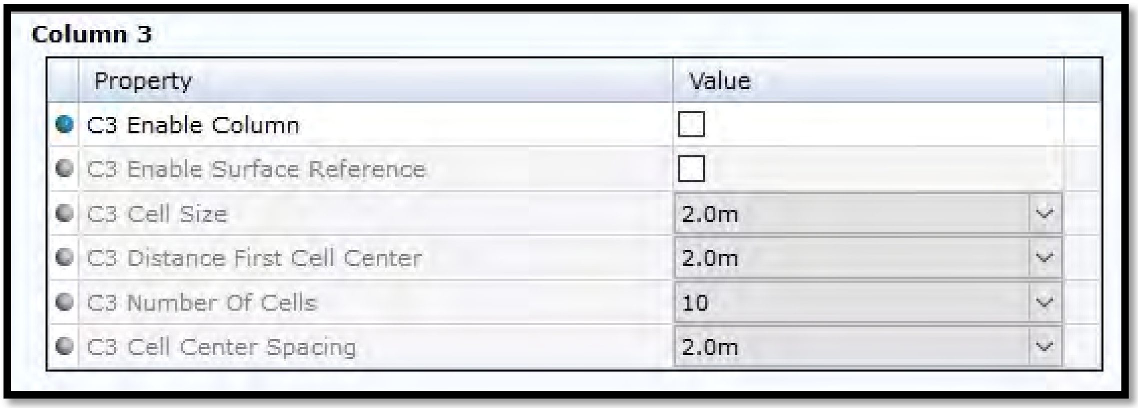


Figure 4-32: Column 3 in System Configuration

C3 Enable Column: Same as for C2 see ***chapter 4.10.7.***

C3 Enable Surface Reference: Same as for C1 see ***chapter 4.10.6.***

C3 Cell Size: Same as for C1 see ***chapter 4.10.6.***

C3 Distance First Cell Center: Same as for C1 see ***chapter 4.10.6.***

C3 Number OF Cells: Available from 1 to 25 cells. The instrument can measure multiple cells along the column from instrument to the maximum range given by the scatter condition, or from surface and down to the instrument dependent on the configuration.

C3 Cell Center Spacing: Same as for C1 see ***chapter 4.10.6.***

4.10.9 Output – Profile Parameters

Figure 4-33: Output - Profile Parameters in System Configuration

While configuring the sensor, it is possible to define which parameters should be calculated and sent from the sensor.

Select Profile Parameters gives the user the choice to either select one of the predefined groups of ***Profile Parameter*** or you might select your own selection in ***User Specified – Profile Parameters*** refer chapter ***3.6.11***, by selecting ***User Specified***. The sensor always outputs the ***Cell State1 and Cell Stat 2***, ***Horizontal Speed*** and ***Direction*** for all the cells (not possible to disable). Available settings for ***Select Profile Parameters*** are:

• ***Simple Output***

• ***Basic Output***

• ***Basic + Beam Output***

• ***Basic + 3-Beam Output***

• ***Basic + Beam + 3-Beam Output***

• ***Full Output***

• ***User Specified***

Refer ***Table 3-1*** for parameters included in each group.

Refer to ***Table 1-7*** for definition of the parameters.

NOTE: Enabling more data also means larger data messages and more time to transfer data.

Enable 4-Beam Auto Replacement. If selected all 4-beam parameters will automatically be replaced with the best 3-beam solution if a disturbance is detected in one of the beam.

Table 4-1: : Profile Parameter sdditional parameters for each group

Profile parameter	Parameter name	Simple Output	Basic Output	Basic + Beam Output	Basic + 3-Beam Output	Basic + Beam + 3-Beam Output	Full Output
	Cell State 1	x	x	x	x	x	x
	Cell State 2	x	x	x	x	x	x
	Horizontal Speed	x	x	x	x	x	x
	Direction	x	x	x	x	x	x
NE Speed Output	North Speed		x	x	x	x	x
	East Speed		x	x	x	x	x
Vertical Speed Output	Vertical Speed		x	x	x	x	x
Std Dev Speed Output	SP Stdev Horizontal		x	x	x	x	x
Strength Output	Strength		x	x	x	x	x
Cross Difference Output	Cross Difference		x	x	x	x	x
Beam Speed Output	Beam1 Speed			x		x	x
	Beam2 Speed			x		x	x
	Beam3 Speed			x		x	x
	Beam4 Speed			x		x	x
Beam Strength Output	Beam1 Strength			x		x	x
	Beam2 Strength			x		x	x
	Beam3 Strength			x		x	x
	Beam4 Strength			x		x	x
Std Dev Beam Speed Output	Beam1 Stdev			x		x	x
	Beam2 Stdev			x		x	x
	Beam3 Stdev			x		x	x
	Beam4 Stdev			x		x	x
Correlation Factor Output	Beam1 Correlation Factor			x		x	x
	Beam2 Correlation Factor			x		x	x
	Beam3 Correlation Factor			x		x	x
	Beam4 Correlation Factor			x		x	x

Profile parameter	Parameter name	Simple Output	Basic Output	Basic + Beam Output	Basic + 3-Beam Output	Basic + Beam + 3-Beam Output	Full Output
3-Beam Combination Output	SP Stdev Beam123				x	x	x
	SP Stdev Beam124				x	x	x
	SP Stdev Beam134				x	x	x
	SP Stdev Beam234				x	x	x
	North Beam123				x	x	x
	North Beam124				x	x	x
	North Beam134				x	x	x
	North Beam234				x	x	x
	East Beam123				x	x	x
	East Beam124				x	x	x
	East Beam134				x	x	x
	East Beam234				x	x	x
3-Beam Combination Output (continue)	Vertical Beam123				x	x	x
	Vertical Beam124				x	x	x
	Vertical Beam134				x	x	x
	Vertical Beam234				x	x	x
AutoBeam Output	SP Stdev AutoBeam						x
	Horizontal Speed AutoBeam						x
	Direction AutoBeam						x
	North AutoBeam						x
	East AutoBeam						x
	Vertical AutoBeam						x
	Point Parameters						
Noise Level Output	Noise Peak Level B1						x
	Noise Peak Level B2						x
	Noise Peak Level B3						x
	Noise Peak Level B4						x
	Noise Average Level B1						x
	Noise Average Level B2						x
	Noise Average Level B3						x
	Noise Average Level B4						x

4.10.10 User Specified – Profile Parameters

User Specified - Profile Parameters

Property	Value
NE Speed Output	Off
3-Beam Combination Output	Output
AutoBeam Output	Output
AutoBeam Speed Type	Rectangular
Vertical Speed Output	Output
Strength Output	Output
Beam Speed Output	Output
Beam Strength Output	Output
Std Dev Speed Output	Output
Std Dev Beam Speed Output	Output
Cross Difference Output	Output
Correlation Factor Output	Output
Noise Level Output	Output

Figure 4-34: User Specified - Profile Parameters

User Specified Profile Parameters settings are setting that only are in use if ***User Specified*** is selected under ***Select Profile Parameters.*** For all other settings the group content displayed in ***Table 3-1*** will overrule the selection and all are stored.

The alternatives are ***Off*** or ***Output.***

NE Speed Output outputs the calculated values for ***North Speed*** and ***East Speed*** where speed in north and east direction gives a positive value and speed in South and West direction gives a negative value.

3-Beam Combination Output outputs the four 3-Beam solutions, Beam 123, Beam 134, Beam 124 and Beam 234 for each of the four parameters, ***SP Stdev Beam*** (Single Ping Standard Deviation Beam), ***North Beam, East Beam*** and ***Vertical Beam***. This information is useful if there are an obstruction in one of the beams but also important as quality control to decide that there are now disturbance in one or more beams.

AutoBeam Output outputs ***SP Stdev AutoBeam*** (Single Ping Standard Deviation AutoBeam), ***Horizontal Speed, Direction, North, East*** and ***Vertical Speed*** which for each parameter is the automatically selected best combination of either one of the 3-beam solutions or the 4-beam solution. If all five solutions is identical or close to identical the sensor will always select the 4-beam solutions because this has more pings and therefore better standard deviation.

AutoBeam Speed Type. If ***AutoBeam Output*** is selected then ***AutoBeam Speed Type*** will set the output type for these parameters. Alternative type is ***Rectangular, Polar*** or ***Rectangular + Polar***.

Vertical Speed Output outputs the measured ***Vertical Speed*** based on the four beams. Alternatively 3 beams if ***Enable 4-Beam Auto Replacement*** is selected.

Strength Output outputs an average of signal strength from the four transducers. Alternatively 3 transducers if ***Enable 4-Beam Auto Replacement*** is selected

Beam Speed Output outputs the individual speed measurements from each of the four beams

Beam Strength Output outputs the individual signal strength from each of the four beams.

Std Dev Speed Output outputs a calculated ***SP Stdev Horizontal*** (Single Ping Standard Deviation Horizontal Speed) based on measurements from the four beams. Alternatively three beams if ***Enable 4-Beam Auto Replacement*** is selected.

Std Dev Beam Speed Output outputs individual standard deviation for each beam.

Cross Difference Output outputs the Cross Difference which is the difference in Doppler shift from transducers on the same axis, for each depth the speed in beam 1 - speed beam 3 + speed beam 2 – speed beam 4 should be close to 0.

Correlation Factor Output outputs the correlation factor for each beam. The result should be close to 0.5. Only for use in Broadband mode.

Noise Level Output outputs the ***Noise Peak Level*** and ***Noise Average Level*** for each of the four transducers. The noise level is a measurement done before the ping measurement where the sensor is only listening to the signal received by the transducers. ***Noise Peak Level*** outputs the highest signal level detected and this gives a good indication on nearby noise sources in the water (other current meters, echo sounders etc.)

4.10.11 Output – Sensor Parameters

Output - Sensor Parameters

Property	Value
Heading Output	Off
Pitch Roll Output	Output
Abs Tilt Output	Output
Max Tilt Output	Output
Tilt Direction Output	Output
Std Dev Heading Output	Output
Std Dev Tilt Output	Output
Temperature Output	Output
Pressure Output	Output

Figure 4-35: Output - Sensor Paramters in System Configuration

In this section sensor parameters related to the compass/tilt measurement are enabled or disabled.
The alternatives are either ***Off*** or ***Output.***

A compass/tilt measurement is taken for each ping measurement (current speed measurement). One ping consists of one ping from each transducer. The given value is an average of all single measurements from the last measurement interval.

Heading Output is the angle in degrees between transducer 1 and magnetic north. Turning the sensor clockwise gives an increasing angle. When looking at the sensor from the label side, transducer 1 is the transducer back to the left (refer to ***chapter CHAPTER 10***). When looking at the sensor from the label side with the sensor upside down, transducer 1 is the transducer back to the right.
The tilt is converted to rotational angles, ***Pitch*** and ***Roll***. The rotational angles are used internally when calculating correct heading from the 3D magnetic field vector and correct current speed components from the acoustic beam vectors in each cell. ***Pitch*** and ***Roll*** output is an average from all measurements in the last measurement interval.
The ***Heading Output*** is the average compass reading referenced to north during one measurement interval.

Pitch Roll Outputs individually outputs ***Pitch*** and ***Roll*** as an average for one measurement interval.

Abs Tilt Output (Absolute tilt) is the tilt between the horizontal plane and the sensor's plane. When upside down, the Abs tilt is varying around 180 degree. This is different from the Aanderaa RDCP (previous profiler generation). The new profiler can sense if it is upside down or not, and the absolute tilt indicates the actual direction of the sensor when it is running.

Max Tilt Output (Maximum tilt is the maximum tilt in any direction measured by the sensor during one measurement interval.

Tilt Direction Output is the average of all tilt direction measurement during one measurement interval.

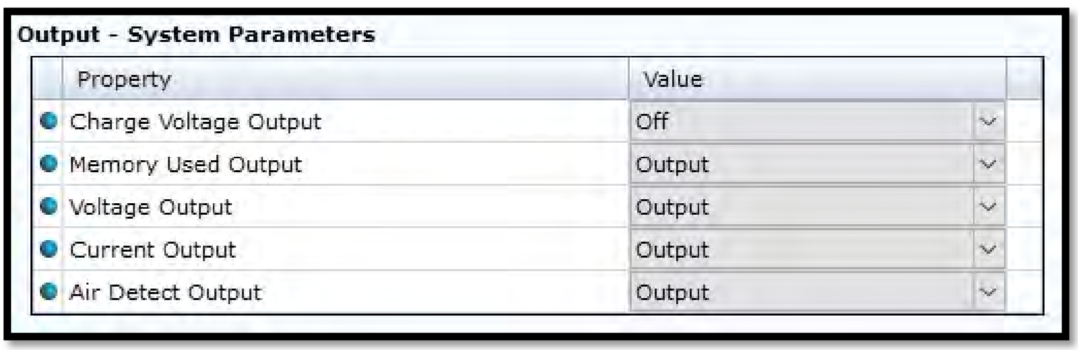
Std Dev Heading Output (Standard Deviation Heading Output). The sensor does one heading measurement for each ping. This is the standard deviation of all the heading measurements during a recording interval.

Std Dev Tilt Output (Standard Deviation Tilt Output). The sensor does one tilt measurement for each ping. This is the standard deviation of all the absolute tilt measurements during a recording interval.

Temperature Output. If a temperature sensor 4080 is installed and calibrated this will output the measured temperature

Pressure Output. Only for 5400P. This will output the measured pressure from the integrated pressure sensor.

4.10.12 Output – System Parameters


Output - System Parameters

Property	Value
Charge Voltage Output	Off
Memory Used Output	Output
Voltage Output	Output
Current Output	Output
Air Detect Output	Output

Figure 4-36: Output - System Parameters in System Configuration

The sensor can also output different system parameters like voltage, current draw while awake, and voltage to the acoustic transmitter circuits etc. that could be necessary during the QA&QC of data.

Charge Voltage Output is the charge voltage to the acoustic Tx circuits. Important information to see if there is something wrong with the charge electronics or the transducers. Used for troubleshooting.

Memory Used Output gives a number for the used heap memory. Used for troubleshooting.

Voltage Output gives the measured input voltage internally in the sensor. This is a way to see if the input supply voltage starts dropping and used to check power consumption. Value is dependent on type of battery or if external power is used.

Current Output is the measured input current to the sensor. This can indicate if something is wrong in the internal electronics if it suddenly starts to rise.

Air Detect Output is the value measured by the air detects circuit. This is a circuit which detects if the sensor is in air or water.

4.10.13 Output – Virtual Sensors

Output - Virtual Sensors

Property	Value
Speed Of Sound Output	Output
Depth Output	Output
Salinity Output	Output
Density Output	Output

Figure 4-37: Output - Virtual Sensors in System Configuration

The sensor can also calculate some virtual parameters. These are more interesting when the sensor is used on a Datalogger where the sensor can receive external sensor input via the Datalogger.

Speed Of Sound Output is the fixed Sound Of Speed setting or calculated from available inputs.

Depth Output is the calculated depth based on fixed settings or calculated from available inputs.

Salinity Output is the calculated salinity based on fixed settings or calculated from available inputs.

Density Output is the calculated density based on fixed settings or calculated from available inputs.

4.10.14 Output

Output

Property	Value
Enable Raw Temperature	☐
Enable Raw Pressure	☑

Figure 4-38: Output in System configuration

These properties are used to enable/disable raw data from optional internal Temperature or Pressure sensor if included.

Enable Raw Temperature is used to enable raw data from Temperature sensor.

Enable Raw Pressure is used to enable raw data from Pressure sensor.

4.11 User Maintenance settings without Acoustic Wave License Key

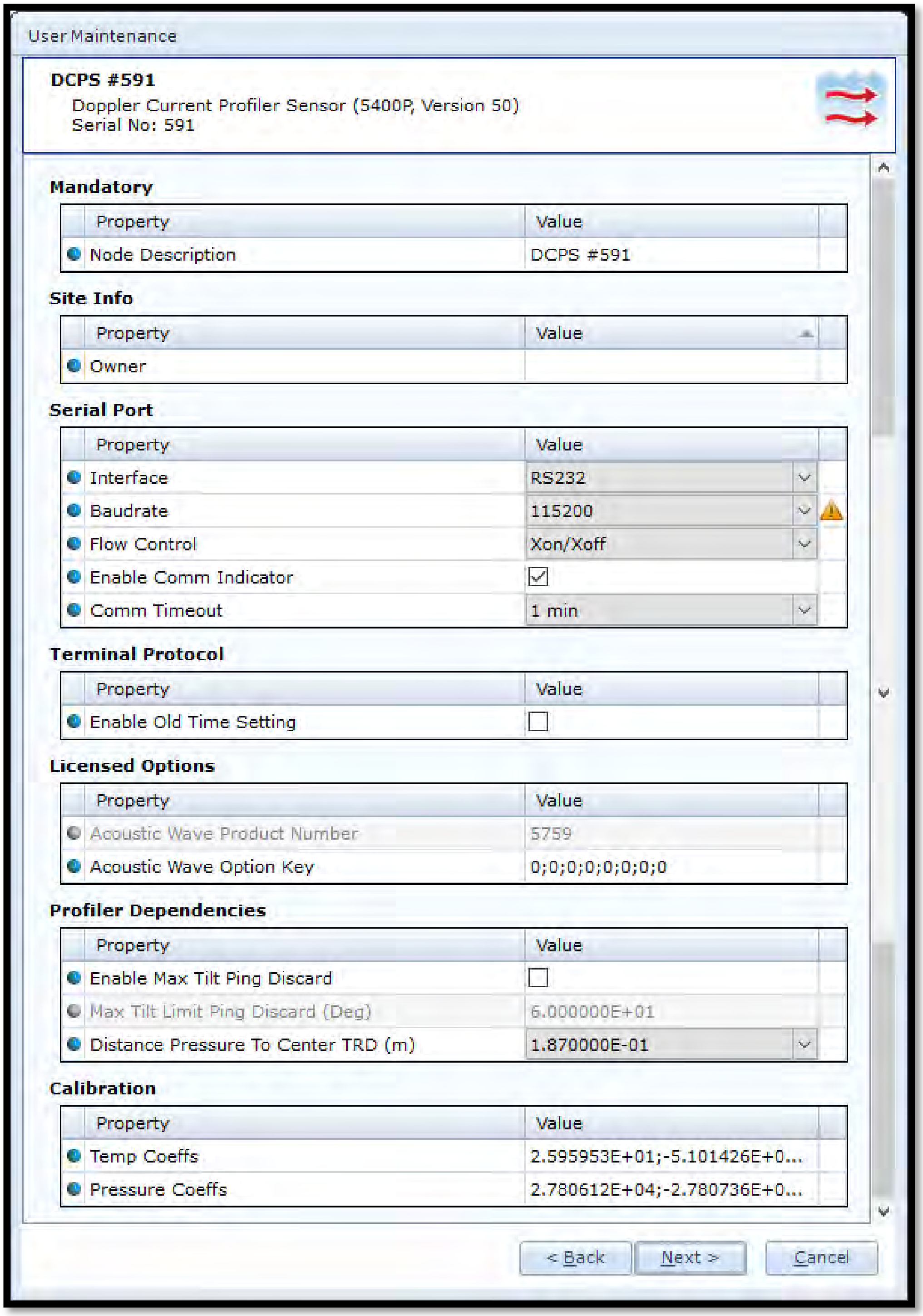


Figure 4-39: User maintenance without Acoustic Wave License Key

Under ***User Maintenance***, you find properties that are password protected and are set / altered by a trained user. It is not recommended to change properties unless instructed.

To access this menu, check the "***Include User Maintenance"*** box in the ***Device Configuration*** before clicking on the "***Get Current Configuration…***" button.

The password is: **1000**.

Then click on the ***Edit*** button under ***User Maintenance***

The calibration coefficients should not be altered unless a new calibration is performed.

For a full description of each property please refer to ***chapter 4.11.2*** through ***4.11.10.***

4.11.1 User Maintenance settings with Acoustic Wave License Key

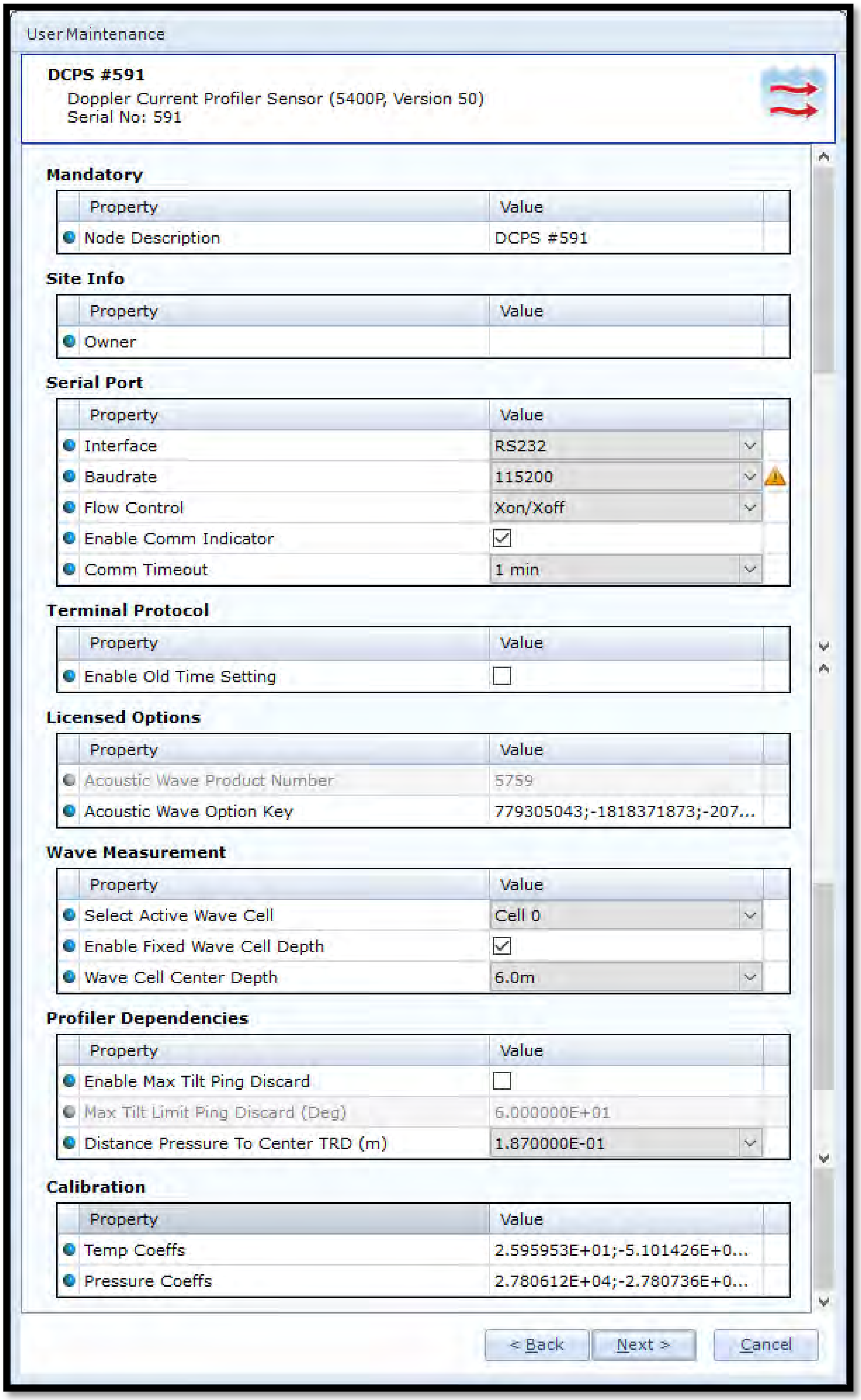


Figure 4-40: User maintenance with Acoustic Wave License Key

Under ***User Maintenance***, you find properties that are password protected and are set / altered by a trained user. It is not recommended to change properties unless instructed.

To access this menu, check the "***Include User Maintenance***" box in the ***Device Configuration*** before clicking on the "***Get Current Configuration…***" button.

The password is: **1000**.
If the wave options is enabled then also one additional groups are available, used to control the position of the wave cell.

For a full description of each property please refer to ***chapter 4.11.2*** through ***4.11.10.***

4.11.2 Mandatory

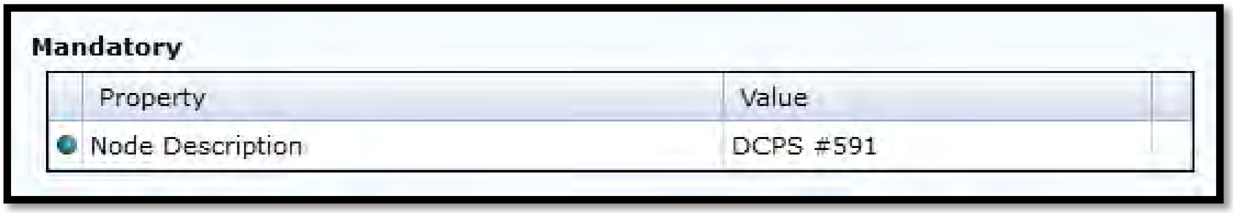


Figure 4-41: Mandatory in User Maintenance

All sensors are given a ***Node Description*** text like DCPS #xxx (xxx is the serial number of the sensor). The user can modify this ***Node Description*** text if required. Be aware that the ***Node Description*** changes to ****Corrupt Configuration*** if it has lost the configuration in flash. Contact the factory if this happens. The configuration is saved in two sectors in flash memory. A flash sector can be corrupted if the power is lost during the saving of new configuration. The double flash sector saving ensures that it does not lose the configuration. If one of the sectors is corrupted, the other sector is used and saved to the corrupt sector.

4.11.3 Site Info

Figure 4-42; Site Info in User Maintenance

Site Info is optional information to be entered to store information about the ***Owner.*** This setting is not used in calculation.

4.11.4 Serial Port

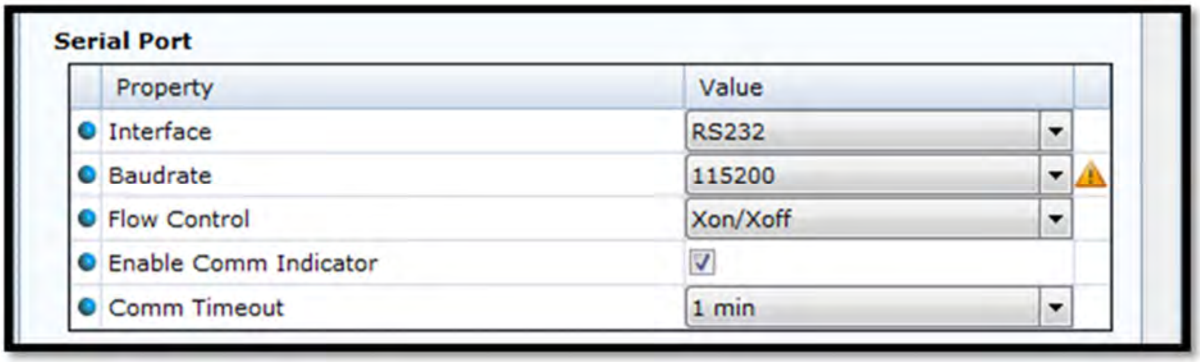


Figure 4-43: Serial Port settings in User Maintenance

The ***Serial Port*** group contains setting that deals with the RS-232 setup. ***Interface*** is only available as RS-232. When using Smart Sensor Terminal make sure that the sensor setting is the same as terminal set-up. The default setting from factory for ***Baudrate*** and ***Flow Control*** is 115200 and Xon/Xoff. ***Enable Comm Indicator*** is enabling communication sleep (‘%’) and communication ready (‘!’) indicators, when set to ***Smart Sensor Terminal*** mode. ‘!’ indicates that the sensor is ready to communicate after sleep and ‘%’ indicates that the sensor is going to sleep due to inactivity longer than the value/time set in ***Comm Timeout*** **.**

4.11.5 Terminal Protocol

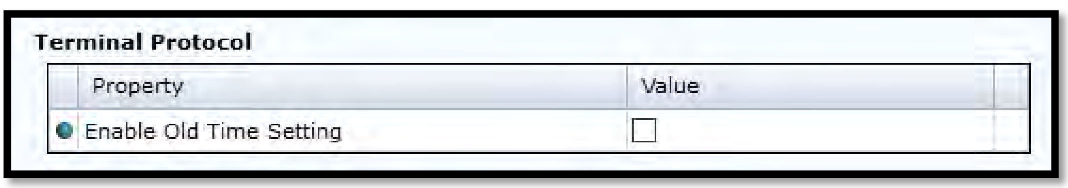


Figure 4-44: Terminal Protocol

Terminal Protocol holds one property. ***Enable Old Time Setting.*** If not enabled interval will be given either in seconds, minutes or hours with unit added. Polled pingrate will be given as Hz, number of pings pr second with unit. If enabled the interval is given in seconds without unit.
See example below.

Table 4-2: Interval and pingrate setting with Enable Old Time Setting

Enable Old Time Setting(No)	Enable Old Time Setting(Yes)
20 s	20
1 min	60
1 hour	3600
10 Hz	10

4.11.6 Licensed Options with Acoustic Wave

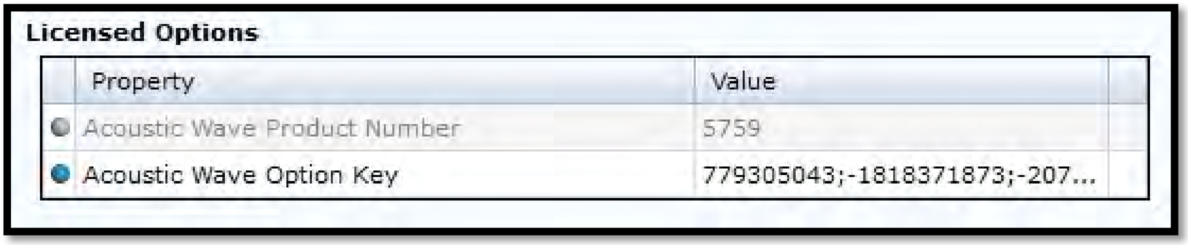


Figure 4-45: Licensed Options

Acoustic Wave Product Number is a fixed setting and cannot be changed by the user.
If Acoustic Wave is ordered, then a unique set of numbers will be stored in ***Acoustic Wave Option Key***. Each sensor has a unique Key generated based on product number and serial number.
Acoustic Wave Option Key is only available with newer software versions and there might also be some hardware limitations if you want to upgrade an older version of the sensor to include Acoustic Wave.

4.11.7 Licensed Options without Acoustic Wave

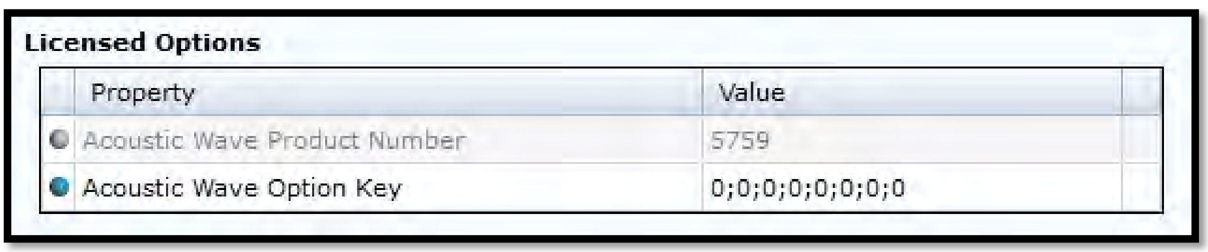


Figure 4-46: Licensed Options without Acoustic Wave

Acoustic Wave Product Number is a fixed setting and cannot be changed by the user.
If no Acoustic Wave option is ordered, then the numbers in ***Acoustic Wave Option Key*** will all be zero. If you want to upgrade to also measure wave a unique set of numbers for this specific sensor can be ordered from the factory or one of our dealers. The key is generated based on product number and serial number.
Acoustic Wave Option Key is only available with newer software versions and there might also be some hardware limitations if you want to upgrade an older version of the sensor to include Acoustic Wave.

4.11.8 Wave Measurement only with Acoustic Wave Option Key

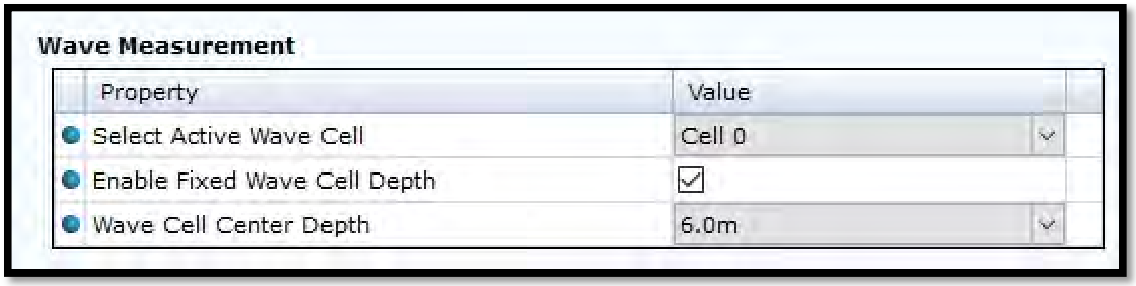


Figure 4-47: Wave Measurement in User Maintenance

The settings in this section are only available if Acoustic Wave Option Key is installed.

Select Active Wave Cell gives you the possibility to select which cell to be used for wave calculation. Available cells are 1,2 and 3 where Cell 1 is closest to the surface. The position of each cell depends on the setting selected for the two other properties in this group.

Enable Fixed Wave Cell Depth is used to either set a static position of cell 1, enabled or dynamic if disabled.

If enabled, then the distance to center of first cell is set by ***Wave Cell Center Depth***. If disabled, the placement of first cell will depend on wave measurement and depth.

4.11.9 Profiler Dependencies

Profiler Dependencies

Property	Value
Enable Max Tilt Ping Discard	☐
Max Tilt Limit Ping Discard (Deg)	6.000000E+01
Distance Pressure To Center TRD (m)	1.870000E-01

Figure 4-48: Profiler Dependencies in User Maintenance

Enable Max Tilt Ping Discard. If this setting is enabled, then if tilts exceed the ***Max Tilt Limit Ping Discard (Deg)***value the ping will not be used. This is used to avoid bad data from ping when the sensor is tilting too much.

Max Tilt Limit Ping Discard (Deg) is the value used to discard ping if ***Enable Max Ping Discard*** is enabled.

Distance Pressure To Center TRD (m) is used to set the distance from pressure sensor inlet port (the reference level for the pressure sensor) to the center of the DCPS transducers. Default value when used mounted on SeaGuardII top-end plate is 0.187 meter. Value for 5400P is 0.15 meter which is the distance from pressure sensor reference level to center of DCPS transducers.

4.11.10 Advanced System Output

Calibration

Property	Value
Temp Coeffs	2.595953E+01;-5.101426E+0...
Pressure Coeffs	2.780612E+04;-2.780736E+0...

Figure 4-49: Advanced System Output in User Maintenance

Temp Coeffs is only used if a 4080 Temperature Sensor installed from factory. This property holds 4 coefficients if the sensor is calibrated at factory. The calibration coefficients are available from the calibration certificate.

Pressure Coeffs are only used for 5400P versions. This property holds 4 coefficients obtained during a calibration process at factory. The calibration coefficients are available from the calibration certificate.

4.12 System Overview

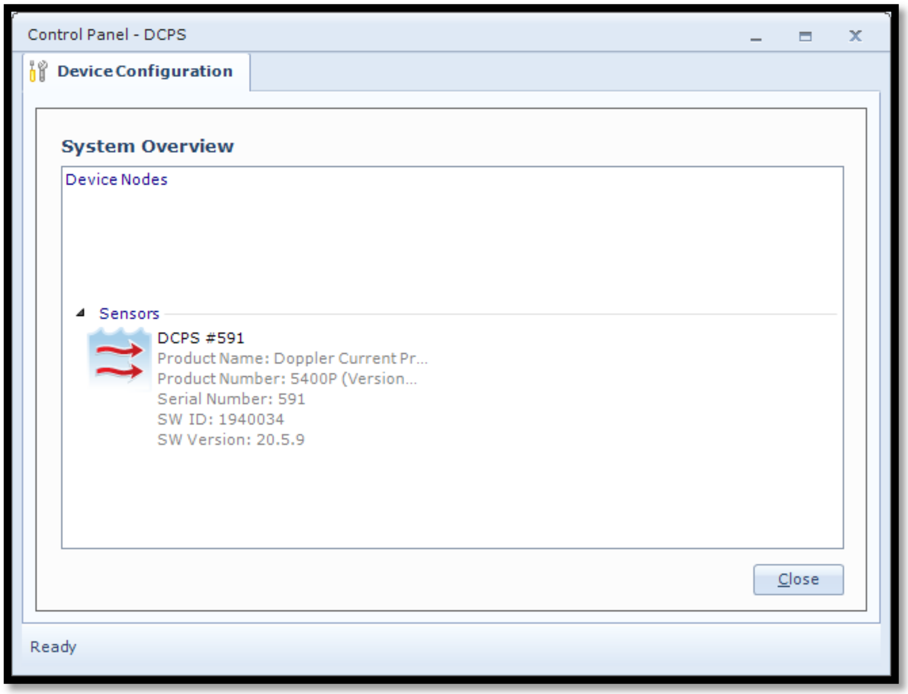


Figure 4-50: System overview

When you select ***System Overview*** under the ***Device Configuration*** tab you will get a short list of sensor information with ***Product Name, Product Number, Serial Number*** and ***Software Version***.

4.13 Save configuration to file.

The example below shows a small excerpt of a saved configuration.

```xml
<?xml version="1.0" encoding="UTF-8"?>
- <Config xmlns="http://www.aadi.no/RTConfigSchema" Time="2023-06-02T13:49:25.861Z" ID="5400P-591-20.5.9-0-209">
  - <NodeConfig ID="5400P-591" NodeTypeID="2000" ConfigVer="50" ProtocolVer="6" IsSensor="true" Adr="8281344" Descr="DCPS #591"
    ProdName="Doppler Current Profiler Sensor" ProdNo="5400P" SerialNo="591">
    - <ConfigCategory ID="0" Descr="Factory Maintenance">
      - <PropertyCategory ID="0" Descr="Mandatory">
          <Property ID="0" Descr="Product Name" Type="VT_BSTR" Access="R1W4">Doppler Current Profiler Sensor</Property>
          <Property ID="1" Descr="Product Number" Type="VT_BSTR" Access="R1W4">5400P</Property>
          <Property ID="2" Descr="Serial Number" Type="VT_I2" Access="R1W4">591</Property>
          <Property ID="6" Descr="SW ID" Type="VT_BSTR" Access="R1">1940034</Property>
          <Property ID="3" Descr="SW Version" Type="VT_ARRAY|VT_I2" Access="R1">20;5;9</Property>
        </PropertyCategory>
      </ConfigCategory>
    - <ConfigCategory ID="1" Descr="User Maintenance">
      - <PropertyCategory ID="0" Descr="Mandatory">
          <Property ID="0" Descr="Node Description" Type="VT_BSTR" Access="R1W2">DCPS #591</Property>
        </PropertyCategory>
      - <PropertyCategory ID="1" Descr="Site Info">
          <Property ID="0" Descr="Owner" Type="VT_BSTR" Access="R1W3"/>
        </PropertyCategory>
      </ConfigCategory>
    - <ConfigCategory ID="2" Descr="System Configuration">
      - <PropertyCategory ID="1" Descr="Common Settings">
          <Property ID="0" Descr="Mode" Type="VT_I4" Access="R1W2" Enum="AiCaP=0;Smart Sensor Terminal=1;AADI Real-Time=2"
            StandAlone="true" ResetRequired="true">1</Property>
          <Property ID="1" Descr="Enable Sleep" Type="VT_BOOL" Access="R1W2" StandAlone="true">true</Property>
        </PropertyCategory>
      - <PropertyCategory ID="2" Descr="Terminal Protocol">
          <Property ID="2" Descr="Enable Polled Mode" Type="VT_BOOL" Access="R1W2" StandAlone="true">false</Property>
          <Property ID="10" Descr="Polled Pingrate" Type="VT_R4" Access="R1W1" Enum="0.1 Hz=1.000000E-01;0.5 Hz=5.000000E-01;1
            Hz=1.000000E+00;2 Hz=2.000000E+00;3 Hz=3.000000E+00;4 Hz=4.000000E+00;5 Hz=5.000000E+00;6 Hz=6.000000E+00;7
            Hz=7.000000E+00;8 Hz=8.000000E+00;9 Hz=9.000000E+00;10 Hz=1.000000E+01" StandAlone="true">5.000000E-01</Property>
          <Property ID="0" Descr="Enable Text" Type="VT_BOOL" Access="R1W2" StandAlone="true">true</Property>
          <Property ID="1" Descr="Enable Decimalformat" Type="VT_BOOL" Access="R1W2" StandAlone="true">false</Property>
        </PropertyCategory>
      - <PropertyCategory ID="15" Descr="Orientation">
          <Property ID="2" Descr="Enable Tilt Compensation" Type="VT_BOOL" Access="R1W2">true</Property>
          <Property ID="3" Descr="Enable Fixed Heading" Type="VT_BOOL" Access="R1W2">false</Property>
          <Property ID="4" Descr="Fixed Heading" Type="VT_R4" Access="R1W2" Unit="Deg.M"
            EnableDependencyID="3">0.000000E+00</Property>
          <Property ID="0" Descr="Enable Upside Down" Type="VT_BOOL" Access="R1W2">false</Property>
```


Figure 4-51: Example of saved .xml

CHAPTER 5 Logging data via AADI Real-Time Collector

5.1 Logging data on PC

The Real-Time Collector can save the incoming data to file, either to a txt-file or to xml-files. For instructions see the following chapters.

5.1.1 Enabling file output

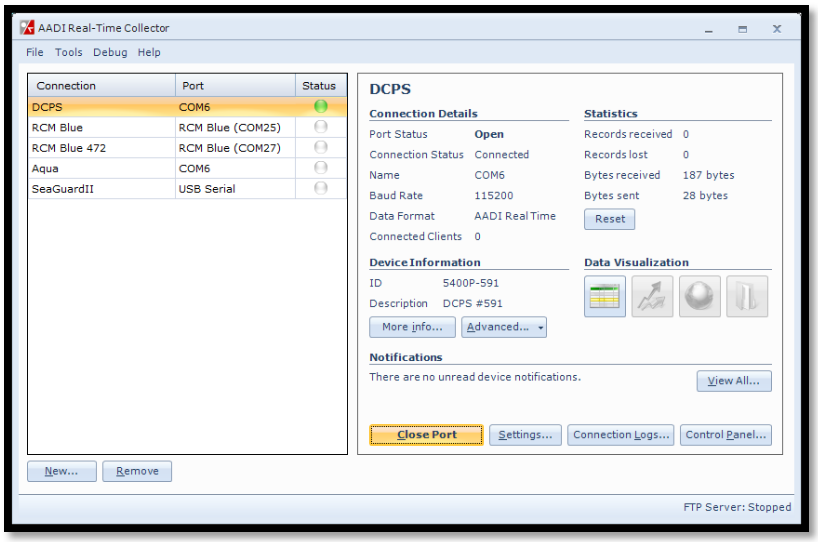


Figure 5-1: AADI Real-Time Collector start up menu

If your connection is open (status green in the AADI Real Time Collector main menu) then first press ***Close Port***.

When the port is closed then highlight the DCPS connection and. click on the “***Settings…”*** button next to ***Close Port/Open Port***, as shown in ***Figure 5-1***.

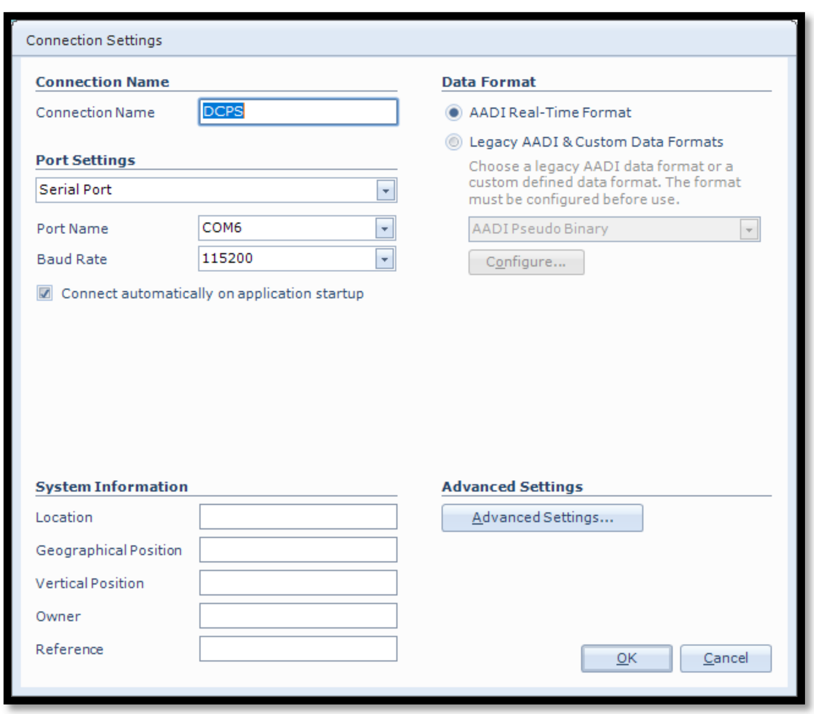


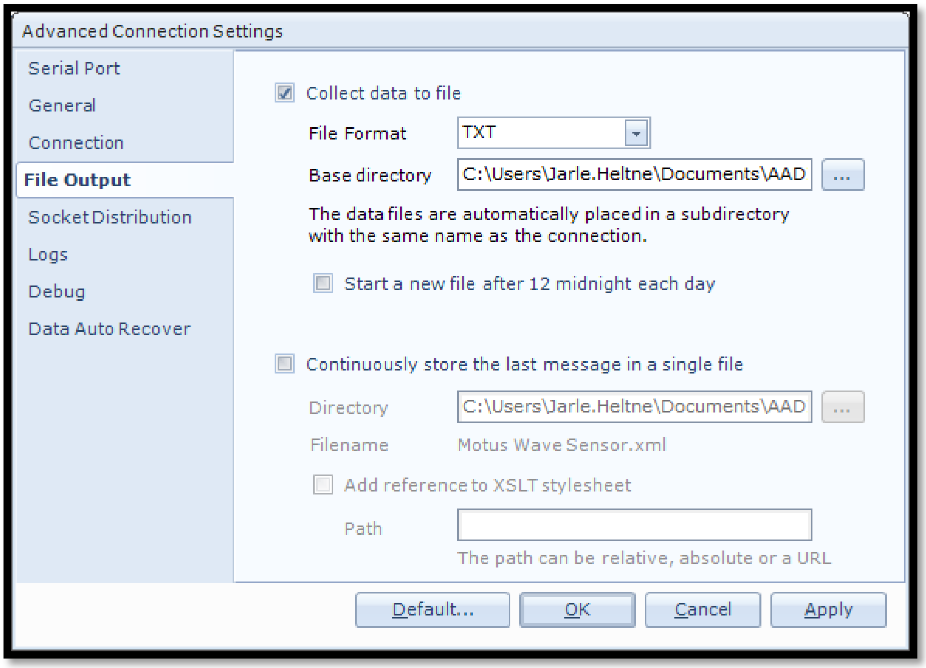
Figure 5-2: Connection settings menu

In the ***Connection Settings*** window select Connection Name and ***Port Settings. Connection Name*** you may select as you want either to make it general for more similar sensor or special for exact this one.

Port Setting will be ***Serial Port*** for all 4531 sensors.

Port Name depends on the connection to your PC and ***Baud Rate*** must be equal to the sensor setting, default ***9600***.

Then click on the ***“Advanced Settings…”*** button and ***OK.***



Choose ***File Output*** from the list on the left side. Check the ***"Collect data to file"*** box to enable file output. Select a file format and choose a base directory where you want the file to be saved.

Alternatively you may select "Continuously store the last message in a single file".

Click "***OK"*** in the Advanced Connection Settings window, and ***"OK"*** in the Connection Settings window.

Figure 5-3: Advanced connection settings / File Output

5.1.2 Starting the sensor and logging to file

In AADI Real-Time Collector start menu, see ***Figure 5-1*** click on the selected connection and ***"Open Port"***. The Status turns green when the port is opened and connected. Click on the ***"Control Panel…"*** button in the lower right corner.

The sensor needs to be set to ***AADI Real-Time*** mode.

In the Control Panel you will find four alternatives:

- ***Recorder Panel***
- ***Device Configuration***
- ***System Status***
- ***Debug***

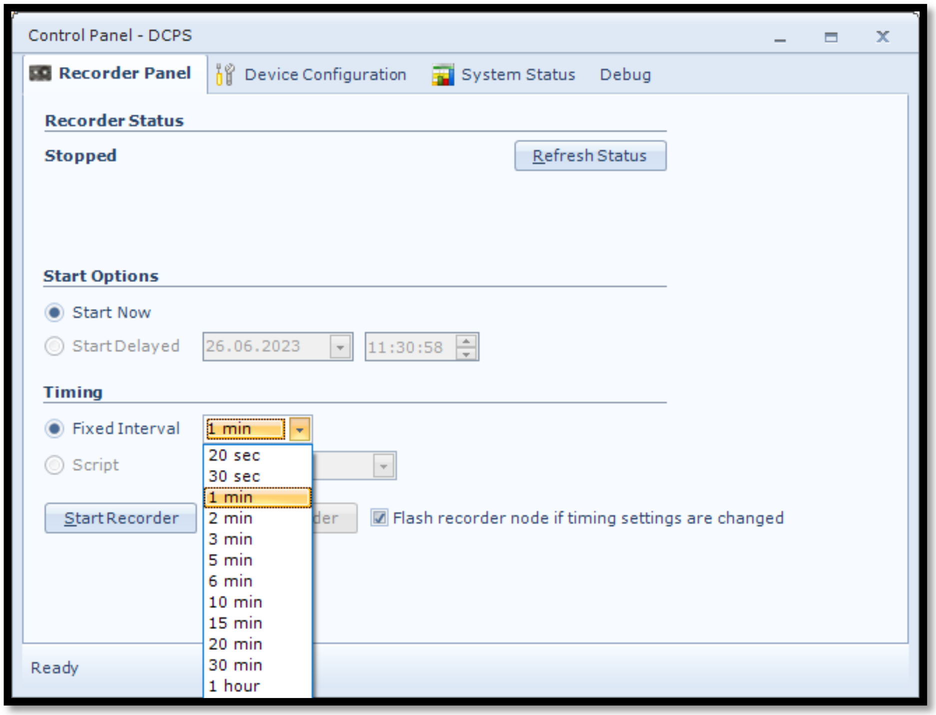
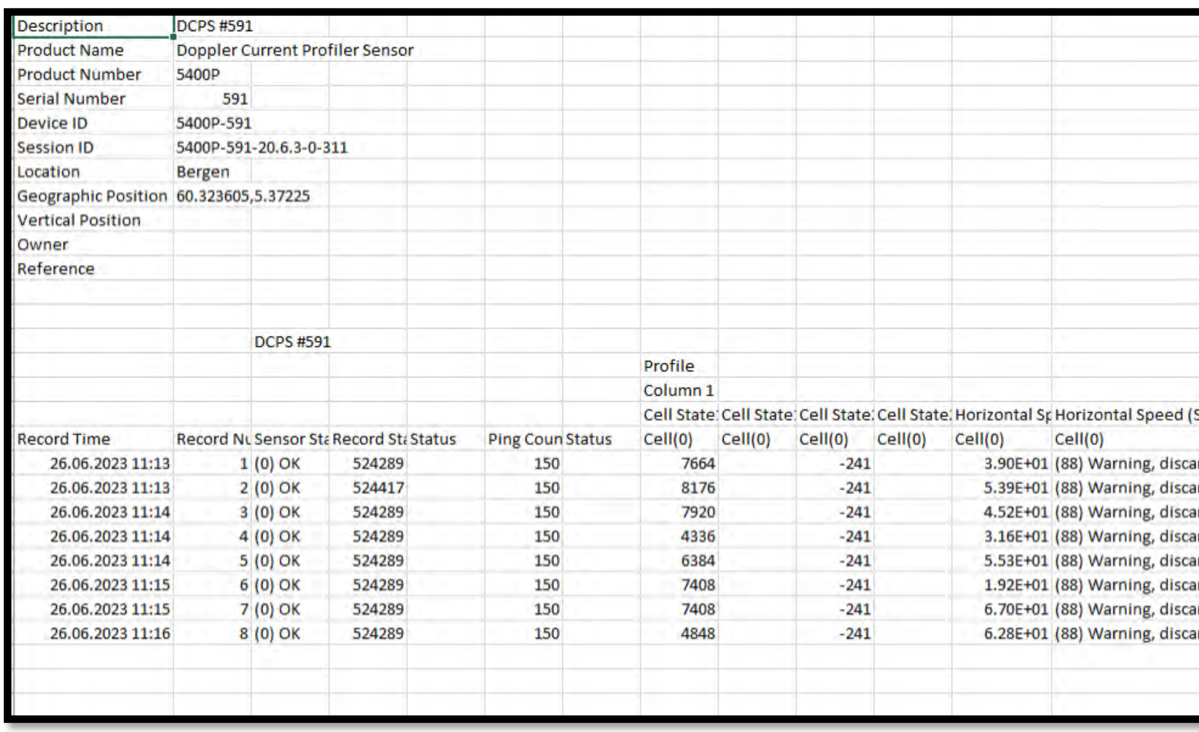


Figure 5-4: Recorder panel

In the ***Recorder Panel*** window select ***Start Now,*** then select ***Fixed Interval*** and click the ***"Start Recorder"*** button.

The shortest interval available depends on the sensor configuration.

Data will start logging in the defined directory. If it is a txt-file, the easiest way to view it is in Excel, Notepad or similar.



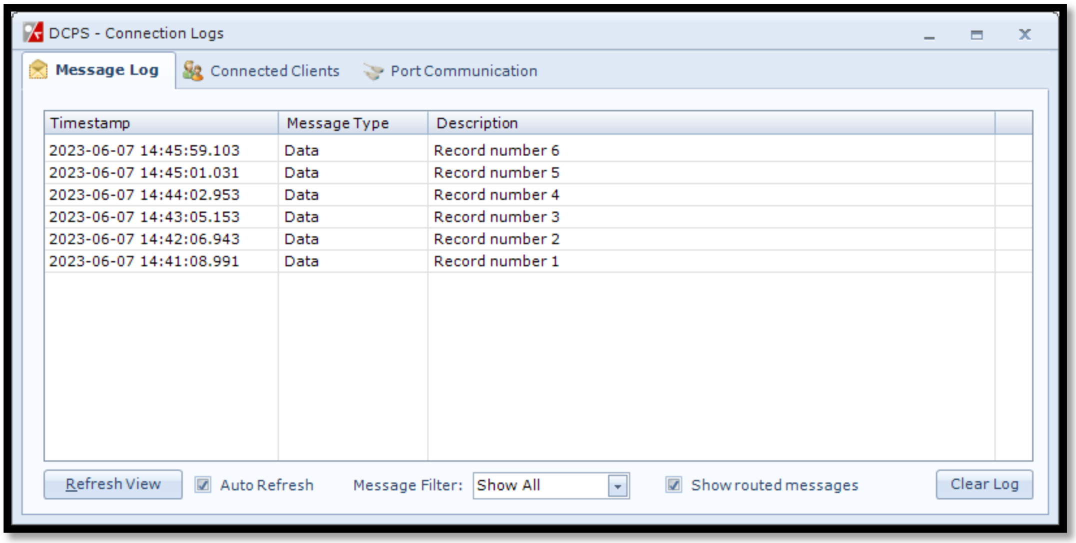
Description	DCPS #591											
Product Name	Doppler Current Profiler Sensor											
Product Number	5400P											
Serial Number	591											
Device ID	5400P-591											
Session ID	5400P-591-20.6.3-0-311											
Location	Bergen											
Geographic Position	60.323605,5.37225											
Vertical Position												
Owner												
Reference												
		DCPS #591										
							Profile					
							Column 1					
							Cell State	Cell State	Cell State	Cell State	Horizontal Sp	Horizontal Speed (S
Record Time	Record Nu	Sensor Sta	Record Sta	Status	Ping Coun	Status	Cell(0)	Cell(0)	Cell(0)	Cell(0)	Cell(0)	Cell(0)
26.06.2023 11:13	1	(0) OK	524289		150		7664		-241		3.90E+01	(88) Warning, disca
26.06.2023 11:13	2	(0) OK	524417		150		8176		-241		5.39E+01	(88) Warning, disca
26.06.2023 11:14	3	(0) OK	524289		150		7920		-241		4.52E+01	(88) Warning, disca
26.06.2023 11:14	4	(0) OK	524289		150		4336		-241		3.16E+01	(88) Warning, disca
26.06.2023 11:14	5	(0) OK	524289		150		6384		-241		5.53E+01	(88) Warning, disca
26.06.2023 11:15	6	(0) OK	524289		150		7408		-241		1.92E+01	(88) Warning, disca
26.06.2023 11:15	7	(0) OK	524289		150		7408		-241		6.70E+01	(88) Warning, disca
26.06.2023 11:16	8	(0) OK	524289		150		4848		-241		6.28E+01	(88) Warning, disca

Figure 5-5: Example of a txt-file obtained from the sensor using RT Collector

Figure 5-5 gives an example of obtained data file. This example is showing output with an absolute minimum configuration. The different parameters are organized in columns.

5.2 Viewing incoming data in real-time

When the sensor is running, the incoming data can be viewed by selecting ***"Connection Logs…"*** in the AADI Real-Time Collector start menu,



Each Record number contains data from one recording period.

Double-click on one of the Record numbers to look at the data.

Figure 5-6: Connection Logs

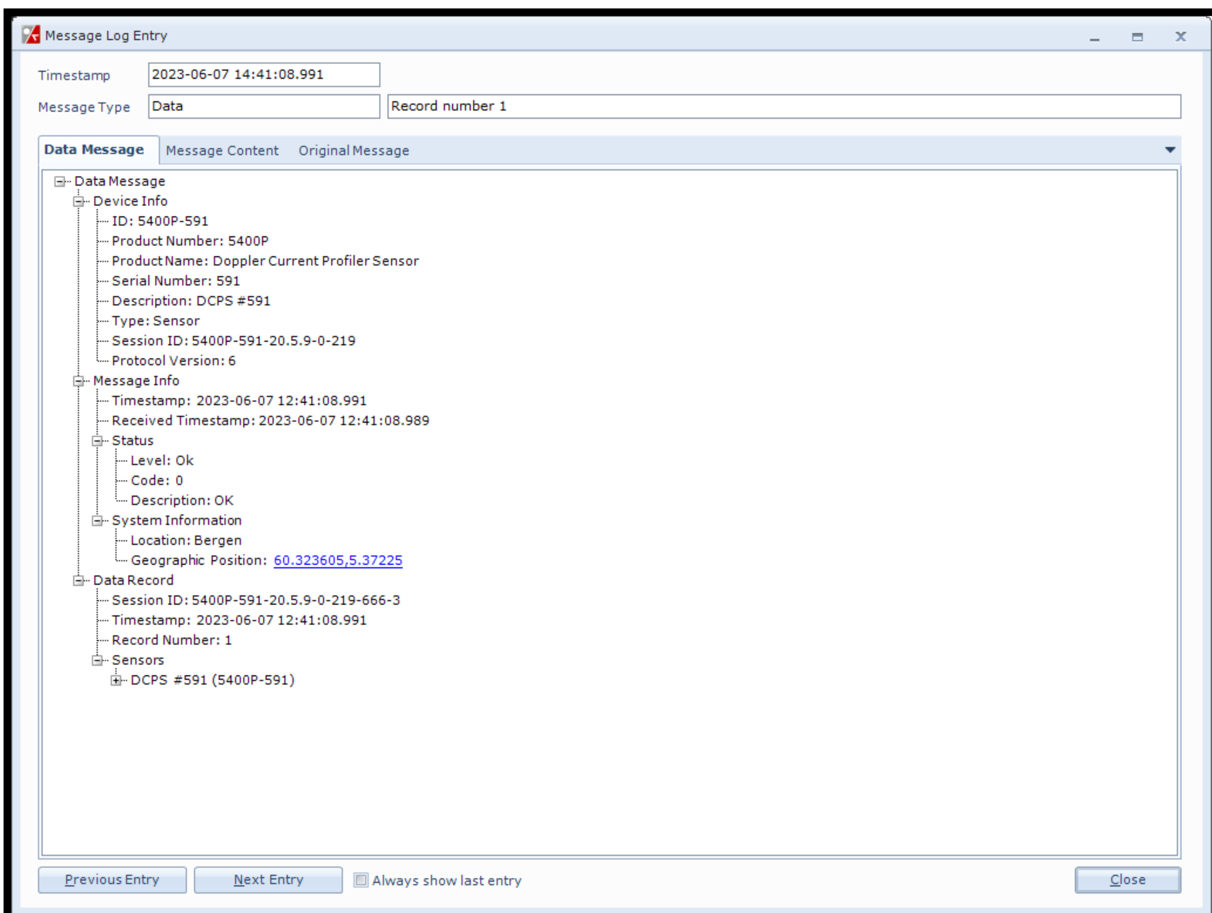


Figure 5-7: Visualization of incoming data from the sensor in real time

Click on the + signs to open and see all the data in the message.

Previous records or newer records can be viewed by clicking on ***Previous Entry*** button or ***Next Entry button***. An automatic update to the last data message can be enabled by checking the Always show last entry check box.
The original message content can be seen if clicking on the ***Original Message*** tab.

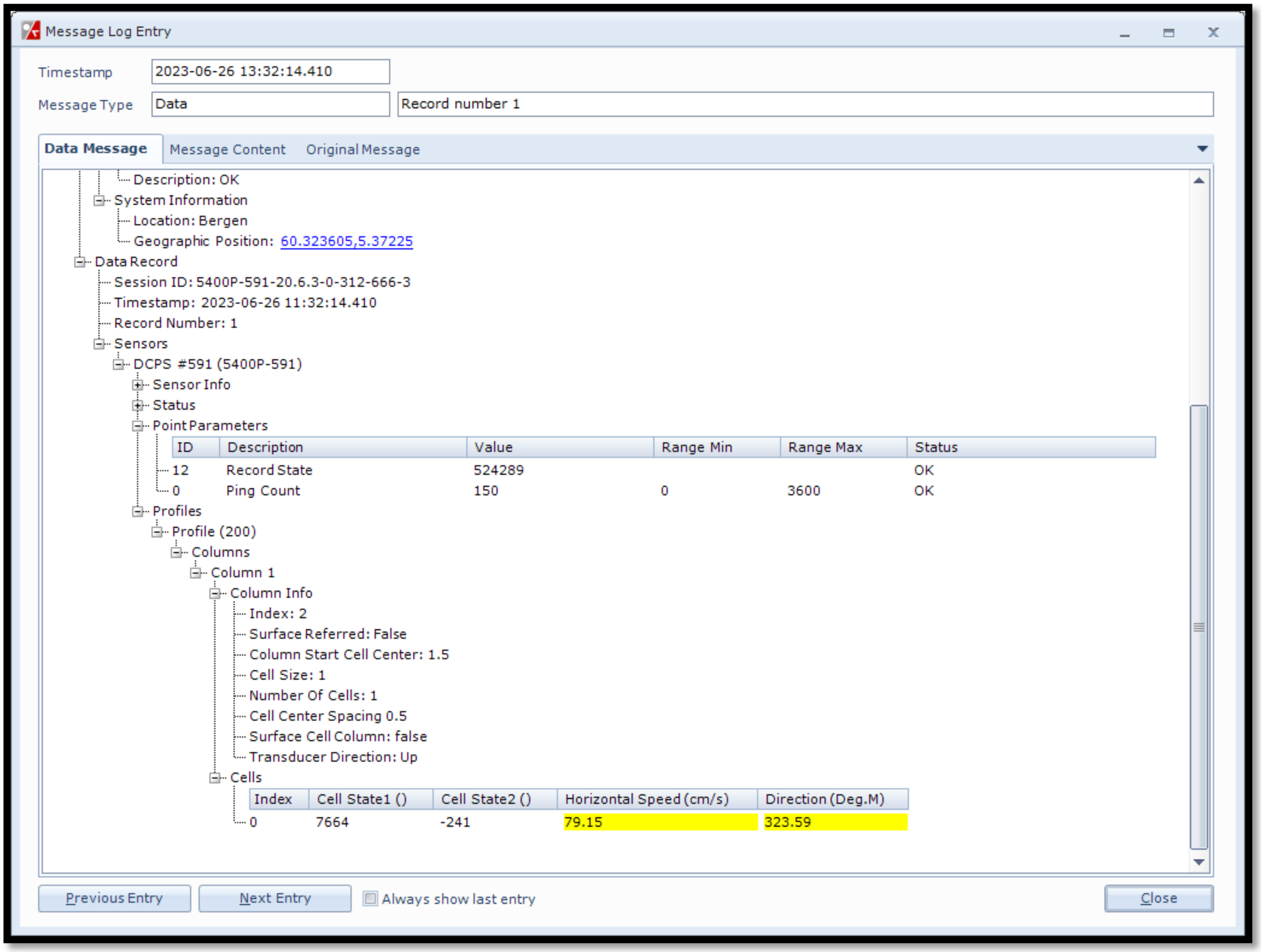


Figure 5-8: Sensor Data

The Sensor Data is separated in Point Parameters that are common for all cells and Cells that are given with an index number. Number of cells and parameters depends on the configuration.

CHAPTER 6 Stand-alone Sensor configuration using Terminal Software

This chapter describes how to communicate with the Doppler Current Sensor using the RS-232 or RS-422 connection and Terminal Software. The sensor can be set to any mode but the mode setting and setting of the different properties will influence on the output from the sensor.

6.1 Sensor versions and interface.

The 5400,5400P, 5402 and 5403 sensors can be used on a SeaGuardII and SmartGuard (AiCaP) Dataloggers or connected to a RS-232 com-port (PC or other devices with RS232 com-port).

The 5400R, 5400PR, 5402R, 5403R sensors can be used connected to an RS-422 com-port or connected with an RS-422 to RS-232 converter to an RS-232 com-port. Or directly to a RS-422 com-port.

6.2 RS-422 transmission line explained.

RS-422 has differential transmission lines with twisted pairs. The sensor signals are less influenced by external noise than with RS-232 serial communication, which makes it possible to use longer cables.

RS-422 has one balanced signal pair for the transmitted signal, TxD (also called TxD+ and TxD-) and one balanced signal pair for the received signal, RxD (also called RxD+ and RxD-).

RxD+ and TxD+ are often named B and called non-inverting input and output, respectively.

RxD- and TxD- are often named A and called inverting input and output, respectively.

The EIA standard uses the notation A and B as described above; many manufacturers of signal converters uses the opposite naming (A for non-inverting input/output, and B on inverting input/output) which is not correct.

Note! Always ensure which signal is non-inverting and which is inverting.

Figure 5-1 illustrates the balanced signals of a RS-422 line during transmission of a byte. The non-inverting signal is called TxD+ while the inverting signal is called TxD-.

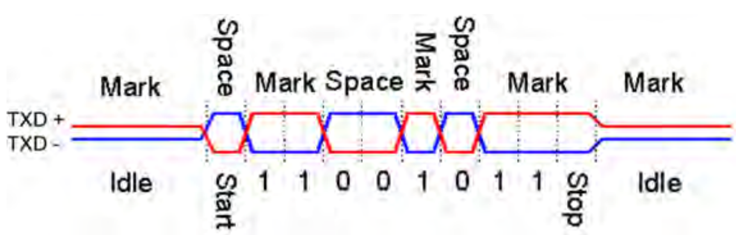


Figure 6-1: RS-422 transmission of a byte

6.3 Communication setup

Most terminal programs can be used for RS-232 communication with the sensor when connected to a PC. For this description we have used TerraTerm.
The following setup is recommended:

115200 Baud
8 Data bits
1 Stop bit
No Parity
Xon/Xoff Flow Control

IMPORTANT! The terminal program must send a Line Feed after each Carriage Return.

Note! If using Tera Terminal Pro, after setting up the com port according to settings above please select "Terminal" in the "Set up" menu and click "Local echo" also select "CR+LF" for both "Receive" and "Transmit" under "New line".

Note! If using Hyper Terminal the options "Send line ends with line feeds" and "Echo line ends with line feeds" in the HyperTerminal ASCII setup must be selected.

6.4 Sensor startup

You will be able to communicate with the sensor via the Terminal software regardless of which mode the sensor is set to. However, the output string from the sensor will depend on the mode setting. The final structure of the output string will also depend on settings like Enable Text, Enable Decimal Format, Enable Raw Data, and so on. The sensor will continue to output measurements after the first startup info. The output frequency will be according to the interval setting. Some properties will not have any effects in all modes but they will still be available. Some properties may also have different effects depending on the mode.

6.4.1 AiCaP mode

In ***AiCaP*** mode the sensor will output ***StartupInfo*** with ***Product Number***, ***Serial Number***, ***Mode***, ***AiCaP Version***, ***Protocol Version*** and ***Config Version***. In this mode the sensor will not output any measurement since it needs an Aanderaa Datalogger as Master. The sensor can be configured for ***AiCaP*** use via the Terminal software.

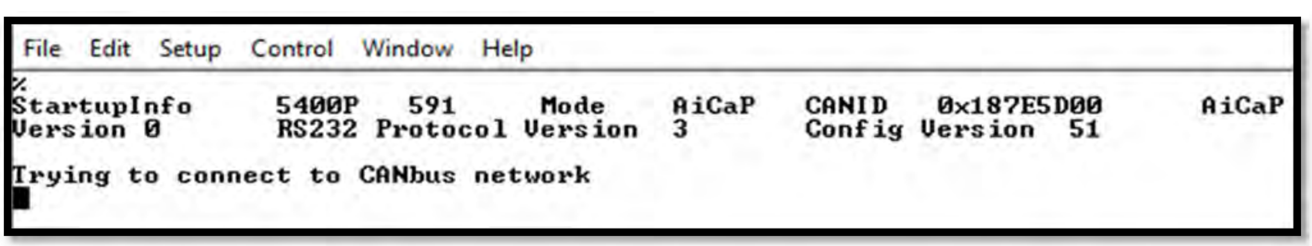
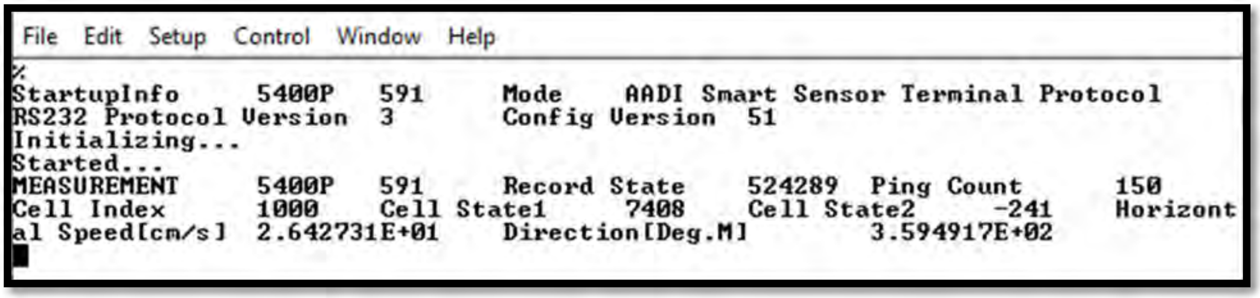


Figure 6-2: Typical power-up output for sensor set to AiCaP mode

6.4.2 Smart Sensor Terminal mode

In Smart Sensor Terminal mode the sensor will output ***StartupInfo*** with ***Product Number***, ***Serial Number***, ***Mode***, ***Protocol Version*** and ***Config Version***. It will also output a first measurement x second, minute or hour after power- up and then a new measurement every x second, minute or hour, where x is the interval set by ***Interval(x)***. The number of parameters in the output string depends on the sensor configuration.

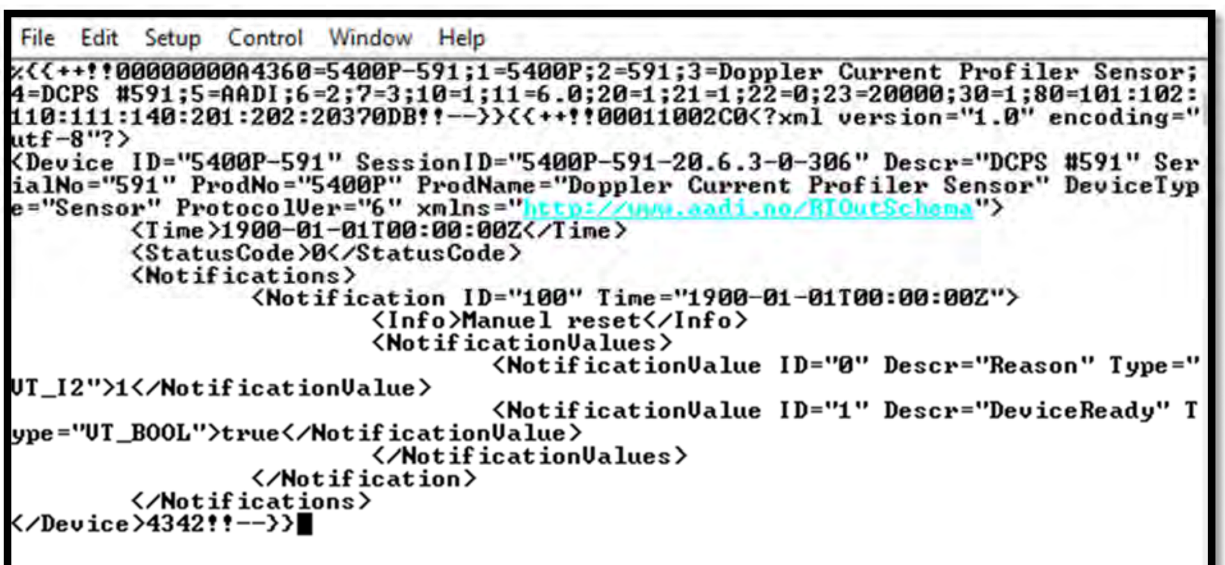


```
File  Edit  Setup  Control  Window  Help
%
StartupInfo      5400P   591     Mode     AADI Smart Sensor Terminal Protocol
RS232 Protocol Version   3       Config Version   51
Initializing...
Started...
MEASUREMENT      5400P   591     Record State     524289  Ping Count       150
Cell Index       1000    Cell State1      7408    Cell State2      -241    Horizont
al Speed[cm/s]   2.642731E+01    Direction[Deg.M]         3.594917E+02
```

Figure 6-3: Typical power-up output for sensor set to Smart Sensor Terminal mode

6.4.3 AADI Real-Time mode

AADI Real-Time mode is also a Serial output but with ***.xml*** instead of ***ASCII***. This is the mode used with ***AADI Real-Time Collector*** and also preferd by some integrators when sensor is connected to 3rd party loggers or interface. The text shown in figure xxx is just a start-up meassage and do not contain any measurements. It will also output a first measurement x second, minute or hour after power- up and then a new measurement every x second, minute or hour, where x is the interval set by ***Interval(x)***. The number of parameters in the output string depends on the sensor configuration.



```
File  Edit  Setup  Control  Window  Help
%<<++!!00000000A4360=5400P-591;1=5400P;2=591;3=Doppler Current Profiler Sensor;
4=DCPS #591;5=AADI;6=2;7=3;10=1;11=6.0;20=1;21=1;22=0;23=20000;30=1;80=101:102:
110:111:140:201:202:20370DB!!-->><<++!!00011002C0<?xml version="1.0" encoding="
utf-8"?>
<Device ID="5400P-591" SessionID="5400P-591-20.6.3-0-306" Descr="DCPS #591" Ser
ialNo="591" ProdNo="5400P" ProdName="Doppler Current Profiler Sensor" DeviceTyp
e="Sensor" ProtocolVer="6" xmlns="http://www.aadi.no/RTOutSchema">
        <Time>1900-01-01T00:00:00Z</Time>
        <StatusCode>0</StatusCode>
        <Notifications>
                <Notification ID="100" Time="1900-01-01T00:00:00Z">
                        <Info>Manuel reset</Info>
                        <NotificationValues>
                                <NotificationValue ID="0" Descr="Reason" Type="
UT_I2">1</NotificationValue>
                                <NotificationValue ID="1" Descr="DeviceReady" T
ype="UT_BOOL">true</NotificationValue>
                        </NotificationValues>
                </Notification>
        </Notifications>
</Device>4342!!-->>
```

Figure 6-4: Typical power-up output for sensor set to AADI Real-Time mode

6.5 Controlling communication

In order to minimize the current drain the sensor normally enters a power down mode after each sampling; the sensor can be awake by any characters and will stay awake for a time set by the ***Comm TimeOut*** property after receiving the last character.

If the property ***Comm TimeOut*** is set to other than ***'Always On'*** the serial interface will not be activated after power-up (or the ***Reset*** command). Any character will activate the serial interface, but a Carriage Return (CR or CR+LF), ***'/'*** or ***';'*** are often preferred since these characters do not interfere with the command syntax. The serial interface will then be active until a period of input inactivity specified by the ***Comm TimeOut*** value.

The ***Communication Sleep Indicator***, ***'%',*** will be transmitted when the serial communication is deactivated, and the ***Communication Ready Indicator, '!'*** is outputted after activation (electronics require up to 500ms start up time). When ***Comm TimeOut*** is set to '***Always On'*** the communication (and microprocessor) will be kept active all time.

The ***Communication Sleep Indicator '%'*** and the ***Communication Ready Indicator '!'*** are not followed by Carriage Return and Line Feed.

Any character will cause the electronics to return to normal operation; when the sensor has responded with the character ***'!'***, new commands may be entered.

When communicating with the sensor, you must start by pressing *Enter*. The sensor will respond in two ways (***Comm TimeOut*** is 1 minute by default in the following description):

- If the sensor is ready for communication, it will not send any response indicator. The sensor will stay awake and ready to receive commands for 1 minute
- If the sensor is in sleep mode and not ready for communication, the sensor will send a 'communication ready' indicator ***(!)*** when awakened (within 500ms). The sensor will then be ready for communication.

6.6 Description of protocol

All inputs to the sensor are given as commands with the following format:

- ***MainCmd SubCmd*** or ***MainCmd Property(Value, ..., Value)***

Description of ASCII coded communication rules:

- The main command***, MainCmd****,* is followed by an optional subcommand (***SubCmd)*** or sensor property (***Property***).
- The ***MainCmd*** and the ***SubCmd/Property*** must be separated with the space ‘ ’ character.
- When entering new settings the *Property* is followed by a parenthesis containing comma-separated values.
- The command string must be terminated by Carriage Return and Line Feed (ASCII code 13 & 10).
- The command string is not case sensitive (UPPER/lower-case).
- The ENUM property settings are case sensitive. E.g. “***Set Mode(AiCaP)”*** Here AICAP will result in argument error.
- A valid command string is acknowledged with the character ‘#’ while character ‘*’ indicates an error. Both are followed by Carriage Return/ Line Feed (CRLF).
- For most errors a short error message is also given subsequent to the error indicator.
- There are also special commands with short names and dedicated tasks, as ***save, reset***, and ***help.***
- All names and numbers are separated by tabulator spacing (ASCII code 9).
- The string is terminated by Carriage Return and Line Feed (ASCII code 13 & 10).

Note! Losing power during the flashing process can cause corruption of vital settings, such as coefficients, serial number, model number etc. If losing settings, contact AADI Service department for new setting file for the specific sensor with further instructions.

6.7 Passkey for write protection

To avoid accidental change, most of the properties are write-protected. There are four levels of access protection, refer ***Table 6-1***.

A special property called ***Passkey*** must be set according to the protection level before changing the value of properties that are write-protected. After a period of inactivity at the serial input, the access level will revert to default. This period corresponds to the ***Comm TimeOut*** setting, or 1 minutes it the ***Comm TimeOut*** is set to ***Always On.***

Table 6-1: Passkey protection

Output	Passkey	Description
No		No Passkey needed for changing property
Low	1	The Passkey must be set to 1 prior to changing property
High	1000	The Passkey must be set to 1000 prior to changing property. This Passkey value also gives read access to factory properties that usually are hidden.
Read Only		The user have only read access
Factory Write	XXXX	Sensor specific code for factory level access

6.8 Save and Reset

When the required properties are set, you should send a ***Save*** command to make sure that the new configuration is saved internally in the flash memory. The sensor always reads the configuration from the internal flash memory after reset and power up. The ***Save*** command takes about 20 seconds to complete (indicated with the character '#').

Always send a ***Reset*** command when a new configuration has been saved (or switch the power OFF and then back ON), or else calculated parameters may be corrupted. This forces the sensor to start up with the new configuration input. If the ***Enable Sleep*** property is set to ***Yes*** and the ***Comm TimeOut*** property is not set to ***Always On*** the sensor enters sleep mode after reset.
At startup/reset the sensor performs measurements according to the interval setting if the mode is ***Smart Sensor Terminal.***

If ***Enable Text*** is set to ***Yes*****,** the ***Startup Info*** is presented. If the ***Save*** command is executed the new setting will be stored in the internal Flash memory. Property changes will be lost when the sensor is reset or loses power unless you type the ***Save*** command.
Refer to ***Figure 6-5***. The number of parameters in the list depends on which parameters are enabled.

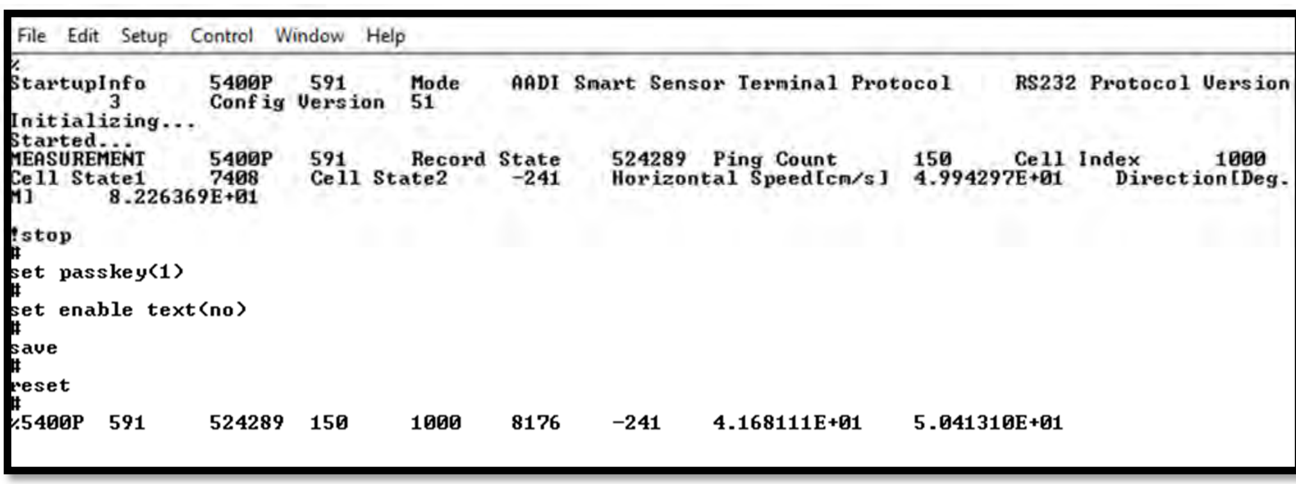


Figure 6-5: Save and reset in Tera Term

6.9 Available commands

Available commands and properties for the sensors are given in ***Table 6-2*** and ***chapter*** *Error! Reference source not found.* respectively.

Table 6-2 Available RS-232 commands.

Command	Description
Start	Start a measurement sequence according to current configuration
Stop	Stop a measurement sequence
Do Sample	Calculates and presents a new single set of measurement data. (used in polled mode).
Do Output	Presents the last set of calculated measurement data (normally only used in polled mode).
Do Refresh	Necessary when the sensor is used in Smart Sensor Terminal mode. If the number of ping or one of the column settings is changed, a Do Refresh is necessary to recalculate the Interval and Polled Pingrate limits.
Do Calc Mintime	The sensor calculates the total time it needs for execution of the number of selected pings with the current configuration (number of columns, number of cells etc.) The communication time is also included, i.e. this time is dependent on the number of enabled output parameters and baud rate.
Get *ConfigXML*	Outputs information about the configuration properties in XML format
Get *DataXML*	Outputs information about available(enabled) parameters in XML format
Get *Property*	Output Property value (refer table 1-1), e.g get interval.
Get All	Output information about the configuration properties (same as shown on Get ConfigXML but without all the metadata)
Get All Parameters	Output information about all parameters value
Set *Property(Value,…, Value)*	Set Property to Value,…, Value (refer table 1-1), eg set interval(60)
Set *Passkey(Value)*	Set passkey to change access level
Save	Store current settings
Load	Reloads previous stored settings
Reset	Resets the sensor with last saved new configuration
Help	Print help information
;	Comment string, following characters are ignored
//	Comment string, following characters are ignored

6.9.1 The Get command.

The ***Get*** command is used to read the value/values of a property and to read the latest value of a parameter.

The command name ***Get*** followed by a ***Property*** returns a string in the following format:

> ***Property ProductNo SerialNo Value, ..., Value***

The string starts with the name of the property, the product number and serial number of the sensor, and finally the value of the property.
The command name ***Get*** followed by a parameter returns the name and unit of the parameter, the product and serial number of the sensor, and finally the latest parameter reading.
A special version, ***Get All***, reads out all available properties in the sensor. Some properties are passkey protected and will not be shown without first writing the passkey. To see all user accessible properties, use ***passkey(1000).***

```
get serial number
Serial Number    5400P    591      591
#
get product number
Product Number   5400P    591      5400P
#
get enable text
Enable Text      5400P    591      No
#
```

Figure 6-6: The Get Command

A special version, ***Get All***, reads out all available properties in the sensor. Some properties are passkey protected and will not be shown without first writing the passkey. To see all user accessible properties, use passkey ***1000.***

```
set passkey(1000)
#
get all
Product Name    5400P   591     Doppler Current Profiler Sensor
Product Number  5400P   591     5400P
Serial Number   5400P   591     591
SW ID   5400P   591     1940034
SW Version      5400P   591     20      6       3
HW ID 1 5400P   591     3969731
HW Version 1    5400P   591     Mod Rev19
HW ID 2 5400P   591     3969730
HW Version 2    5400P   591     Rev08
HW ID 3 5400P   591     3969730
HW Version 3    5400P   591     Rev08
System Control  5400P   591     0       0       0
Production Date 5400P   591     2021-4-20
Last Service    5400P   591
Last Calibration        5400P   591
Calibration Interval[Days]      5400P   591     365
Cross Diff Limits       5400P   591     1.000000E+01    2.500000E+01    4.000000E+01
Strength Limits NB      5400P   591     -4.000000E+01   -4.400000E+01   -4.800000E+01   -5.000000E+01
Strength Limits BB      5400P   591     -4.000000E+01   -4.400000E+01   -4.800000E+01   -5.000000E+01
SP Stdev Limits NB      5400P   591     6.000000E+01    8.000000E+01    1.000000E+02
SP Stdev Limits BB      5400P   591     7.000000E+00    2.000000E+01    3.300000E+01
Vertical Current Limits 5400P   591     1.000000E+01    2.000000E+01    3.000000E+01
Cross Correlation High Limit    5400P   591     6.000000E-01
Noise Limit 1   5400P   591     -4.800000E+01
Noise Limit 2   5400P   591     -3.800000E+01
Noise Limit 3   5400P   591     -2.800000E+01
Air Detect Threshold    5400P   591     322
Node Description        5400P   591     DCPS #591
```

Figure 6-7: The Get All Command

6.9.2 The Set command

The ***Set*** command is used for changing a property. The corresponding ***Get*** command can be used to verify the new setting, as shown in ***Figure 6-8***. Please note depending on the configuration a too short interval will give an error message.

```
set interval(1 min)
#
get interval
Interval        5400P   591     1 min
#
```

Figure 6-8: The Set Command

Use the ***Save*** commands to permanently store the new property value. Remember to always wait for the acknowledge character '#' after a save before switching off power to the sensor. If the power is lost while saving, the previous configuration saved to flash is used by the sensor.
The ***Mode*** and ***Baudrate*** property will require a ***Reset*** before the change is executed. All other property changes will be executed immediately.
Some properties are passkey protected and will not be accessible without first writing the passkey. If the passkey is needed you get the error message***: "ERROR PROTECTED PROPERTY".*** Using ***passkey 1000*** opens all user accessible property settings. Refer ***Table 6-1*** for more info.

6.9.3 XML commands

The ***Get ConfigXML*** command outputs all available sensor properties in XML-format.
The ***Get DataXML*** command outputs all available sensor parameters in XML-format.
The ***XML-output*** is a general format shared by all Aanderaa smart sensors; the output from different types of smart sensors can be read and presented as e.g. in a general smart sensor setup program.

6.10 Example – How to configure sensor in Smart Sensor Terminal mode

In the following examples several configuration changes are shown. The command ***Stop*** is recommended to avoid output strings while configuring the sensor. If the sensor has started to transmit data when the user tries to communicate, it may take a while before the command response is sent from the sensor. This depends on configuration, timing and number of output parameters etc.

6.10.1 Example 1: Configure 1 column, the other columns disabled

//Press Enter to start communicating with the sensor
↵ //press Enter
Stop ↵//Wait for ack #. Repeat if necessary
Set Passkey(1) ↵
Set ↵//wait for ack #
Set C1 Distance First Cell Center(6.0m) ↵//wait for ack #
Set C1 Cell Size(2.0m) ↵//wait for ack #
Set C1 Number Of Cells(25) ↵//wait for ack #
Set C1 Cell Center Spacing(2.0m) ↵//wait for ack #
Set C2 Enable Column(No) ↵//wait for ack #
Set C3 Enable Column(No) ↵//wait for ack #
Set Enable Surface Cell(No) ↵//wait for ack #
Do Refresh↵//necessary if column settings or ping number is changed before the interval
Set Interval(1 min) //an error message is sent from the sensor if the interval is too short
Save ↵// wait for ack #
Reset ↵// the sensor will restart with new settings.

```
Stop
#
Set Passkey(1000)
#
Set C1 Enable Surface Reference(No)
#
Set C1 Distance First Cell Center(6.0m)
#
Set C1 Cell Size(2.0m)
#
Set C1 Number Of Cells(25)
#
Set C1 Cell Center Spacing(2.0m)
#
Set C2 Enable Column(No)
#
Set C3 Enable Column(No)
#
Set Enable Surface Cell(No)
#
Do Refresh
#
Set Interval(1 min)
#
Save
#
Reset
#
%
```

Figure 6-9: Example 1

Comments to example 1:

It is possible to enable the ***Surface Cell*** and the ***Surface Reference*** for the column, but this requires that the sensor knows the correct pressure. The automatic surface referencing was made for the SeaGuardII and SmartGuard where the DCPS can receive the pressure measured directly from the Datalogger via AiCaP(as parameter input from a pressure sensor connected to the same SeaGuardII/SmartGuard).To use ***Surface Reference*** on a sensor without a SeaGuardII /SmartGuard with a pressure sensor connected, the user must set the correct ***Fixed Installation Pressure*** setting (can be changed while sensor is running).
Column 1 is set up to 25 cells with 2m cell size. Since the Cell Center Spacing is 2m and equal to the Cell Size there will be no overlap and this gives a column which is 2m * 25 = 50m long. Since the Distance First Cell Center is 2m, the column covers from 1m to 51m range from the sensor head. The first cell starts 1 meter away from the head because the distance to first cell center is 2 meter and since the first cell is 2 meter this cell will stretch from 1 meter to 3 meter away from the head.

The available/selectable values for Cell Size, Distance to First Cell, Number of Cells and Cell Spacing can be found by sending the command ***Help***. This gives a printout from the sensor showing a short help text from the sensor, refer ***Figure 6-14***. Setting a value which is not shown here for enumerated properties gives an error message ***(*ERROR ARGUMENT ERROR***).

A ***Do Refresh*** command should always be sent after a reconfiguration of the column settings, bandwidth or the ping number. This must be done to be able to show the user an error message if the time settings are out of range (interval or polled ping rate). The shortest interval or highest polled ping rate possible depends on the number of cells, bandwidth (narrowband/broadband), number of pings (non-polled mode) and number of enabled output parameters.
The available sub commands (***Do Sample***, ***Do Output***, ***Do Refresh*** and ***Do Calc MinTime***) are listed next. All available values on the enumerated properties are also shown here. Some of the enumerations will change depending on configuration (Polled Pingrate property and Interval property).

The three columns have almost the same available settings. The difference between them is that column 1 can have up to 75 cells, column 2 up to 50 cells and column 3 up to 25 cells (150 cells totally).
The user is allowed to set up columns which are way too long, the sensor can sample approximately 115m, the acoustic range is in most cases much shorter than this (The practical acoustic range varies between 30 and 70m in broadband mode and 35 to 80m in narrowband mode depending on the backscatter conditions). Setting a way too long column does not give an error message. If for example the cell size is 5.0m, number of cells 50 and cell spacing 5m this only gives valid data up to cell 23. The Cell Status parameter on all the rest of the cells will indicate that these are out of range.

6.10.2 Example 2: Setting orientation and measurement properties

//Press Enter to start communicating with the sensor
↵ //press Enter
Stop ↵//Wait for ack #. Repeat if necessary
Set Passkey(1) ↵
Set Enable Upside Down(Yes) ↵//wait for ack #
Set Enable Surface Cell(No) ↵//if it was enabled, has to be disabled with upside down enabled
Set C1 Enable Surface Reference(No) ↵//same as for surface cell
Set C2 Enable Surface Reference(No) ↵//same as for surface cell if column 2 is enabled
Set C3 Enable Surface Reference(No) ↵//same as for surface cell if column 3 is enabled
Set Enable Tilt Compensation(Yes) ↵//wait for ack #
Set Enable Fixed Heading(No) ↵//wait for ack #
Set Bandwidth(Broadband) ↵//wait for ack #
Set Enable Ambiguity Lock(Yes) ↵//wait for ack #
Set Ping Number(20) ↵//wait for ack #
Set Enable Burst Mode(No) ↵//wait for ack #
Do Refresh↵//Bandwidth changed, necessary to do this
Set Interval(2 min) ↵//The present interval can be too short, always wise to try to set again (error if too short)
Save ↵// wait for ack #
Reset ↵// the sensor will restart with new settings

```
Stop
#
Set Passkey(1)
#
Set Enable Upside Down(Yes)
#
Set Enable Surface Cell(No)
#
Set C1 Enable Surface Reference(No)
#
Set C2 Enable Surface Reference(No)
#
Set C3 Enable Surface Reference(No)
#
Set Enable Tilt Compensation(Yes)
#
Set Enable Fixed Heading(No)
#
Set Bandwidth(Broadband)
#
Set Enable Ambiguity Lock(Yes)
#
Set Ping Number(20)
#
Set Enable Burst Mode(No)
#
Do Refresh
#
Set Interval(2 min)
#
Save
#
Reset
#
```

Figure 6-10: Example 2

Comments to example 2:

When the user wants to use the sensor downwards, the ***Upside Down*** should be enabled. The sensor can sense the orientation itself and it uses the measured orientation when calculating north and east speed components and the correct heading and pitch/roll.

The user is allowed to enable upside down, surface cell and surface reference even if this does not work.

If the sensor is upside down while the surface cell is enabled, the surface cell parameter's status is set to not valid error and the values are zero. If surface referred is enabled, the column is forced to be sensor referred.
If the tilt compensation is disabled, the sensor uses zero tilt for all calculations. The tilt compensation should normally be enabled (default setting from factory). The fixed heading is normally disabled. The fixed heading can be used when the sensor is in a fixed position, for example on a location where the magnetic field is disturbed by something nearby.

6.10.3 Example 3: Output from sensor when all selectable output is off

//Press Enter to start communicating with the sensor.
↵ //press Enter
Stop ↵// Stop current measurement. Wait for ack #. Repeat if necessary.
Set Passkey(1) ↵//wait for ack #
Set C1 Number Of Cells(1) ↵//wait for ack #
Set Select Profile Parameters(User Specified) ↵//wait for ack #
Set NE Speed Output(Off) ↵//wait for ack #
Set 3-Beam Combination Output(Off) ↵//wait for ack #
Set AutoBeam Output(Off) ↵//wait for ack #
Set Vertical Speed Output(Off) ↵//wait for ack #
Set Strength Output(Off) ↵//wait for ack #
Set Beam Speed Output(Off) ↵//wait for ack #
Set Beam Strength Output(Off) ↵//wait for ack #
Set Std Dev Speed Output(Off) ↵//wait for ack #
Set Std Dev Beam Speed Output(Off) ↵//wait for ack #
Set Cross Difference Output(Off) ↵//wait for ack #
Set Correlation Factor Output(Off) ↵//wait for ack #
Set Noise Level Output(Off) ↵//wait for ack #
Set Heading Output(Off) ↵//wait for ack #
Set Pitch Roll Output(Off) ↵//wait for ack #
Set Abs Tilt Output(Off) ↵//wait for ack #
Set Max Tilt Output(Off) ↵//wait for ack #
Set Tilt Direction Output(Off) ↵//wait for ack #
Set Std Dev Heading Output(Off) ↵//wait for ack #
Set Std Dev Tilt Output(Off) ↵//wait for ack #
Set Charge Voltage Output(Off) ↵//wait for ack #
Set Memory Used Output(Off) ↵//wait for ack #
Set Voltage Output(Off) ↵//wait for ack #
Set Current Output(Off) ↵//wait for ack #
Set Air Detect Output(Off) ↵//wait for ack #
Set Speed Of Sound Output(Off) ↵//wait for ack #
Set Depth Output(Off) ↵//wait for ack #
Set Salinity Output(Off) ↵//wait for ack #
Set Density Output(Off) ↵//wait for ack #
Do Refresh ↵
Set Interval(10 sec) ↵
Save ↵// wait for ack #
Reset ↵// the sensor will restart with new settings

```
%
StartupInfo    5400   43     Mode    AADI Smart Sensor Terminal Protocol    RS232 Protocol Version  3     Config Version  49
Initializing...
Started...
MEASUREMENT    5400   43     Record State    524289  Ping Count    800    Cell Index    1000    Cell State1    6384    Cell State2    -241
Horizontal Speed[cm/s]  38.13   Direction[Deg.M]     34.19
```

Figure 6-11: Reference after Example 3

Comments example 3:

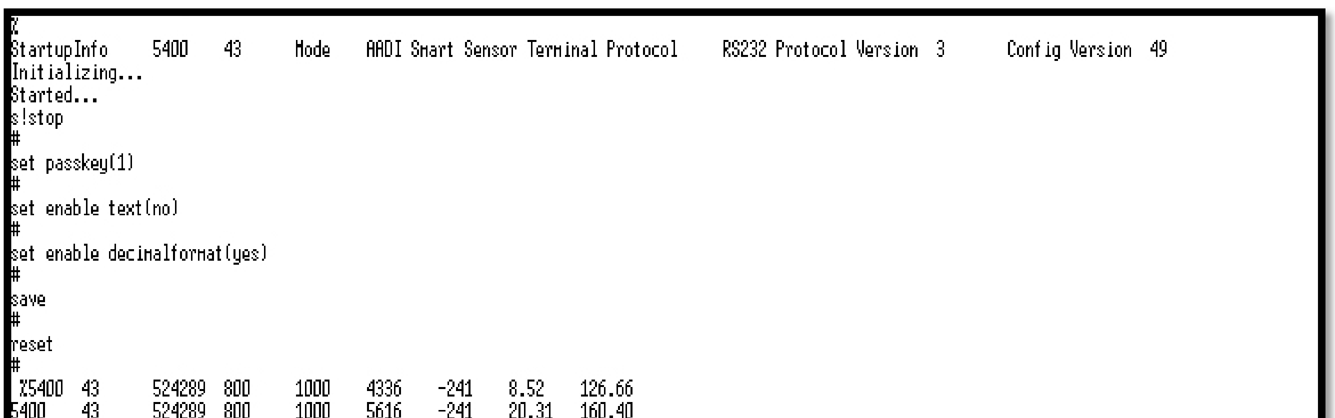
The sensor always outputs some information which is not possible to disable. In this example only 1 cell is enabled just to show the shortest possible output first, see *Error! Reference source not found.*.

The data output message starts with MEASUREMENT followed by ***Product Number***, ***Serial Number*** (tabulator between). The rest of the message is the output parameters which change from record to record. First there is a ***Record State*** which gives information about different quality parameters per record and then ping count per record. After this comes all the profile data. The ***Cell Index*** gives information about the column and cell number. Column 1 starts with cell index 1000, column 2 with 2000 and column 3 with 3000. The highest cell index in column 1 is 1074 (cell 0 to 74), in column 2 it is 2049 (cell 0 to 49) and in column 3 it is 3024 (cell 0 to 24). If the surface cell is enabled a cell index 0 is also shown (treated as a column with 1 cell). ***Cell State 1*** and ***Cell State 2*** gives information about the data quality in each cell. ***Horizontal Speed*** and ***Direction*** is the minimum output from each cell.

The parameter names and values are separated by tabulator (ASCII code 09).

6.10.4 Example 4: Even more compact output, text off and decimal format

//Press Enter to start communicating with the sensor.
↵ //press Enter
Stop ↵// Stop current measurement. Wait for ack #. Repeat if necessary.
Set Passkey(1) ↵//wait for ack #
Set Enable Text(No) ↵//wait for ack #
Set Enable Decimalformat(Yes) ↵//wait for ack #
Save ↵// wait for ack #
Reset ↵// the sensor will restart with new setting.



```
%
StartupInfo	5400	43	Mode	AADI Smart Sensor Terminal Protocol	RS232 Protocol Version	3	Config Version	49
Initializing...
Started...
s!stop
#
set passkey(1)
#
set enable text(no)
#
set enable decimalformat(yes)
#
save
#
reset
#
 %5400	43	524289	800	1000	4336	-241	8.52	126.66
5400	43	524289	800	1000	5616	-241	20.31	160.40
```

Figure 6-12: Example of output message with text off and decimal format

When you turn off text you also turn off the ***StartupInfo*** so this example gives an output without start up message and the parameter names also disappears; refer *Error! Reference source not found.*.

6.10.5 Example 5: The parameters output outside the profile data

//Press Enter to start communicating with the sensor↵ //press Enter
Stop ↵// Stop current measurement. Wait for ack #. Repeat if necessary.
Set Heading Output(Output) ↵//wait for ack #
Set Pitch Roll Ouput(Output) ↵//wait for ack #
Set Abs Tilt Output(Output) ↵//wait for ack #
Set Max Tilt Output(Output) ↵//wait for ack #
Set Tilt Direction Output(Output) ↵//wait for ack #
Set Noise Level Output(Output) ↵//wait for ack #
Set Std Dev Heading Output(Output) ↵//wait for ack #
Set Std Dev Tilt Output(Output) ↵//wait for ack #
Set Temperature Output(Output) ↵//wait for ack #
Set Pressure Output(Output) ↵//wait for ack #
Set Charge Voltage Output(Output) ↵//wait for ack #
Set Memory Used Output(Output) ↵//wait for ack #
Set Voltage Output(Output) ↵//wait for ack #
Set Current Output(Output) ↵//wait for ack #
Set Air Detect Output(Output) ↵//wait for ack #
Set Speed Of Sound Output(Output) ↵//wait for ack #
Set Depth Output(Output) ↵//wait for ack #
Set Salinity Output(Output) ↵//wait for ack #
Set Density Output(Output) ↵//wait for ack #
Set Enable Text(Yes) ↵//wait for ack #, text on again to see the parameter names
Set Enable Decimalformat(No) ↵//wait for ack #, back to scientific numbers
Save ↵// wait for ack #
Reset ↵// the sensor will restart with new settings

The output with all parameters outside the columns is described in the Figure 6-13.

```
%
StartupInfo     5400P   591     Mode     AADI Smart Sensor Terminal Protocol     RS232 Protocol Version
3       Config Version  51
Initializing...
Started...
MEASUREMENT     5400P   591     Temperature[Deg.C]      2.477102E+01    Pressure[kPa]   9.596094E+01
Heading[Deg.M]  2.993685E+02    Std Dev Heading[Deg.M]  1.186100E+00    Pitch[Deg]      4.573795E+01
Roll[Deg]       -9.000007E+01   Abs Tilt[Deg]   9.000000E+01    Max Tilt[Deg]   9.000000E+01    Std Dev
 Tilt[Deg]      0.000000E+00    Tilt Direction[Deg]     1.409586E+02    Speed Of Sound[m/s]     1.50000
0E+03   Depth[m]        0.000000E+00    Salinity[PSU]   3.500000E+01    Density[kg/m^3] 1.023455E+03
Charge Voltage Vtx1[V]  4.969116E+00    Charge Voltage Vtx2[V]  4.981018E+00    Min Input Voltage[V]
8.257500E+00    Input Voltage[V]        8.540000E+00    Input Current[mA]       4.425000E+01    Memory
Used[Bytes]     469220  Air Detect[LSB] 340     Noise Peak Level B1[dB] -4.647610E+01   Noise Peak Leve
l B2[dB]        -4.736411E+01   Noise Peak Level B3[dB] -4.949816E+01   Noise Peak Level B4[dB] -4.9128
11E+01  Noise Average Level B1[dB]      -5.359954E+01   Noise Average Level B2[dB]      -5.475352E+01
Noise Average Level B3[dB]      -5.386032E+01   Noise Average Level B4[dB]      -5.185456E+01   Record
State   524298  Ping Count      147     Cell Index      1000    Cell State1     752     Cell State2
-256    Horizontal Speed[cm/s]  7.718903E+01    Direction[Deg.M]        3.039102E+02
```

Figure 6-13: All parameters output outside profile data

Then the Record Status and Ping Count are the last parameters before the first cell parameter in the first column is output.

6.11 Help command output

Figure 6-14: Output example from the Help command

```
help
#
Commands:       Do_SUBCMD<CRLF>                 = Execute SUBCMD
                Get_PROPERTY<CRLF>              = Output PROPERTY value.
                Get_All<CRLF>                   = Output all property values.
                Get_All Parameters<CRLF>        = Output all parameter values.
                Set_PROPERTY(V,..V)<CRLF>       = Set PROPERTY to V,..V.
                Set_Passkey(V)<CRLF>            = Set Passkey.
                Save<CRLF>                      = Store current settings.
                Load<CRLF>                      = Load stored settings.
                Reset<CRLF>                     = Reset node.
                Stop<CRLF>                      = Stop measurement
                Start<CRLF>                     = Start measurement
                Help<CRLF>                      = Print help information.
Sub commands:           Sample
                Output
                Refresh
                Calc MinTime
                Set Clock
                Get Clock
Argument list for enumerated properties:
                Interface:      RS232
                Baudrate:       4800,9600,57600,115200
                Flow Control:   None,Xon/Xoff
                Comm Timeout:   Always On,10 s,20 s,30 s,1 min,2 min,5 min,10 min
                Mode:   AiCaP,Smart Sensor Terminal,AADI Real-Time
                Polled Pingrate:        0.1 Hz,0.5 Hz,1 Hz,2 Hz,3 Hz,4 Hz,5 Hz,6 Hz,7 Hz,8 Hz,9 Hz,10 Hz
                Bandwidth:      Narrowband,Broadband
                Ping Number:    10,20,30,40,50,60,70,80,90,100,150,200,250,300,400,500,600,800,1200,2400,3600,7200
                Burst Period Placement: Start Of Interval,End Of Interval
                Surface Cell Size:      0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
                C1 Cell Size:   0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
                C1 Distance First Cell Center:  1.5m,1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.
8m,2.9m,3.0m,3.5m,4.0m,4.5m,5.0m,5.5m,6.0m,6.5m,7.0m,7.5m,8.0m,8.5m,9.0m,9.5m,10.0m,11.0m,12.0m,13.0m,14.0m,15.0m,1
6.0m,17.0m,18.0m,19.0m,20.0m,22.0m,24.0m,26.0m,28.0m,30.0m,32.0m,34.0m,36.0m,38.0m,40.0m,42.0m,44.0m,46.0m,48.0m,50
.0m,55.0m,60.0m,65.0m,70.0m
                C1 Number Of Cells:     1,2,3,4,5,6,7,8,9,10,12,15,20,25,30,35,40,45,50,55,60,65,70,75
                C1 Cell Center Spacing: 0.1m,0.2m,0.3m,0.4m,0.5m,0.6m,0.7m,0.8m,0.9m,1.0m,1.1m,1.2m,1.3m,1.4m,1.5m,
1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.8m,2.9m,3.0m,3.2m,3.6m,4.0m,5.0m,6.0m,7.0m,8.0m,9.0m,
10.0m,11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m,19.0m,20.0m,25.0m,30.0m
                C2 Cell Size:   0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
                C2 Distance First Cell Center:  1.5m,1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.
8m,2.9m,3.0m,3.5m,4.0m,4.5m,5.0m,5.5m,6.0m,6.5m,7.0m,7.5m,8.0m,8.5m,9.0m,9.5m,10.0m,11.0m,12.0m,13.0m,14.0m,15.0m,1
6.0m,17.0m,18.0m,19.0m,20.0m,22.0m,24.0m,26.0m,28.0m,30.0m,32.0m,34.0m,36.0m,38.0m,40.0m,42.0m,44.0m,46.0m,48.0m,50
.0m,55.0m,60.0m,65.0m,70.0m
                C2 Number Of Cells:     1,2,3,4,5,6,7,8,9,10,12,14,16,18,20,25,30,35,40,45,50
                C2 Cell Center Spacing: 0.1m,0.2m,0.3m,0.4m,0.5m,0.6m,0.7m,0.8m,0.9m,1.0m,1.1m,1.2m,1.3m,1.4m,1.5m,
1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.8m,2.9m,3.0m,3.2m,3.6m,4.0m,5.0m,6.0m,7.0m,8.0m,9.0m,
10.0m,11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m,19.0m,20.0m,25.0m,30.0m
                C3 Cell Size:   0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
                C3 Distance First Cell Center:  1.5m,1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.
8m,2.9m,3.0m,3.5m,4.0m,4.5m,5.0m,5.5m,6.0m,6.5m,7.0m,7.5m,8.0m,8.5m,9.0m,9.5m,10.0m,11.0m,12.0m,13.0m,14.0m,15.0m,1
6.0m,17.0m,18.0m,19.0m,20.0m,22.0m,24.0m,26.0m,28.0m,30.0m,32.0m,34.0m,36.0m,38.0m,40.0m,42.0m,44.0m,46.0m,48.0m,50
.0m,55.0m,60.0m,65.0m,70.0m
                C3 Number Of Cells:     1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25
                C3 Cell Center Spacing: 0.1m,0.2m,0.3m,0.4m,0.5m,0.6m,0.7m,0.8m,0.9m,1.0m,1.1m,1.2m,1.3m,1.4m,1.5m,
1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.8m,2.9m,3.0m,3.2m,3.6m,4.0m,5.0m,6.0m,7.0m,8.0m,9.0m,
10.0m,11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m,19.0m,20.0m,25.0m,30.0m
                Select Profile Parameters:      Simple Output,Basic Output,Basic + Beam Output,Basic + 3-Beam Outpu
t,Basic + Beam + 3-Beam Output,Full Output,User Specified
                NE Speed Output:        Off,Output
                3-Beam Combination Output:      Off,Output
                AutoBeam Output:        Off,Output
                AutoBeam Speed Type:    Polar,Rectangular,Polar+Rectangular
                Vertical Speed Output:  Off,Output
                Strength Output:        Off,Output
                Beam Speed Output:      Off,Output
                Beam Strength Output:   Off,Output
                Std Dev Speed Output:   Off,Output
                Std Dev Beam Speed Output:      Off,Output
                Cross Difference Output:        Off,Output
                Correlation Factor Output:      Off,Output
                Noise Level Output:     Off,Output
                Heading Output: Off,Output
                Pitch Roll Output:      Off,Output
                Abs Tilt Output:        Off,Output
                Max Tilt Output:        Off,Output
                Tilt Direction Output:  Off,Output
                Std Dev Heading Output: Off,Output
                Std Dev Tilt Output:    Off,Output
                Temperature Output:     Off,Output
                Pressure Output:        Off,Output
                Charge Voltage Output:  Off,Output
                Memory Used Output:     Off,Output
                Voltage Output: Off,Output
                Current Output: Off,Output
                Air Detect Output:      Off,Output
                Speed Of Sound Output:  Off,Output
                Depth Output:   Off,Output
                Salinity Output:        Off,Output
                Density Output: Off,Output
                Interval:       20 sec,30 sec,1 min,2 min,3 min,5 min,6 min,10 min,15 min,20 min,30 min,1 hour,2 ho
ur,3 hour
Argument list for properties with default values:
                Distance Pressure To Center TRD:        .187000,0.150000
                Sound Speed:    1473.000000,1500.000000,1525.000000
#
```

6.12 Help command output.

Please note that some of the alternative values might be different with your sensor due to a different configuration or mode.

Commands:

Do_SUBCMD<CRLF>	= Execute SUBCMD
Get_PROPERTY<CRLF>	= Output PROPERTY value.
Get_All<CRLF>	= Output all property values.
Get_All Parameters<CRLF>	= Output all parameter values.
Set_PROPERTY(V,..V)<CRLF>	= Set PROPERTY to V,..V.
Set_Passkey(V)<CRLF>	= Set Passkey
Save<CRLF>	= Store current settings.
Load<CRLF>	= Load stored setting.
Reset<CRLF>	= Reset node.
Stop<CRLF>	= Stop measurement
Start<CRLF>	= Start measurement
Help<CRLF>	= Print help information.

Sub commands:

Sample
Output
Refresh
Calc MinTime
Set Clock
Get Clock

Argument list for enumerated properties:

Interface:	RS-232/RS-422
Baudrate:	4800,9600,57600,115200
Flow Control:	None, Xon/Xoff
Comm Timeout:	Always On,10 s,20 s,30 s,1 min,2 min,5 min,10 min
Mode:	AiCaP, Smart Sensor Terminal, AADI Real-Time
Polled Pingrate:	0.1 Hz,0.5 Hz,1 Hz,2 Hz,3 Hz,4 Hz,5 Hz,6 Hz,7 Hz, 8 Hz,9 Hz, 10 Hz
Bandwidth:	Narrowband, Broadband
Ping Number:	10,20,30,40,50,60,70,80,90,100,150,200,250,300, 400,500,600,800,1200,2400,3600,7200
Burst Period Placement:	Start Of Interval, End Of Interval
Surface Cell Size:	0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
C1 Cell Size:	0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
C1 Distance First Cell Center:	1.5m,1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m, 2.5m,2.6m,2.7m,2.8m, 2.9m, 3.0m,3.5m,4.0m,4.5m,5.0m, 5.5m,6.0m,6.5m,7.0m,7.5m,8.0m,8.5m,9.0m,9.5m,10.0m, 11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m, 19.0m,20.0m,22.0m,24.0m,26.0m,28.0m,30.0m,32.0m, 34.0m,36.0m,38.0m,40.0m,42.0m,44.0m,46.0m,48.0m, 50.0m,60.0m,65.0m,70.0m
C1 Number Of Cells:	1,2,3,4,5,6,7,8,9,10,12,15,20,25,30,35,40,45,50,55, 60,65,70,75

C1 Cell Center Spacing:	0.1m,0.2m,0.3m,0.4m,0.5m,0.6m,0.7m,0.8m,0.9m,1.0m, 1.1m,1.2m,1.3m,1.4m,1.5m,1.6m,1.7m,1.8m,1.9m,2.0m, 2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.8m,2.9m,3.0m, 3.2m,3.6m,4.0m,5.0m,6.0m,7.0m,8.0m,9.0m,10.0m, 11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m, 19.0m,20.0m,25.0m,30.0m
C2 Cell Size:	0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
C2 Distance First Cell Center:	1.5m,1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m, 2.4m, 2.5m,2.6m,2.7m,2.8m,2.9m,3.0m,3.5m,4.0m,4.5m,5.0m, 5.5m,6.0m,6.5m,7.0m,7.5m,8.0m,8.5m,9.0m,9.5m,10.0m, 11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m, 19.0m,20.0m,22.0m,24.0m,26.0m,28.0m,30.0m,32.0m, 34.0m,36.0m,38.0m,40.0m,42.0m,44.0m,46.0m,48.0m, 50.0m,55.0m,60.0m,65.0m,70.0m
C2 Number Of Cells:	1,2,3,4,5,6,7,8,9,10,12,14,16,18,20,25,30,35,40,45,50
C2 Cell Center Spacing:	0.1m,0.2m,0.3m,0.4m,0.5m,0.6m,0.7m,0.8m,0.9m,1.0m, 1.1m,1.2m,1.3m,1.4m,1.5m,1.6m,1.7m,1.8m,1.9m,2.0m, 2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.8m,2.9m,3.0m, 3.2m,3.6m,4.0m,5.0m,6.0m,7.0m,8.0m,9.0m,10.0m, 11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m, 19.0m,20.0m,25.0m,30.0m
C3 Cell Size:	0.5m,1.0m,1.5m,2.0m,2.5m,3.0m,3.5m,4.0m,4.5m,5.0m
C3 Distance First Cell Center:	1.5m,1.6m,1.7m,1.8m,1.9m,2.0m,2.1m,2.2m,2.3m,2.4m, 2.5m,2.6m,2.7m,2.8m,2.9m,3.0m,3.5m,4.0m,4.5m,5.0m, 5.5m,6.0m,6.5m,7.0m,7.5m,8.0m,8.5m,9.0m,9.5m,10.0m, 11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m, 19.0m,20.0m,22.0m,24.0m,26.0m,28.0m,30.0m,32.0m, 34.0m,36.0m,38.0m,40.0m,42.0m,44.0m,46.0m,48.0m, 50.0m,55.0m,60.0m,65.0m,70.0m
C3 Number Of Cells:	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21, 22,23,24,25
C3 Cell Center Spacing:	0.1m,0.2m,0.3m,0.4m,0.5m,0.6m,0.7m,0.8m,0.9m,1.0m, 1.1m,1.2m,1.3m,1.4m,1.5m, 1.6m,1.7m,1.8m,1.9m,2.0m, 2.1m,2.2m,2.3m,2.4m,2.5m,2.6m,2.7m,2.8m,2.9m,3.0m, 3.2m,3.6m,4.0m,5.0m,6.0m,7.0m,8.0m,9.0m,10.0m, 11.0m,12.0m,13.0m,14.0m,15.0m,16.0m,17.0m,18.0m, 19.0m,20.0m,25.0m,30.0m
Select Profile Parameters:	Simple Output, Basic Output, Basic + Beam Output, Basic + 3-Beam Output, Basic + Beam + 3-Beam Output, Full Output, User Specified
NE Speed Output:	Off, Output
3-Beam Combination Output:	Off, Output
AutoBeam Output:	Off, Output
AutoBeam Speed Type:	Polar, Rectangular, Polar+Rectangular
Vertical Speed Output:	Off, Output
Strength Output:	Off, Output
Beam Speed Output:	Off, Output
Beam Strength Output:	Off, Output
Std Dev Speed Output:	Off, Output
Std Dev Beam Speed Output:	Off, Output
Cross Difference Output:	Off, Output
Correlation Factor Output:	Off, Output

Noise Level Output:	Off, Output
Heading Output:	Off, Output
Pitch Roll Output:	Off, Output
Abs Tilt Output:	Off, Output
Max Tilt Output:	Off, Output
Tilt Direction Output:	Off, Output
Std Dev Heading Output:	Off, Output
Std Dev Tilt Output:	Off, Output
Charge Voltage Output:	Off, Output
Memory Used Output:	Off, Output
Voltage Output:	Off, Output
Current Output:	Off, Output
Air Detect Output:	Off, Output
Speed Of Sound Output:	Off, Output
Depth Output:	Off, Output
Salinity Output:	Off, Output
Density Output:	Off, Output
Interval:	10 sec,20 sec,30 sec,1 min,2 min,3 min,5 min,6 min, 10 min,15 min,20 min,30 min,1 hour, 2 hour,3 hour

Argument list for properties with default values:

Distance Pressure To Center TRD:	0.187000, 0.150000
Sound Speed:	1473.000000,1500.000000,1525.000000

The available sub commands (***Do Sample***, ***Do Output***, ***Do Refresh*** and ***Do Calc MinTime***) are listed next. All available values on the enumerated properties are also shown here. Some of the enumerations will change depending on configuration (Polled Pingrate property and Interval property).
The three columns have almost the same available settings. The difference between the three is that column 1 can have up to 75 cells, column 2 up to 50 cells and column 3 up to 25 cells (150 cells totally).
The user is allowed to set up columns which are way too long, the sensor is able to sample approximately 115m, the acoustic range is in most cases much shorter than this (The practical acoustic range varies between 30 and 70m in broadband mode and 35 to 80m in narrowband mode depending on the backscatter conditions). Setting a way too long column does not give an error message. If for example the cell size is 5.0m, number of cells 50 and cell spacing 5m this only gives valid data up to cell 23. The Cell Status parameter on all the rest of the cells will indicate that these are out of range.

CHAPTER 7 **Output parameters and error codes**

7.1 Parameters outside profile data

These data are output first before the parameters from all cells in the columns. The name with unit shown in ***Table 7-1*** is the exact same way as these are sent from the sensor, i.e. parameter name with unit in [ ] parentheses. The parameter name and the value output are separated by a tabulator (ASCII code 09). The output is a long string terminated by carriage return + line feed after all the profile data at the end.

Table 7-1: Sensor parameter details and explanation outside profile data

Name with unit	Type	Explanation
Heading[Deg.M]	Float	Averaged heading from one interval, one heading measurement per ping, vector averaged.
Std Dev Heading[Deg.M]	Float	Standard deviation calculation on all heading values from one interval. Indicates how much the sensor rotates around the vertical axis during a measurement interval.
Pitch[Deg]	Float	Pitch angle, average from one interval, one tilt measurement per ping. Pitch is the rotation angle around the x-axis of the sensor (same axis as Transducer 1 and 3)
Roll[Deg]	Float	Roll angle, average from one interval, one tilt measurement per ping. Roll is the rotation angle around the y-axis of the sensor (same axis as transducer 4 and 2)
Abs Tilt[Deg]	Float	Angle between sensor plane and horizontal plane. Calculates one value per ping from pitch and roll angles, average of all values.
Max Tilt[Deg]	Float	Maximum absolute tilt from the interval
Std Dev Tilt[Deg]	Float	Standard deviation tilt from all values of the absolute tilt in the interval. Indicates if the sensor is moving around with variable tilt during the measurement interval.
Tilt Direction[Deg.M]	Float	A tilt direction is calculated per ping, this is the average from the interval. Gives the direction where the sensor has its largest tilt, with magnetic north as reference.
Speed Of Sound[m/s]	Float	Either the fixed input setting or the derived sound speed (from other settings), averaged.[1)]
Depth[m]	Float	Depth calculated from input settings, averaged.[1)]
Salinity[PSU]	Float	Same as input setting. In AiCaP on SeaGuardII this can be calculated from Conductivity, Temperature and Pressure sensor inputs.[1)]
Density[kg/m^3]	Float	Calculated from Temperature, Pressure and Conductivity. In AiCaP on SeaGuardII this can be calculated from sensor inputs.[1)]

Name with unit	Type	Explanation
Charge Voltage Vtx1[V]	Float	The measured voltage to the capacitor on transmitter electronics to Transducer 1 and 2. It should normally be >4.8V.
Charge Voltage Vtx2[V]	Float	The measured voltage to the capacitor on transmitter electronics to Transducer 3 and 4. It should normally be >4.8V
Min Input Voltage[V]	Float	The minimum input voltage measured while charging the capacitor bank. It should normally be >6.0V
Input Current[mA]	Float	The current measured when not charging while awake, averaged.
Memory Used[Bytes]	Integer	Used heap memory.
Air Detect	Integer	Gives the raw value measured by the air detect sensor. The air detect function disables the ping pulse from the transducers (if the value is below the Air detect Threshold value). Only available on DCPS 5400, not on 5402 and 5403.
Noise Peak Level B1[dB]	Float	Signal measured from Transducer 1 before ping and Doppler measurement. One measurement before each ping, outputs the highest noise strength.[2)]
Noise Peak Level B2[dB]	Float	Signal measured from Transducer 2 before ping and Doppler measurement. One measurement before each ping, outputs the highest noise strength.[2)]
Noise Peak Level B3[dB]	Float	Signal measured from Transducer 3 before ping and Doppler measurement. One measurement before each ping, outputs the highest noise strength.[2)]
Noise Peak Level B4[dB]	Float	Signal measured from Transducer 4 before ping and Doppler measurement. One measurement before each ping, outputs the highest noise strength.[2)]
Record State	Integer	A 32-bit status number which provides quality warnings.
Ping Count	Integer	Number of pings executed, can be lower than configured number of pings to be done.

[1)] *The sensor has input settings for Sound Speed (m/s), Air Pressure (kPa), Local Gravity Constant (m/s^2), Salinity (PSU), Fixed Installation Pressure (kPa) and Temperature (Deg.C). When the sensor is used in AiCaP mode on a SeaGuardII or SmartGuard the sensor can receive sensor input from other sensors to calculate Density, Depth, Salinity and Sound Speed in water (CTD input data). Without an Aanderaa SeaGuardII or SmartGuard the user has to send down the new settings to be able to get surface referred columns and surface cell. Usually the salinity does not change much during a short time period. This is normally the case for Temperature also (the DCPS5400 can also be ordered with its own temperature 4080). The Air Pressure and Fixed Installation Pressure can for example be sent to the sensor more often to make the sensor able to calculate its own depth used for correct surface positioning/referencing.*

[2)] *The noise peak levels gives an indication if something nearby is sending out acoustic signals in the sea water or if there is noise on the input supply to the sensor.*

7.2 Cell Parameters

All Cells have the same number of parameters; the parameters shown in ***Table 7-2*** are repeated for each cell. The sensor can output from 1 cell in 1 column up to 150 cells total divided over three columns (75 in column 1, 50 in column 2 and 25 in column 3).

Table 7-2: Profile parameters details

Cell parameter with unit	Type	Description
Cell index	Int	An index which gives column and cell number. A 1xxx is column 1, 2xxx is column 2 and 3xxx is column 3. The cell index in column 1 is in the range from 1000-1074 dependent on number of cells, column 2 is 2000-2049 and column 3 is 3000-3024. . The surface cell has a cell index 0. This index is only shown in Smart Sensor Terminal mode. The xml-output in the other modes (AiCaP and AADI Real-Time) gives profile data with separate column and cell index.
Cell State1	Int	The cell status indicates different conditions like for example if a cell is out of range (too far away). If zero, everything is ok. See ***Table 7-4*** for explanation.
Cell State 2	Int	The cell status indicates different conditions at beam level. If zero, everything is ok. See ***Table 7-5*** for explanation.
Horizontal Speed[cm/s]	Float	Horizontal speed calculated from the 4 beams and compensated for tilt, average of all pings over the interval duration. If the *AutoBeam Ouput* is enabled and the *AutoBeam Speed Type* is set *to Replace 4-Beam Data*, the autobeam algorithm output is used instead of the 4-beam solution (available from software version 8.2.1)
Direction[Deg.M]	Float	The current direction calculated from the 4 beams combined with compass heading to determine the current direction. If the *AutoBeam Ouput* is enabled and the *AutoBeam Speed Type* is set *to Replace 4-Beam Data*, the autobeam algorithm output is used instead of the 4-beam solution (available from software version 8.2.1)
North Speed[cm/s]	Float	North speed component, average of all pings over the recording interval.
East Speed[cm/s]	Float	East speed component, average of all pings over the recording interval.
Vertical Speed[cm/s]	Float	Vertical speed component, average of all pings over the recording interval.
Sp Stdev Horizontal[cm/s]	Float	Single ping standard deviation is the standard deviation calculated from all horizontal speed data in the interval.
Sp Stdev Beam123[cm/s]	Float	Standard deviation for the horizontal speed data calculated from the 3-beam combination of beam 1, 2 and 3.[3)]
Sp Stdev Beam124[cm/s]	Float	Standard deviation for the horizontal speed data calculated from the 3-beam combination of beam 1, 2 and 4.[3)]

Cell parameter with unit	Type	Description
Sp Stdev Beam134[cm/s]	Float	Standard deviation for the horizontal speed data calculated from the 3-beam combination of beam 1, 3 and 4.[3)]
Sp Stdev Beam234[cm/s]	Float	Standard deviation for the horizontal speed data calculated from the 3-beam combination of beam 2, 3 and 4.[3)]
SpStdev AutoBeam[cm/s]	Float	Standard deviation calculated using the Autobeam algorithm for horizontal speed data.[4)]
Strength[dB]	Float	Averaged signal from the four beams. The signal strength is calculated for each beam for each ping and averaged at the end of the interval.
Horizontal Speed AutoBeam [cm/s]	Float	Horizontal speed from the Autobeam solution. The best data found automatically from the different beam solutions. Introduced from software version 8.2.1
Direction AutoBeam[Deg.M]		The current direction calculated from the 4 beams combined with compass heading to determine the current direction. Introduced from software version 8.2.1
North Beam123[cm/s]	Float	Averaged North speed based on a 3-beam solution from beam 1,2,3
North Beam124[cm/s]	Float	Averaged North speed based on a 3-beam solution from beam 1,2,4
North Beam134[cm/s]	Float	Averaged North speed based on a 3-beam solution from beam 1,3,4
North Beam234[cm/s]	Float	Averaged North speed based on a 3-beam solution from beam 2,3,4
North AutoBeam[cm/s]	Float	North speed from the Autobeam solution. The best data found automatically from the different beam solutions.
East Beam123[cm/s]	Float	Averaged East speed based on a 3-beam solution from beam 1,2,3
East Beam124[cm/s]	Float	Averaged East speed based on a 3-beam solution from beam 1,2,4
East Beam134[cm/s]	Float	Averaged East speed based on a 3-beam solution from beam 1,3,4
East Beam234[cm/s]	Float	Averaged East speed based on a 3-beam solution from beam 2,3,4
East AutoBeam[cm/s]	Float	East speed from the Autobeam solution. The best data found automatically from the different beam solutions.
Vertical Beam123[cm/s]	Float	Averaged Vertical speed based on a 3-beam solution from beam 1,2,3
Vertical Beam124[cm/s]	Float	Averaged Vertical speed based on a 3-beam solution from beam 1,2,4
Vertical Beam134[cm/s]	Float	Averaged Vertical speed based on a 3-beam solution from beam 1,3,4

Cell parameter with unit	Type	Description
Vertical Beam234[cm/s]	Float	Averaged Vertical speed based on a 3-beam solution from beam 2,3,4
Vertical AutoBeam[cm/s]	Float	Vertical speed from the Autobeam solution. The best data found automatically from the different beam solutions.
Beam1 Speed[cm/s]	Float	Averaged speed for beam 1.
Beam2 Speed[cm/s]	Float	Averaged speed for beam 2.
Beam3 Speed[cm/s]	Float	Averaged Speed for beam 3.
Beam4 Speed[cm/s]	Float	Averaged Speed for beam 4.
Beam1 Strength[dB]	Float	Averaged strength for beam 1.
Beam2 Strength[dB]	Float	Averaged strength for beam 2.
Beam3 Strength[dB]	Float	Averaged strength for beam 3.
Beam4 Strength[dB]	Float	Averaged strength for beam 4.
Beam1 Stdev[cm/s]	Float	Standard deviation calculated from all the beam 1 speeds in the interval.
Beam2 Stdev[cm/s]	Float	Standard deviation calculated from all the beam 2 speeds in the interval.
Beam3 Stdev[cm/s]	Float	Standard deviation calculated from all the beam 3 speeds in the interval.
Beam4 Stdev[cm/s]	Float	Standard deviation calculated from all the beam 4 speeds in the interval.
Cross Difference[cm/s]	Float	Calculated as (Beam1 Speed + Beam 3 Speed)-(Beam2 Speed+ Beam4 Speed) where the BeamX speeds are tilt compensated. The Cross Difference is calculated for each ping and averaged at the end of the interval. In a homogeneous water flow this value is close to zero.
Beam1 Correlation Factor[cm/s]	Float	In broadband mode only, this gives an indication of the quality of the speed data from beam1. The correlation factor should be close to 0.5
Beam2 Correlation Factor[cm/s]	Float	In broadband mode only, this gives an indication of the quality of the speed data from beam2. The correlation factor should be close to 0.5
Beam3 Correlation Factor[cm/s]	Float	In broadband mode only, this gives an indication of the quality of the speed data from beam3. The correlation factor should be close to 0.5
Beam4 Correlation Factor[cm/s]	Float	In broadband mode only, this gives an indication of the quality of the speed data from beam4. The correlation factor should be close to 0.5

The order of the output parameters from the sensor can change. The correct order can be found by sending the Get Dataxml command to the sensor. The configuration properties can be seen by sending a Get All command or a Get Configxml command to the sensor.

Table 7-3: Commands and Properties for enabling/disabling of Cell Parameters

Cell parameter with unit	How to disable/enable output
Cell index	Always on. Not possible to disable.
Cell Status	Always on. Not possible to disable.
Horizontal Speed[cm/s]	Always on. Not possible to disable. This is the 4-Beam solution but is overwritten if the AutoBeam algorithm is enabled (AutoBeam Output set to Output), and Set AutoBeam Speed Type is set to Replace 4-Beam Data
Direction[Deg.M]	Always on. Not possible to disable. This is the 4-Beam solution but is overwritten if the AutoBeam algorithm is enabled (Set AutoBeam Output(Output)), and Set AutoBeam Speed Type is set to Replace 4-Beam Data
North Speed[cm/s]	Set NE Speed Output(Off/Output)
East Speed[cm/s]	Set NE Speed Output(Off/Output)
Vertical Speed[cm/s]	Set Vertical Speed Output(Off/Output)
Sp Stdev Horizontal[cm/s]	Set Std Dev Speed Output(Off/Output). . This is the 4-Beam solution but is overwritten if Set AutoBeam Speed Type is set to Replace 4-Beam Data
Sp Stdev Beam123[cm/s]	Set 3-Beam Combination Output (Off/Output) and Set NE Speed Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
Sp Stdev Beam124[cm/s]	Set 3-Beam Combination Output (Off/Output) and Set NE Speed Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
Sp Stdev Beam134[cm/s]	Set 3-Beam Combination Output (Off/Output) and Set NE Speed Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
Sp Stdev Beam234[cm/s]	Set 3-Beam Combination Output (Off/Output) and Set NE Speed Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
SpStdev AutoBeam[cm/s]	Set AutoBeam Output(Off/Output) and Set NE Speed Output(Off/Output) (both set to output to be enabled). From software version 8.2.1: Set AutoBeam Output(Off/Output) together withSet Std Dev Speed Output(Off/Output)

Cell parameter with unit	How to disable/enable output
Strength[dB]	Set Strength Output(Off/Output)
Horizontal Speed AutoBeam [cm/s]	Set AutoBeam Output(Off/Output) and Set AutoBeam Speed Type(Polar/Rectangular/Polar+Rectangular/Replace 4-Beam Data) set to Output and Polar to be enabled
Direction AutoBeam[Deg.M]	Set AutoBeam Output(Off/Output) and Set AutoBeam Speed Type(Polar/Rectangular/Polar+Rectangular/Replace 4-Beam Data) set to Output and Polar to be enabled
North Beam123[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
North Beam124[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
North Beam134[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled).This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
North Beam234[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
North AutoBeam[cm/s]	Set NE Speed Output(Off/Output) Set AutoBeam Output(Off/Output) From software version 8.2.1: Set AutoBeam Speed Type(Polar/Rectangular/Polar+Rectangular/ Replace 4-Beam Data) and Set AutoBeam Output(Off/Output) set to Rectangular and Output to be enabled
East Beam123[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter

Cell parameter with unit	How to disable/enable output
East Beam124[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
East Beam134[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
East Beam234[cm/s]	Set NE Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
East AutoBeam[cm/s]	Set NE Speed Output(Off/Output) Set AutoBeam Output(Off/Output) From software version 8.2.1:Set AutoBeam Speed Type(Polar/Rectangular/Polar+Rectangular/ Replace 4-Beam Data) and Set AutoBeam Output(Off/Output) set to Rectangular and Output to be enabled
Vertical Beam123[cm/s]	Set Vertical Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
Vertical Beam124[cm/s]	Set Vertical Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
Vertical Beam134[cm/s]	Set Vertical Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter
Vertical Beam234[cm/s]	Set Vertical Speed Output(Off/Output) and Set 3-Beam Combination Output(Off/Output) (both set to output to be enabled). This is changed from software version 8.2.1. From this version only Set 3-Beam Combination Output(Off/Output) affects the output of this parameter

Cell parameter with unit	How to disable/enable output
Vertical AutoBeam[cm/s]	Set NE Speed Output(Off/Output) Set AutoBeam Output(Off/Output) From software version 8.2.1: Set AutoBeam Output(Off/Output) and Set Vertical Speed Output(Off/Output)
Beam1 Speed[cm/s]	Set Beam Speed Output(Off/Output)
Beam2 Speed[cm/s]	Set Beam Speed Output(Off/Output)
Beam3 Speed[cm/s]	Set Beam Speed Output(Off/Output)
Beam4 Speed[cm/s]	Set Beam Speed Output(Off/Output)
Beam1 Strength[dB]	Set Beam Strength Output(Off/Output)
Beam2 Strength[dB]	Set Beam Strength Output(Off/Output)
Beam3 Strength[dB]	Set Beam Strength Output(Off/Output)
Beam4 Strength[dB]	Set Beam Strength Output(Off/Output)
Beam1 Stdev[cm/s]	Set Std Dev Beam Speed Output(Off/Output)
Beam2 Stdev[cm/s]	Set Std Dev Beam Speed Output(Off/Output)
Beam3 Stdev[cm/s]	Set Std Dev Beam Speed Output(Off/Output)
Beam4 Stdev[cm/s]	Set Std Dev Beam Speed Output(Off/Output)
Cross Difference[cm/s]	Set Cross Difference Output(Off/Output)
Beam1 Correlation Factor[cm/s]	Set Bandwidth(Broadband) Set Correlation Factor Output(Off/Output)
Beam2 Correlation Factor[cm/s]	Set Bandwidth(Broadband) Set Correlation Factor Output(Off/Output)
Beam3 Correlation Factor[cm/s]	Set Bandwidth(Broadband) Set Correlation Factor Output(Off/Output)
Beam4 Correlation Factor[cm/s]	Set Bandwidth(Broadband) Set Correlation Factor Output(Off/Output)

7.3 Cell States

For SW version 8.3.6. and newer. For older version see previous version.

Table 7-4: Cell State1

Cell State1 bits		Meaning
Bit no	Bit pattern (x don't care)	
0	Binary: xxxxxxxxxxxxxxx1 Hexadecimal: xxx1	High broadband cross correlation beam1, above cross correlation high limit [7)]
1	Binary: xxxxxxxxxxxxxx1x Hexadecimal: xxx2	High broadband cross correlation beam2, above cross correlation high limit [7)]
2	Binary: xxxxxxxxxxxxx1xx Hexadecimal: xxx4	High broadband cross correlation beam3, above cross correlation high limit [7)]
3	Binary: xxxxxxxxxxxx1xxx Hexadecimal: xxx8	High broadband cross correlation beam4, above cross correlation high limit [7)]
4	Binary: xxxxxxxxxxx1xxxx Hexadecimal: xx1x	Cell has Weak signal, strength below weak strength limit 1 [3)]
5	Binary: xxxxxxxxxx1xxxxx Hexadecimal: xx2x	Cell has weak signal, strength below weak strength limit 2 [3)]
4 and 5	Binary: xxxxxxxxxx11xxxx Hexadecimal: xx3x	Cell has weak signal, strength below weak strength limit 3 [3)]
6	Binary: xxxxxxxxx1xxxxxx Hexadecimal: xx4x	Cell has High standard deviation, above SP standard deviation 1 limit [4)]
7	Binary: xxxxxxxx1xxxxxxx Hexadecimal: xx8x	Cell has High standard deviation, above SP standard deviation 2 limit [4)]
6 and 7	Binary: xxxxxxxx11xxxxxx Hexadecimal: xxCx	Cell has High standard deviation, above SP standard deviation 3 limit [4)]
8	Binary: xxxxxxx1xxxxxxxx Hexadecimal: x1xx	Cell has High cross difference, above cross difference limit 1 [5)]
9	Binary: xxxxxx1xxxxxxxxx Hexadecimal: x2xx	Cell has High cross difference, above cross difference limit 2 [5)]
8 and 9	Binary: xxxxxx11xxxxxxxx Hexadecimal: x3xx	Cell has High cross difference, above cross difference limit 3 [5)]
10	Binary: xxxxx1xxxxxxxxxx Hexadecimal: x4xx	Cell has High vertical current, above high vertical limit 1 [6)]
11	Binary: xxxx1xxxxxxxxxxx Hexadecimal: x8xx	Cell has High vertical current, above high vertical limit 2 [6)]
10 and 11	Binary: xxxx11xxxxxxxxxx Hexadecimal: xCxx	Cell has High vertical current, above high vertical limit 3 [6)]

Cell State1 bits		Meaning
12	*Binary: xxx1xxxxxxxxxxxx* *Hexadecimal: 1xxx*	*Cell inside blanking zone [1)]*
13	*Binary: xx1xxxxxxxxxxxxx* *Hexadecimal: 2xxx*	*Cell inside illegible zone [8)]*
14	*Binary: x1xxxxxxxxxxxxxx* *Hexadecimal: 4xxx*	*Cell out of range [2)]*
15	*Binary: 1xxxxxxxxxxxxxxx* *Hexadecimal: 8xxx*	*Data not ready*

[1)] The cell can have been configured to be behind the instrument or very close to the instrument. This can also change during the deployment dependent on water level changes and sensor tilt.
[2)] Cells can have been configured to be too far away. Tilting of the instrument can also result in out of range on some of the beam cells.
[3)] Indicates that the signal is weak. Two bits are used to indicate three different levels below -40 dB, below -45 dB or below -50dB.
*[4)] Indicates high single ping standard deviation on horizontal speed. Two bits are used to indicate three different levels. Narrowband and Broadband have different limits. The limit input is set as single ping standard deviation per meter since it is dependent on the cell size (and pulse length). The limits for Broadband are 10, 30 and 50 cm/s. The limits for narrowband are 60, 80 and 100 cm/s. These limits are used for a 1 meter cell (and pulse). The standard deviation limits used are calculated from these as follows, SP Stdev limit = SP Stdev per meter limit/sqrt(cellsize*pulselength). Broadband uses a fixed pulse length = 1m. In narrowband the pulse length follows the column with the smallest cell size. If for example narrowband with 2m cell size and 2m pulse length, the single ping standard deviation limits becomes 30, 40 and 100 cm/s.*
[5)]Indicates high cross difference. Two bits are used to indicate three different levels. The cross difference limits are 10, 20 and 30 cm/s.
[6)] Indicates high vertical current. Two bits are used to indicate three different levels. The limits are 10, 20 and 30 cm/s.
[7)] The cross correlation is normally close to 0.5. Two bits and limits are used, one indicates low cross correlation and the other high cross correlation. The low limit is 0.25 and the high limit is 0.6.
[8)] The illegible zone: if surfaced referred column, approximately 10% of the distance from surface to the instrument is contaminated by side lobes.

Table 7-5: Cell State2

Cell State2 bits		Meaning
Bit no	Bit pattern (x don't care)	
0	Binary: xxxxxxxxxxxxxxx1 Hexadecimal: xxx1	Beam1 cell inside blanking zone 1)
1	Binary: xxxxxxxxxxxxxx1x Hexadecimal: xxx2	Beam2 cell inside blanking zone 1)
2	Binary: xxxxxxxxxxxxx1xx Hexadecimal: xxx4	Beam3 cell inside blanking zone 1)
3	Binary: xxxxxxxxxxxx1xxx Hexadecimal: xxx8	Beam4 cell inside blanking zone 1)
4	Binary: xxxxxxxxxxx1xxxx Hexadecimal: xx1x	Beam1 cell out of range (too far away) 2)
5	Binary: xxxxxxxxxx1xxxxx Hexadecimal: xx2x	Beam2 cell out of range (too far away) 2)
6	Binary: xxxxxxxxx1xxxxxx Hexadecimal: xx4x	Beam3 cell out of range (too far away) 2)
7	Binary: xxxxxxx1xxxxxxx Hexadecimal: xx8x	Beam4 cell out of range (too far away) 2)
8	Binary: xxxxxxx1xxxxxxxx Hexadecimal: x1xx	Beam 1 cell weak signal strength, below weak signal limit 1 3)
9	Binary: xxxxxx1xxxxxxxxx Hexadecimal: x2xx	Beam 1 cell weak signal strength, below weak signal limit 2 3)
8 and 9	Binary: xxxxxx11xxxxxxxx Hexadecimal: x3xx	Beam 1 cell weak signal strength, below weak signal limit 3 3)
10	Binary: xxxxx1xxxxxxxxxx Hexadecimal: x4xx	Beam 2 cell weak signal strength, below weak signal limit 1 3)
11	Binary: xxxx1xxxxxxxxxxx Hexadecimal: x8xx	Beam 2 cell weak signal strength, below weak signal limit 2 3)
10 and 11	Binary: xxxx11xxxxxxxxxx Hexadecimal: xCxx	Beam 2 cell weak signal strength, below weak signal limit 3 3)
12	Binary: xxx1xxxxxxxxxxxx Hexadecimal: 1xxx	Beam 3 cell weak signal strength, below weak signal limit 1 3)
13	Binary: xx1xxxxxxxxxxxxx Hexadecimal: 2xxx	Beam 3 cell weak signal strength, below weak signal limit 2 3)
12 and 13	Binary: xx11xxxxxxxxxxxx Hexadecimal: 3xxx	Beam 3 cell weak signal strength, below weak signal limit 3 3)
14	Binary: x1xxxxxxxxxxxxxx Hexadecimal: 4xxx	Beam 4 cell weak signal strength, below weak signal limit 1 3)

Cell State2 bits		Meaning
15	Binary: 1xxxxxxxxxxxxxxx Hexadecimal: 8xxx	Beam 4 cell weak signal strength, below weak signal limit 2 [3)]
14 and 15	Binary: 11xxxxxxxxxxxxxx Hexadecimal: Cxxx	Beam 4 cell weak signal strength, below weak signal limit 3 [3)]

[1)] The cell can have been configured to be behind the instrument or very close to the instrument. This can also change during the deployment dependent on water level changes and sensor tilt.
[2)] Cells can have been configured to be too far away. Tilting of the instrument can also result in out of range on some of the beam cells.
[3)] Indicates that the signal is weak. Two bits are used to indicate three different levels below -40 dB, below -45 dB or below -50dB.

7.4 Record Status

Table 7-6: Record Status parameter explained; A record status value is also output for each measurement interval. This is a 32-bit value where each bit has a status as shown in the table.

Record Status bits		Meaning
Bit no	Bit pattern (x don’t care)	
Bit 0	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx1	Orientation mismatch, configuration vs measurement [1)]
Bit 1	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx1x	High ambient noise measured on Beam 1 [2)]
Bit 2	xxxxxxxxxxxxxxxxxxxxxxxxxxxxx1xx	Higher ambient noise measured on Beam 1 [2)]
Bit 1,2	xxxxxxxxxxxxxxxxxxxxxxxxxxxxx11x	Even higher ambient noise measured on Beam 1 [2)]
Bit 3	xxxxxxxxxxxxxxxxxxxxxxxxxxxx1xxx	High ambient noise measured on Beam 2 [3)]
Bit 4	xxxxxxxxxxxxxxxxxxxxxxxxxxx1xxxx	Higher ambient noise measured on Beam 2 [3)]
Bit 3,4	xxxxxxxxxxxxxxxxxxxxxxxxxxx11xxx	Even higher ambient noise measured on Beam 2 [3)]
Bit 5	xxxxxxxxxxxxxxxxxxxxxxxxxx1xxxxx	High ambient noise measured on Beam 3 [4)]
Bit 6	xxxxxxxxxxxxxxxxxxxxxxxxx1xxxxxx	Higher ambient noise measured on Beam 3 [4)]
Bit 5,6	xxxxxxxxxxxxxxxxxxxxxxxxx11xxxxx	Even higher ambient noise measured on Beam 3 [4)]
Bit 7	xxxxxxxxxxxxxxxxxxxxxxxx1xxxxxxx	High ambient noise measured on Beam 4 [5)]
Bit 8	xxxxxxxxxxxxxxxxxxxxxxx1xxxxxxxx	Higher ambient noise measured on Beam 4 [5)]
Bit 7,8	xxxxxxxxxxxxxxxxxxxxxxx11xxxxxxx	Even higher ambient noise measured on Beam 4 [5)]
Bit 9	xxxxxxxxxxxxxxxxxxxxxx1xxxxxxxxx	High standard deviation heading [6)]
Bit 10	xxxxxxxxxxxxxxxxxxxxx1xxxxxxxxxx	Higher standard deviation heading [6)]
Bit 9,10	xxxxxxxxxxxxxxxxxxxxx11xxxxxxxxx	Even higher standard deviation heading [6)]
Bit 11	xxxxxxxxxxxxxxxxxxxx1xxxxxxxxxxx	High standard deviation tilt [7)]
Bit 12	xxxxxxxxxxxxxxxxxxx1xxxxxxxxxxxx	Higher standard deviation tilt [7)]
Bit 11,12	xxxxxxxxxxxxxxxxxxx11xxxxxxxxxxx	Even higher standard deviation tilt [7)]
Bit 13	xxxxxxxxxxxxxxxxxx1xxxxxxxxxxxxx	Low input voltage, set if voltage below 6V

Bit 14	xxxxxxxxxxxxxxxxx1xxxxxxxxxxxxxx	High input voltage, set if voltage above 28V
Bit 15	xxxxxxxxxxxxxxxx1xxxxxxxxxxxxxxx	High input current, set if current above 300mA
Bit 16	xxxxxxxxxxxxxxx1xxxxxxxxxxxxxxxx	Low Vtx1 voltage detected, set if Vtx1 below 4.8V
Bit 17	xxxxxxxxxxxxxx1xxxxxxxxxxxxxxxxx	Low Vtx2 voltage detected, set if Vtx2 below 4.8V
Bit 18	xxxxxxxxxxxxx1xxxxxxxxxxxxxxxxxx	Low heap memory detected [8)]
Bit 19	xxxxxxxxxxxx1xxxxxxxxxxxxxxxxxxx	Sensor is in air, set when in air if air detection is active [9)]
Bit 20	xxxxxxxxxxx1xxxxxxxxxxxxxxxxxxxx	Upside down surface mismatch reference mismatch [10)]
Bit 21	xxxxxxxxxx1xxxxxxxxxxxxxxxxxxxxx	Upside down surface cell mismatch [11)]

[1)]The upside down selection does not correspond to the actual orientation detected by the sensor.
[2)]The sensor measures the signal level on Beam 1 before pinging. This can indicate that another acoustic transmitter is sending out a sound signal nearby in the water (for example an echo sounder on a boat/ship). The noise level on Beam1 is indicated by two bits, bit 1 and 2, which gives three level indications. If bit1 is set, the noise is above –48dB. If bit 2 is set the level is above –38dB and if both are set the level is above –28dB.
[3)]Same levels as for Beam1 but here bit 3 and 4 indicates the three noise levels.
[4)]Same levels as for Beam1,2 but here bit 5 and 6 indicates the three noise levels.
[5)]Same levels as for Beam1,2,3 but here bit 7 and 8 indicates the three noise levels.
[6)]Bit 9 and 10 indicates if the standard deviation for heading is above limit 1, limit 2 or limit 3. Limit 1 is 10°, limit 2 is 20° and limit 3 is 30° standard deviation on heading.
[7)]Bit 11 and 12 indicates if the standard deviation for tilt is above limit 1, limit 2 or limit 3. Limit 1 is 10°, limit 2 is 20° and limit 3 is 30° standard deviation on absolute tilt.
[8)]The internal software allocates memory for variables and objects. Sw bugs may cause memory leakage which again gives less and less room on the heap.
[9)]Factory enabled setting to detect if the sensor is in air (not used on first delivered units).
[10)]The combination of upside down and surface reference is not allowed (still possible to set both in Real Time Collector and from a Terminal program). This mismatch is indicated by this bit. A surface referred column is forced to be sensor referred if the sensor is placed upside down.
[11)]The combination of upside down and surface cell is not allowed (still possible to set both in Real Time Collector and from a Terminal program). This mismatch is indicated by this bit. The surface cell data is also set as not valid.

CHAPTER 8 **Use of External Compass**

8.1 General information

An important input parameter for calculation of wave parameters is the heading information. If the magnetic distortion at the location where the sensor is to be installed is too large the heading should be provided by an external compass placed at an undistorted location, for instance in the mast.
In a system with SmartGuard logger the external compass can be connected directly to the logger or directly to the wave sensor:

- External compass connected directly to sensor:
  - The wave sensor has a separate connector for connection of external compass. When properly configured the sensor will power up the external compass and receive heading information at preset intervals. Refer to chapter **Error! Reference source not found.** when controlled via logger or chapter **Error! Reference source not found.**, when used as stand-alone sensor, for detailed information on how to configure the sensor for connection of external compass.
  - A special configuration option is provided for the HSC100 compass from Digital Yacht. By using this option no setup of the compass itself will be required.
  - When an external compass is connected directly to the sensor and the wave sensor is connected to SmartGuard via AiCaP bus the external compass heading information can be distributed to other AiCaP sensors in the system.

- External compass reading input from SmartGuard.
  - In cases where the buoy is equipped with sensors giving heading information directly to the logger the heading information can be distributed by the logger to other sensors connected to the AiCaP bus. This feature enables the wave sensor to receive heading information from other connected sensor in the system via SmartGuard or SeaGuardII.

When using an external compass the orientation angle between the wave sensor and the compass must be taken into account. This angle must be set in the ***Ext Compass Alignment Offset (Deg.M)*** - property in the sensor configuration. By default this is set to zero which means that if the external compass can be aligned to the orientation arrow of the wave sensor the direction will be correct. A self-leveling crossline laser might be a god tool for aligning the two sensors. If the installation does not allow for alignment, the angle between the sensors should be measured and the ***External Compass Offset*** updated accordingly.

For cable assembly refer to chapter **Error! Reference source not found.** in this document.

8.2 External compass types

8.2.1 HSC 100-NMEA

- Digital Yacht HSC100 Compass sensor

Figure 8-1: Digital Yacht HSC100

- Mounting Bracket:
  - Included in delivery of compass sensor.

- Connecting cable:
  - Supplied with a 15-meter cable.
  - Link cable between SmartGuard serial port and sensor cable.

- Data output (RS-232):
  - NMEA0183 sentence ‘HDG’ (Magnetic Heading).
  - Baud rate: 4800 , 8N1

8.2.2 Airmar H2183

Figure 8-2: Airmar H2183

- Airmar H2183 Heading sensor

- Mounting Bracket:
  - Included in delivery of compass sensor.

- Connecting cable:
  - Cable between Sensor and SmartGuard included

- Data output (RS-232):
  - NMEA HDG
  - Baud rate: 4800 , 8N1

8.3 Input format for external compass

$HC**HDG**

Summary
NMEA 0183 standard Heading, Deviation and Variation.
Syntax
$HCHDG,<1>,<2>,<3>,<4>,<5>*hh<CR><LF>
Fields
<1> Magnetic sensor heading, degrees, to the nearest 0.1 degree.
<2> Magnetic deviation, degrees east or west, to the nearest 0.1 degree.
<3> E if field <2> is degrees East
W if field <2> is degrees West
<4> Magnetic variation, degrees east or west, to the nearest 0.1 degree.
<5> E if field <4> is degrees East
W if field <4> is degrees West

$HC**HDT**

Summary
NMEA 0183 standard Heading relative to True North
Syntax
$HCHDT,<1>,<2>*hh<CR><LF>
Fields
<1> Heading relative to True North
<2> T = True

$HC**HDM**

Summary
NMEA 0183 standard Heading in degrees Magnetic derived from the true heading calculated
$HCHDM,<1>,<2>*hh<CR><LF>
Fields
<1> Current Heading in degrees
<2> M = Magnetic heading

$HC**HCC**

Summary
NMEA 0183 standard Compass Heading , which differs from magnetic heading by the amount of uncorrected magnetic deviation.
$HCHCC,<1>*hh<CR><LF>
Fields
<1> Compass Heading in degrees

$GP**HDT**

Summary
NMEA 0183 standard Heading relative to True North
Syntax
$HCHDT,<1>,<2>*hh<CR><LF>
Fields
<1> Heading relative to True North
<2> T = True

$GP**HDM**

Summary
NMEA 0183 standard Heading in degrees Magnetic derived from the true heading calculated
$HCHDM,<1>,<2>*hh<CR><LF>
Fields
<1> Current Heading in degrees
<2> M = Magnetic heading

CHAPTER 9 **Electro Magnetic Compatibility and Cables**

In order for a manufacturer to legally produce and sell a product, it has to apply for CE marking. This means that the commercialized product is conform to the CE applicable standards and can freely circulate within the EFTA (European Free Trade Association) & European Union countries. The applicable directive for the DCPS sensor is the EU EMC 89/336/EMC (all electrical and electronic appliances) which mainly focus on the electromagnetic disturbances the sensor can generate, which should not exceed a level allowing radio and telecommunication equipment to operate as intended, and that the sensor has an adequate level of intrinsic immunity to electromagnetic disturbance to be able to operate as intended.
This chapter describes the requirements for the Electromagnetic Compatibility (EMC) of the sensor. And also addresses the different cables available for use with the sensor.

9.1 EMC Testing

The DCPS sensor has been tested at an accredited test laboratory to verify that the sensor fulfils the requirements in the EU EMC directive (89/336/EMC).

Applied standards

- EN 55011 (2009)+A1
- EN 61326-1 (2013)

Applied tests

- Conducted Emissions
- Electrostatic Discharge Immunity
- Surge Immunity
- Conducted RF Disturbance Immunity

9.2 Cables

Different cables are available for stand-alone use with free end and connectors. The cables have both power and signal lines RS-232. See chapter **Error! Reference source not found.** for more information on cables that is best suited for use in the actual application. When delivered, system drawings/cable drawings give details on parts connection and installation overview with best EMC performance (best noise and surge immunity).

9.3 Power – Voltage range

The input voltage range is from 6 to 30Vdc. When using long cables the voltage should be as close to 30V as possible. The peak current while the sensor is measuring (after power on) is normally well below, but it varies dependent on how high the input voltage is and how large the voltage drop is in the cable (lower voltage on the sensor gives higher peak current).

CHAPTER 10 **Other details**

10.1 Compass heading 0° reference direction

In some cases it is necessary to know the orientation of the sensor's axes. This can be necessary when the sensor is placed in a fixed position with a fixed orientation (for example in a frame on the sea floor) where the magnetic influence by an object nearby gives an erroneous heading measurement. In this case the fixed heading input can be enabled, but to set the correct fixed heading the 0° reference has to be known. On surface buoys made of iron/steel there can also be problems related to magnetic influence from the buoy structure/body. This can be improved by using an external compass (parameter input via SeaGuardII or SmartGuard Datalogger) placed away on a mast arm which gives a more correct compass heading to the sensor. In this case the misalignment/offset between the external compass and the axes on the DCPS must be known.

10.1.1 Transducer 1 is 0° reference.

When transducer 1 on the sensor is orientated towards magnetic North, the compass heading is 0°. One method is to measure in which direction transducer 1 is pointing. Position of transducer 1 is shown in ***Figure 10-1***. Moving transducer 1 clockwise gives an increasing heading.

- Find direction of magnetic north.

Figure 10-1 Orientation transducer 1

- Find x-axis on DCPS, axis with transducer 1 and 3 (opposite side on same axis).
- If a fixed and non-moving application, align x-axis and transducer 1 towards correct magnetic north. Alternatively measure the angle clockwise from magnetic north to x-axis transducer 1 and set the fixed heading equal to this value (degrees).
- If used on a buoy with external compass input, align the x-axis transducer 1 in the same direction as the north mark on the compass. Alternatively, try to measure the clockwise angle from the north mark (0 degree) on the external compass to the x-axis transducer1 on the DCPS. Set the heading alignment offset equal to this measured angle (input parameter heading see ***chapter 3.13.9***. Also remember to select the external compass as heading input to the DCPS.

NOTE: To check the value measured by the tilt and heading sensor refer to chapter Error! Reference source not found.**. Viewing incoming data in real-time.**
The same procedure can be used if the DCPS is orientated upside-down.

10.1.2 Orientation/Steering pin as reference

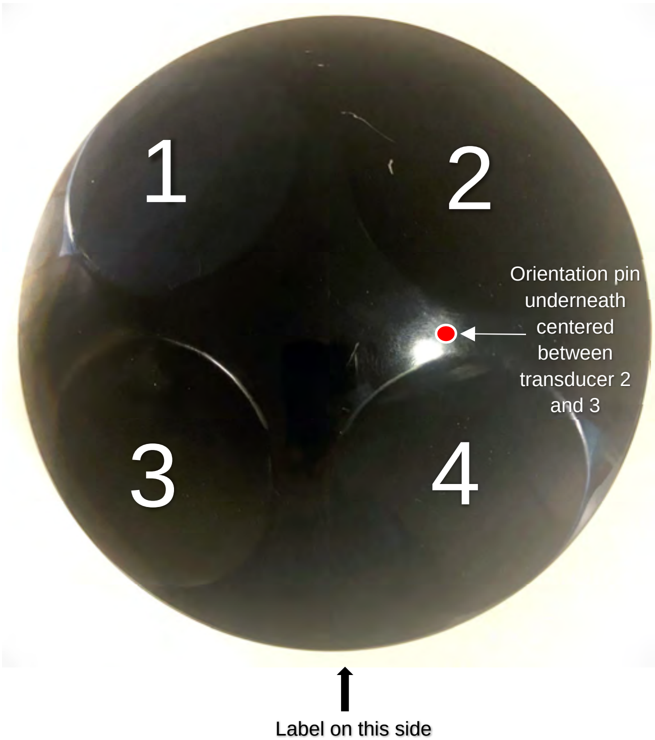


Figure 10-2 Orientation pin and transducers

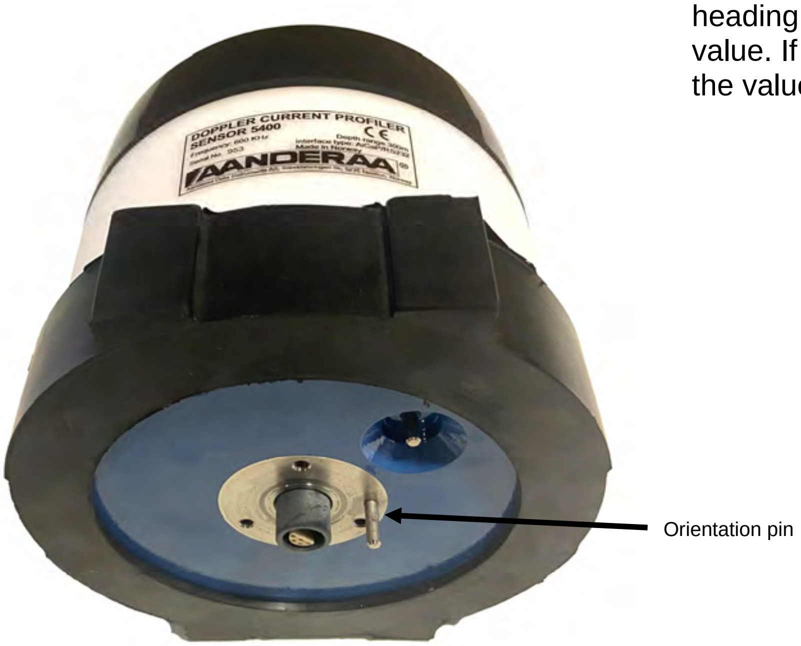


Figure 10-3 Orientation pin placement on end plate

Another method is to use the orientation pin underneath the sensor. This pin is placed between transducer 2 and 3. The heading is 225 degrees (360-135) if the orientation pin is towards magnetic north, i.e. transducer 1 is 225 degree clockwise from the orientation pin. The positioning of the orientation pin is shown in the ***Figure 10-2*** and ***Figure 10-3***.

- Use the same methods as described in ***chapter 10.1.1***
- Remember that the angle between transducer 1 and the steering/orientation pin is 225 degrees.
- Add 225 degrees to the measured orientation of this pin when used as fixed heading setting. If larger than 360, subtract 360 from the value.
- If external compass input, add 225 degrees to the angle measured between the external compass and the orientation pin. Set the heading alignment offset value equal to this value. If larger than 360, subtract 360 from the value.

10.1.3 Transducer 1 as reference when upside-down

Use the same method as when the sensor is upward looking. Rotating clockwise gives an increasing angle. The sensor is able to sense its vertical orientation sensor and automatically correct for the upside-down orientation of the sensor.
NOTE: To check the value measured by the tilt and heading sensor refer to chapter Error! Reference source not found.**. Viewing incoming data in real-time.**

10.1.4 Orientation/Steering pin as reference when upside-down

Now transducer 1 is 135 degrees clockwise from the orientation pin. Add 135 degrees instead of 225 degrees.

10.2 Checking the compass

First point transducer 1 towards North. The compass heading should lie close to 360°/0° (same point).
NOTE: To check the value measured by the tilt and heading sensor refer to chapter Error! Reference source not found.**. Viewing incoming data in real-time.**

A clockwise rotation gives an increasing compass angle. Keep the sensor away from magnetic object like table legs (if iron, these are acting as a permanent magnet magnetized by the earth magnetic field). Big objects like for example a car outside the room where the compass is tested can affect the earth magnetic field at the point where the sensor is placed. Also the structure of the building can influence on the earth magnetic field around the sensor.
Be aware that nearby objects may influence the magnetic field when the sensor is used. This can for example be a problem on a buoy as described above or if hanging from a boat. The rule of thumb is that the bigger the magnetic object is (hard and/or soft magnetic) the further away sensor should be positioned to eliminate the influence. If the sensor is in a fixed position the fixed heading input can be used as described earlier in this chapter. On buoys the solution is often to use an external compass which is placed on a non-magnetic mast away from the buoy.
Even alkaline batteries can be a problem if placed close enough to the sensor. When used on SeaGuardII the upper battery compartment can give problems when using alkaline battery cells. The battery cells provided by Aanderaa do not give problems when using the lower battery compartment. When batteries are own-built, you have to be aware of this problem. The influence from the batteries can be checked by looking at the heading output from the sensor while placing the batteries closer to the sensor. Moving the batteries around a hand held compass also gives a good indication on whether the batteries are low magnetic or not. Batteries can also be degaussed to reduce the magnetic influence from the batteries.

10.3 Checking the tilt sensor

The sensor has a 3-axis inclinometer. The tilt is converted to rotational angles pitch and roll. When the sensor is placed horizontal the pitch and roll should be close to zero. Pitch is the rotation around the y-axis while roll is the rotation angle around the x-axis. The x-axis is aligned with transducer 1 and 3 and the y-axis is aligned with transducer 2 and 4.

- Place the sensor horizontal. See that the pitch and roll is close to zero.
- Tilt sensor towards transducer 1 (transducer 1 downwards) and see that the pitch value is decreasing (more negative).
- Tilt the sensor in the opposite direction against transducer 3 and see that the pitch is increasing (positive).
- Tilt the sensor towards transducer 2 and see that the roll value is increasing (positive).
- Tilt the sensor towards transducer 4 and see that the roll value is decreasing (more negative).
- Hold the sensor upside-down and horizontal. The roll should now be close to 180 degrees.
- Place the sensor upside-down on a table on transducer 1. The pitch should be close to -25 degrees and the roll close to 180.
- Do the same now on transducer 3. The pitch should now be close to +25 degrees and the roll close to 180.
- Do the same now on transducer 2. The roll should be close to 155 degrees while the pitch should be close to 0.
- Do the same on transducer 4. The roll should be close to 205 degrees and the pitch close to 0. For software version 8.2.1 and over, the roll range is ±180 so the roll reading should be close to -155.

NOTE: To check the value measured by the tilt and heading sensor refer to chapter Error! Reference source not found.**. Viewing incoming data in real-time.**

10.4 Checking the acoustics

The best way to check the acoustics is to do a short pre-deployment where the sensor is hanging from a floating raft or boat. Checking the signal strength from the different beams gives an indication on if some of the beams are much weaker than the others. When checking the beam strengths close to the sensor, the signal strength should normally be within 2-3dB between the different beams.
A weaker signal strength on all transducers than seen earlier is not necessarily an indication that something is wrong with the sensor. The signal strength can show big variations during a year due to changes in biological activities, etc. Some places variations of the backscatter conditions can give several dB in signal strength variation.

CHAPTER 11 **Maintenance**

With 50 years of instruments design and production for the scientific community, in use around the world, you can count on our reputation for designing the most reliable products available.
We are guided by three underlying principles: quality, service, and commitment. We take these principles seriously, as they form the foundation upon which we provide lasting value to our customers. Our unmatched quality is based on a relentless program of continuous monitoring to maintain the highest standards of reliability.
In order to assure the quality of this sensor, critical properties are tested during production. A special form, named 'Test and Specification Sheet' (delivered with the sensor) lists the tests and their results and checkpoints.

11.1 Retrieval of the sensor

Clean the Transducer Head after each deployment.

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 sensor 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.

When removing or disconnecting the sensor from attached cables always protect connectors on sensor and cables with appropriate dummy plugs. Always apply grease on connectors and sealing plugs if earlier applied grease is dried out.

Figure 11-1: Grease for Subconn plug

11.2 Anti-fouling on transducer surface

The front layer on the transducers is optimized to give optimal matching between the transducers and the sea water to get as high sensitivity as possible. Applying anti-fouling to the surface may give reduced sensitivity. The best way to keep the fouling away would have been to wash the surface at a regular interval, for example once a week or dependent on how fast the growth is. This is however not very practical.

If applying anti-fouling, use a very thin and evenly layer on the transducer surfaces. The best is to use a coating which can be sprayed on as very thin layer.

11.3 Factory service

Factory service is offered for maintenance, repair or calibration.

Before returning the sensors to factory please contact Aanderaa.support@xyleminc.com for a RMA number and needed paper.

When returning Doppler Current Profiler Sensor, 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

11.4 Status Codes

The sensor produces some status codes if there are some errors with the sensor or with the quality of collected data. These status codes are either shown in the data string or when using post-processing software. Each status code has both a hexadecimal value and a decimal value shown in table below. The status codes are separated in three groups. ***Ok*** is when everything is normal and this status code will not be visible. An ***Error*** status code is critical state and requires normally a service and repair on the sensor. ***Warnings*** are more temporary errors that may reduce the data quality for a shorter period and normally don't need a factory service but it still important to investigate and remove the cause.

OK

Parameter	***Hex value***	***Status Code***	***Description***
Ok	0	0	Ok

Errors

Parameter	***Hex value***	***Status Code***	***Description***
InvalidVectorError	41	65	Internal use only
AccessError	42	66	Access error
RequestTimeError	43	67	Input time is shorter than the processing time
NotValidError	44	68	Some internal fails
CopyDataError	45	69	Recorder error

Warnings

Parameter	***Hex value***	***Status Code***	***Description***
OutOfMeasureRange	51	81	Data outside range. The data is not reliable
OutOfCalibRange	52	82	Data Outside Calibration range. The data can be reliable, but out of calibration range
ReducedQuality	53	83	e.g. supply voltage to low
NotReady	54	84	e.g., timeseries is not finish to the first recording
NotImplemented	55	85	Not a valid parameter
StoredDataWarning	56	86	e.g. Storing data that reduce precision
LowQuality	57	87	Indicates lower quality than reduced quality
DiscardData	58	88	Data useless, can be discarded

11.5 Software versions

The first software versions on the DCPS were made for use together with the SeaGuardII and SmartGuard Datalogger only. Using the sensor with a lower software version than 8.1.25 as a stand-alone sensor without a SeaGuard II or SmartGuard is not recommended and will not work properly.
Software versions below v8.1.27 have a different input on the Interval property and the Polled Pingrate property. These did not show up as enumerated types when sending the Help command to the sensor.

11.6 Interval and Polled Pingrate from software version 8.1.27

The Help command gives the available settings for the Interval and the Polled Pingrate. The lowest Interval available and the highest Polled Pingrate available is limited. After configuration and a Do Refresh command the listing under will show only the values allowed.
The input for the interval is now as follows
10 sec, 20 sec, 30 sec, 1 min, 2 min, 3 min, 5 min, 6 min, 10 min, 15 min, 20 min, 30 min, 1 hour or 2 hour.
The input for the Polled Pingrate is as follows
0.1 Hz, 0.5 Hz, 1 Hz, 2 Hz, 3 Hz, 4 Hz, 5 Hz, 6 Hz, 7 Hz, 8 Hz, 9 Hz and 10 Hz

11.7 Enabling old input on software versions from 8.1.34

It is possible to enable the old input as it was before software version 8.1.27 (from sw version 8.1.34) doing as follows

//Press Enter to start communicating with the sensor.
Stop ↵ //Wait for ack #
Set Passkey(1000) ↵ //Wait for ack #
Set Enable Old Time Setting(Yes) ↵ //Wait for ack #
Save ↵ //Wait for ack #
Reset↵

CHAPTER 12 Acoustic Wave

12.1 General information

12.2 Parameter list

Table 12-1 Parameter list

Output parameters	*Symbol*	*Type*
Energy Spectrum	E(f)	Research
Directional Spectrum	$DWS_m(f)$	Research
Principal Directional Spectrum	$DWS_p(f)$	Research
Orbital Ratio Spectrum	K(f)	Research
Fourier Coefficients Spectrum	A1(f),B1(f),A2(f),B2(f)	Research
Wave Mean Direction	θ_{avg}	Operational
Significant Wave Height H_{m0}	H_{m0}	Operational
Significant Wave Height $H_{1/3}$	$H_{1/3}$	Operational
Wave Mean Period T_{m02}	T_{m02}	Operational
Wave Energy Period T_{m10}	T_{m10}	Operational

See description and calculation of all parameters in ***chapter 12.3***.

12.3 Parameter calculation

The ***Energy Spectrum, E(f)*** gives the vertical wave energy density for each frequency bin, accumulated from all directions.
Fourier Coefficients Spectrum, A1(f), B1(f), A2(f), B2(f) are used to calculate all frequency based parameters.

Two different directional Spectrums are calculated

1. ***Direction Spectrum, $DWS_m(f)$*** is calculated as mean wave direction for each frequency bin in the spectrum based on the first order Fourier Coefficients.

1.

$$\theta_1(f) = atan(b_1(f_i)/a_1(f_i))$$

2. ***Principal Dir Spectrum, $DWS_p(f)$*** is calculated based on the second order Fourier Coefficients. The principal wave direction has an ambiguity direction of 180 degree, but is forced to be in the same interval as the mean wave direction.

2.

$$\theta_2(f) = 0.5 \cdot atan(b_2(f_i)/a_2(f_i))$$

Orbital Ratio Spectrum, K(f) gives the ratio of vertical to horizontal motions corrected for the wavenumber and water depth

$$\mathrm{K(f)} = \left\{\frac{1}{\tanh(\mathrm{k(f)} \cdot \mathrm{h})}\right\} \cdot \sqrt{\frac{\mathrm{C}_{11}(\mathrm{f})}{\mathrm{C}_{22}(\mathrm{f}) + \mathrm{C}_{33}(\mathrm{f})}}$$

where:
C11(f), C22(f), and C33(f), are the cross-spectra of displacement in Vertical, East and North direction. k(f), is the wave number and h is the water depth.

Wave Mean Direction, θ_{avg} is the energy weighted mean direction over all frequency bins.

$$\theta_{avg} = atan\left(\sum_i E(f_i) \cdot b_1(f_i)/a_1(f_i)\right)$$

The spreading angle is a measure of how wide the directional cone is over which the wave direction is distributed (Kumar and Anoop, 2013).

Significant wave height is defined traditionally as the mean wave height (trough to crest) of the highest third of the waves ($H_{1/3}$). A modern definition of significant wave height is usually defined as four times the standard deviation of the surface elevation. The symbol H_{m0} is usually used for that latter definition. The significant wave height may thus refer to H_{m0} or $H_{1/3}$; the difference in magnitude between the two definitions is only a few percent.
Significant Wave Height, $H_{1/3}$ is the mean of the highest third of the waves in a time-series computed on the basis of a spectrum and is referred to as $H_{1/3}$.

Wave Mean Period, T_{m02} is the mean wave period calculated from the spectrum.

$$T_{m02} = \sqrt{\frac{m_2}{m_0}},$$

where:
m_n is the n order moment calculated from the Energy spectrum as;

$$m_n = \int_0^{\infty} f^n E(f) df$$

12.4 Other wave descriptions

Wave Crest is the point on a wave with the maximum value or upward displacement within a cycle.

Wave Troughs is the point on a wave with the minimum or lowest point in a cycle.

Wavelength is the distance from a certain point on one wave to the same point on the next wave
(e.g. distance between two consecutive wave crests or between two consecutive wave troughs).

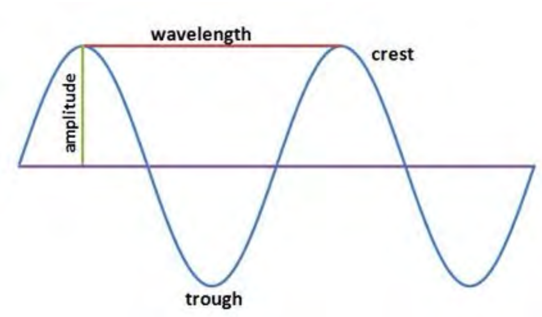


Figure 12-1: wave descriptions

Wave amplitude is one half the distances from the crest to the trough. Wave amplitude is a more technical term for wave height and is used in engineering technology.

Wave frequency is the number of waves passing a fixed point in a specified period of time. Frequency has units of waves per second or cycles per second. Another unit for frequency is the Hertz (abbreviated Hz) where 1 Hz is equivalent to 1 cycle per second.

Wave period are the time it takes for two successive crests (one wavelength) to pass a specified point.

Wave speed is the distance the wave travels divided by the time it takes to travel that distance. Wave speed is determined by dividing the wavelength by the wave period. In symbols c = λBB; / T, where c is the wave speed, λ (lambda) is the wavelength, and T is the period.

Wave Steepness is the ratio of height to wavelength. When wave steepness exceeds 1:7, breakers form. If a wave has height of one foot and a length from crest to crest of 8 feet, then the ratio is 1:8 and this wave is not going to break. But if the height is 1 foot and the length decreases to 5 feet, then the ratio is 1:5 and this wave has now become so steep that the crest topples and the wave breaks.

CHAPTER 13 **Installation**

The sensor can either be used stand alone or connected to a logger. The sensor can either be used in a bottom mooring frame stand-alone with counterweight to make it stable or connected to a SeaGuardII logger

Figure 13-1: Bottom Mooring Frame 3448

If you want to install the sensor or instrument away from the bottom our in-line frame 5744/5744A is a popular choice. This frame may be used with DCPS pointing upwards or downward dependent on which part of the water column you want to measure. 5744 is designed for use with SeaGuardII with attached sensors and 5744A is made for stand-alone DCPS.

5744A consist of the inline frame and a Sensor Bracket 5746 that is used to fix the DCPS sensor foot to the frame.

The frame is also available with Protecting Rod Kit 3967 for extra protection especially during deployment and recovery.

The third alternative is to mount the sensor underneath a buoy. Then we recommend the sensor rack that is designed for use with DB1750. For more information please contact Aanderaa.sales@xylem.com

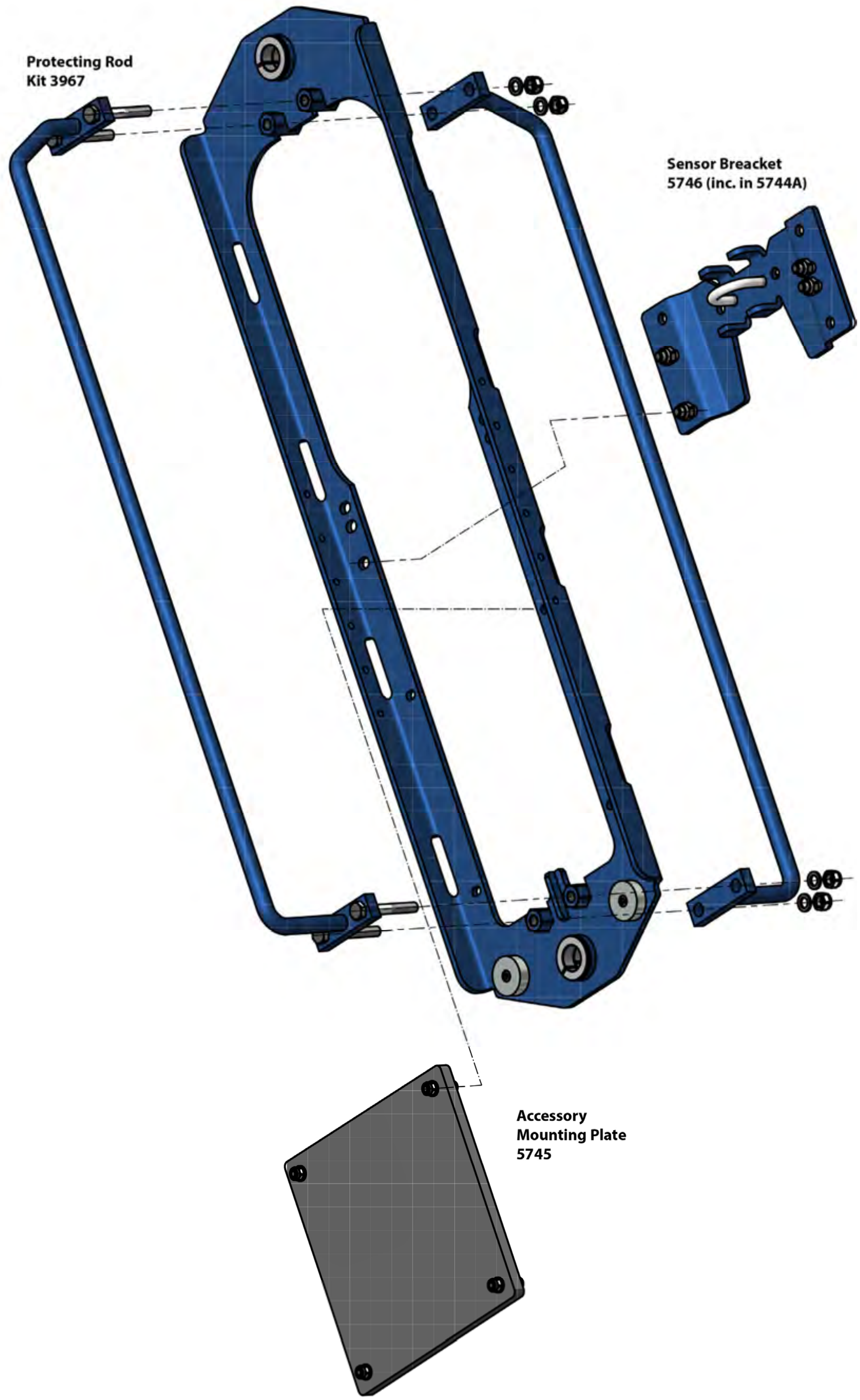


Figure 13-2: Inline mooring frame 5744A

13.1 Mounting considerations

When installing the sensor please make sure that there is no object in front of the transducer. When using one of our frames the orientation will make sure that there is open space in front of the transducers but its also important to make sure that any cables or rescue line is secured to avoid any disturbance. It also important to add enough weight to the bottom of the mooring and enough buoyancy to make use that the sensor is as stable as possible. The choice of material is also important to avoid any magnetic disturbance on the internal compass.

If your sensor is used close to one of the magnetic poles you might need to add a declination angle to compensate for the difference between magnetic north and true north, For more info see ***chapter 3.13.2.***

13.2 Application examples

DCPS is a flexible sensor that can be used in many different applications, either as a part of a SeaGuard II self-contained multiparameter observatory or as a part of a flexible user designed observation point. The factory also helps users with designing system to solve a specific task. The next examples are just two of many hundreds system already delivered.

First example in ***Figure 13-3*** shows a small system designed for a fish farm measuring Current in multiple layers, Salinity at one depth and Oxygen at four depths. This system is easily scalable to fit the individual needs.

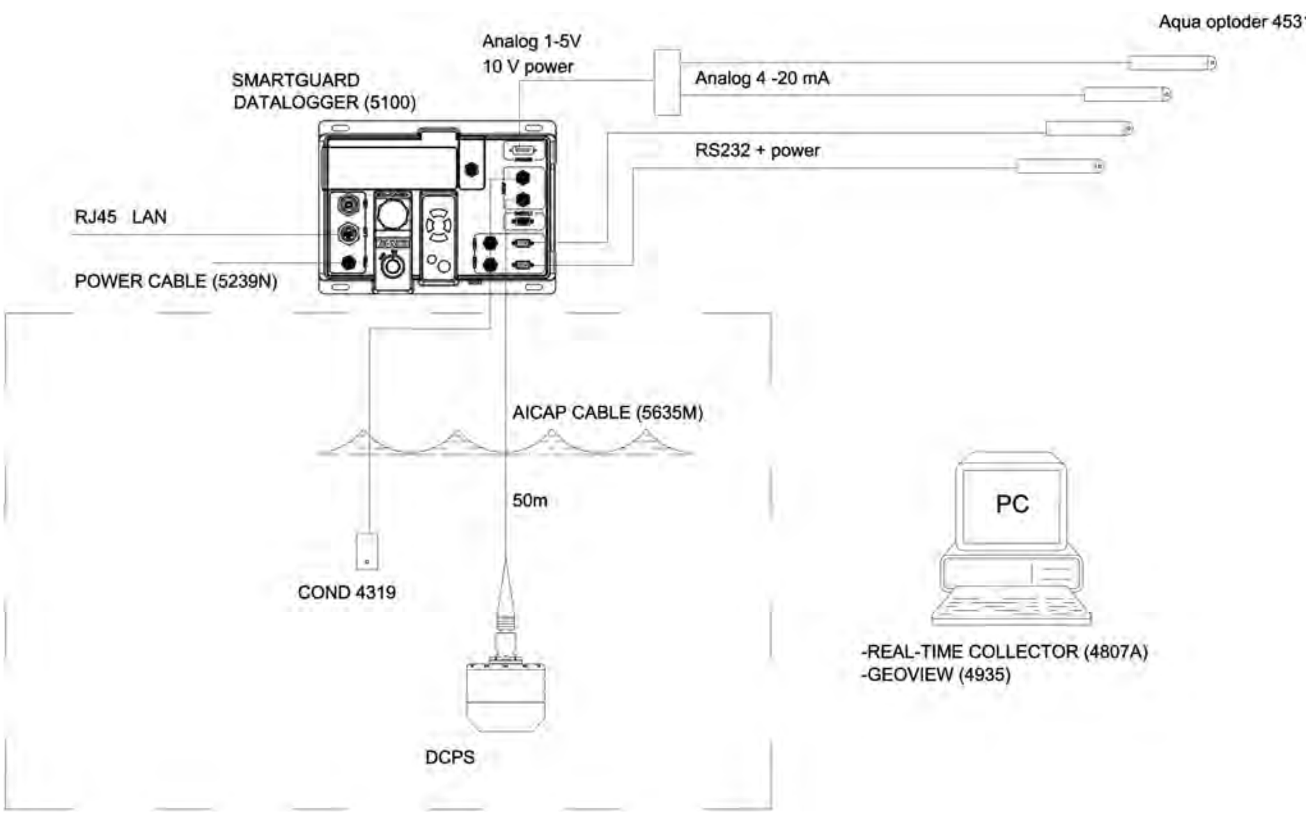


Figure 13-3: Example 1

Example 2 in ***Figure 13-4*** shows a more complex buoy system with meteorological sensors, satellite communication, solar panels as well as Motus directional wave sensor and DCPS. This system is also easily scalable with possibilities for adding water quality sensors and single-point current measurement for measuring current close to the surface.

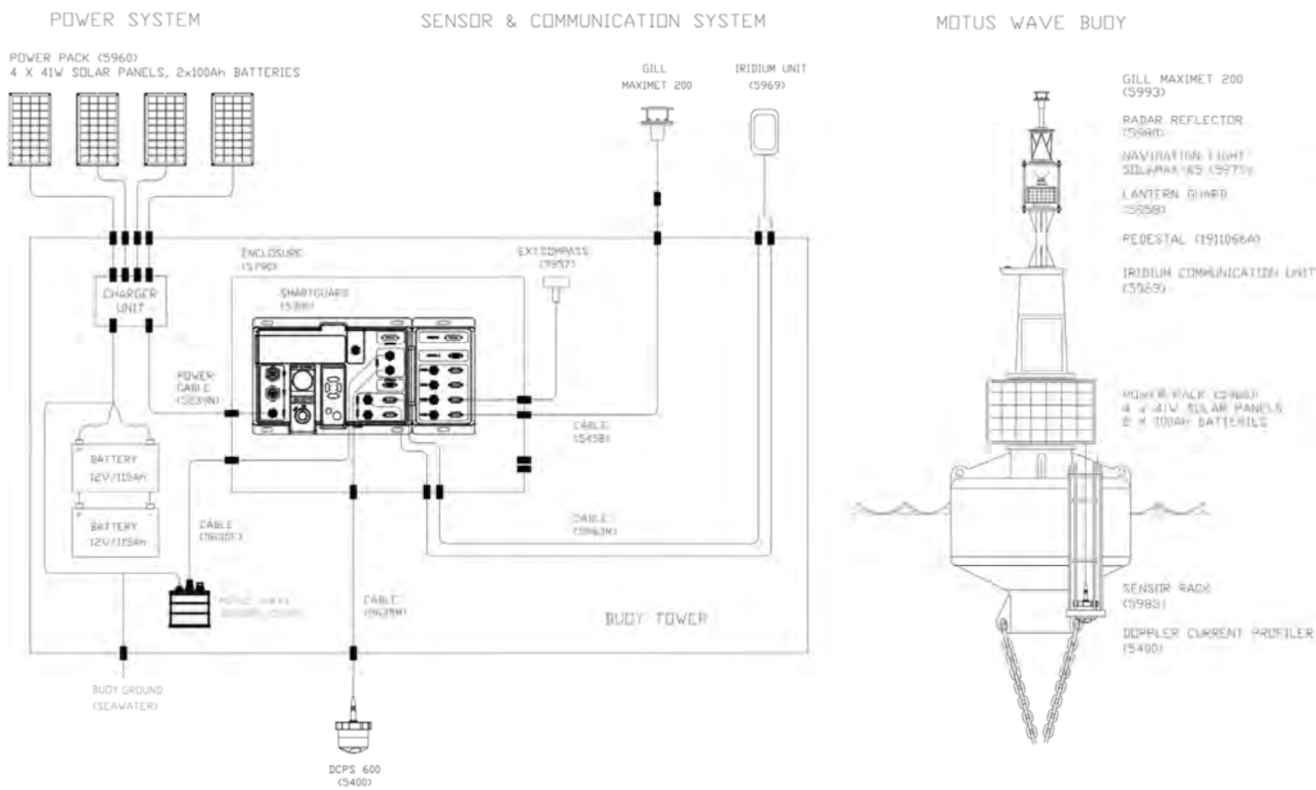


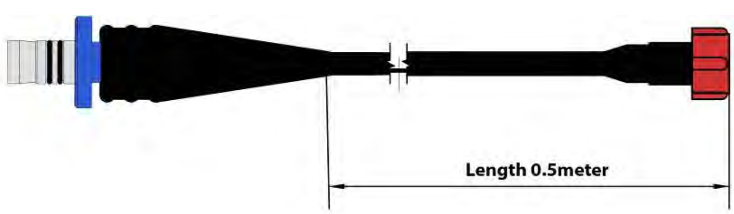
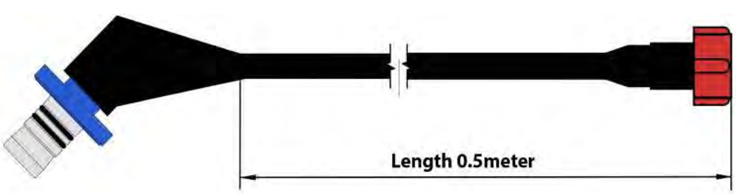
Figure 13-4: Example 2

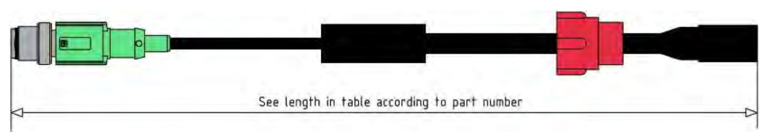
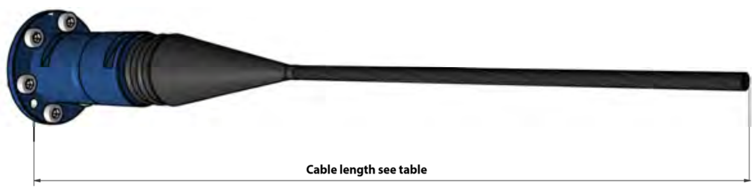
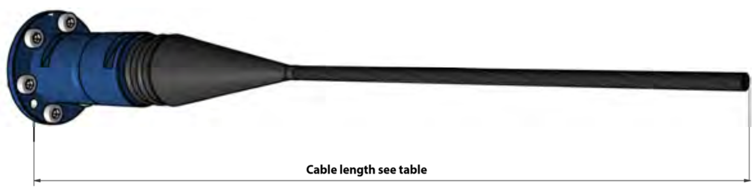
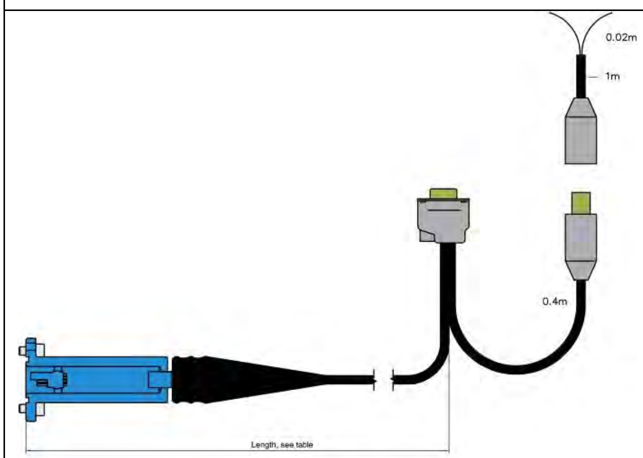
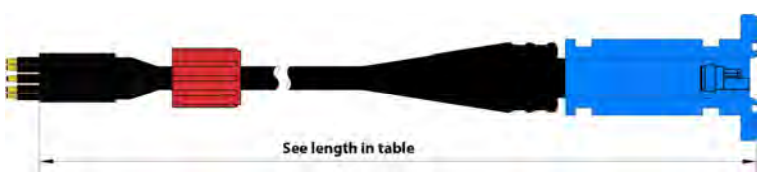
13.3 Connecting Cables

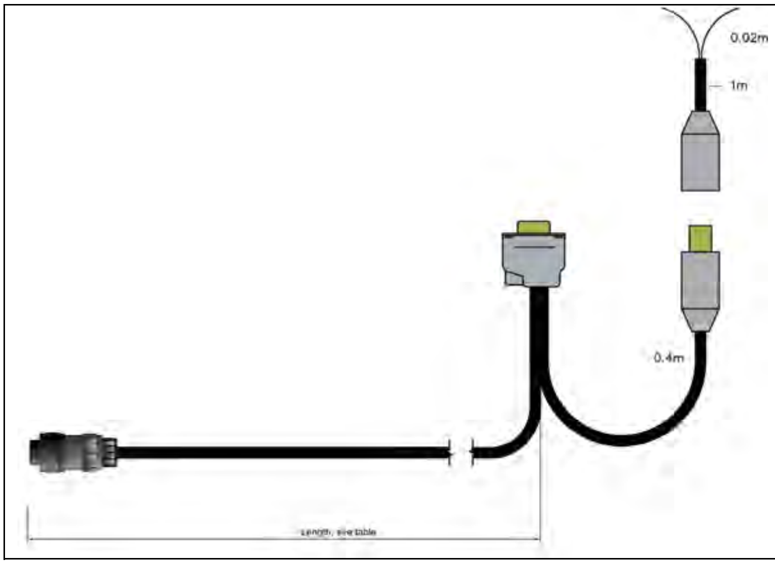
Aanderaa offers a wide range of standard cables;

13.3.1 For AiCaP and RS-232 use

Table 13-1: Available cables for AiCaP and RS-232

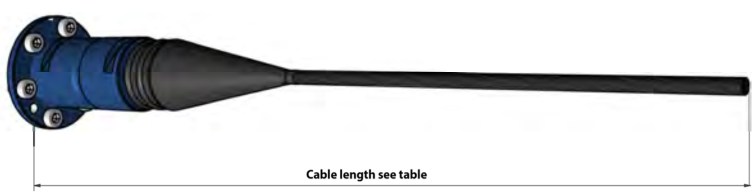
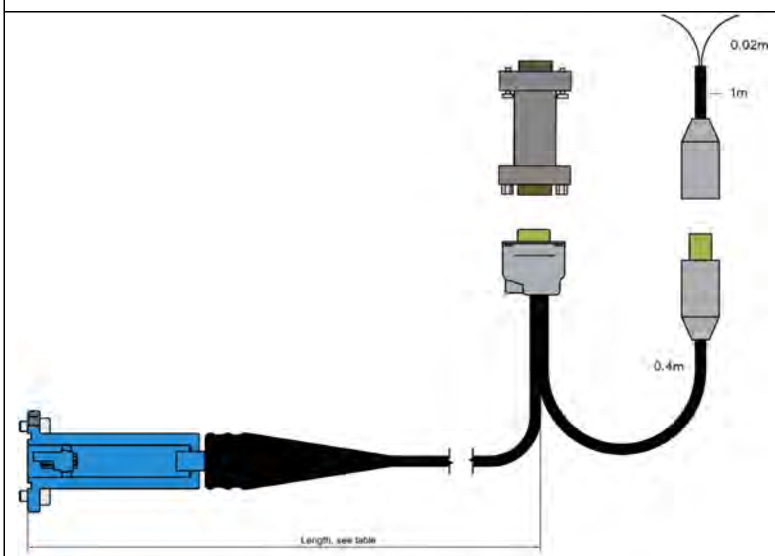
	• 4318 Sensor Foot AiCaP • Used to connect DCPS to SeaGuardII top-end plate • Only for use in center hole
	• 4838 Sensor Cable AiCaP • Used for remote connection of DCPS, between sensor and SeaGuardII top-end plate • Only for use in center hole
	• 5340 Sensor Cable AiCaP and RS-232 • Used for remote connection of DCPS, between sensor and top-end plate via male 8pin Subconn • Needs 5662 or 4872 for connection to SeaGuard top-end plate or 5245 for connection to SmartGuard
	• 5662 Connection Cable AiCaP • Connection between straight plug on SeaGuardII top-end plate using sensor hole and 8pin Subconn on 5340 cable • Needs 5340 cable for connection
	• 4872 Connection Cable AiCaP • Connection between angular plug on SeaGuardII top-end plate using sensor hole and 8pin Subconn on 5340 cable • Needs 5340 cable for connection

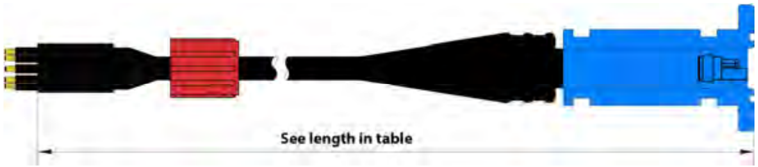
	• 5245 Connection Cable AiCaP • Connection between SmartGuard M12 plug and 8pin Subconn on 5340 cable • Needs 5340 cable for connection
	• 5414 Sensor Cable AiCaP • Free end cable for connection between sensor and Aanderaa logger
	• 4860 Sensor Cable RS-232 • Free end cable for connection between sensor and 3rd party logger
	• 4834 Sensor Cable • Sensor cable with 9pin DsuB for connection between DCPS and PC
	• 5159 Sensor Cable RS-232 • RS-232 • To be used with Real-Time cable

	• 3855 Set-up and configuration cable • Non watertight Set-up cable with 9pin DsuB for connection between 10pin Lemo and PC for laboratory use only

13.3.2 For RS-422 use

Table 13-2: Available cables for RS-422

	• 4860 Sensor Cable RS-422 • Free end cable for connection between sensor and 3rd party logger
	• 4902 Sensor Cable • Sensor cable with 9pin DsuB for connection between DCPS and PC • RS-422/RS-232 converter included.

	• 5159 Sensor Cable RS-422 • To be used with Real-Time cable
	• 5618 Set-up and configuration cable • Non watertight Set-up cable with 9pin DsuB for connection between 10pin Lemo and PC for laboratory use only • RS-422/RS-232 converter included

13.4 Example of Test & Specifications sheet and Certificates

TEST & SPECIFICATIONS

Form No. 572, Oct 2014

Product: DCPS 5400
Serial No: 355

Digital Board
1. Tested according to Test Procedure DID-50855.

Analog Board x2
2. Tested according to Test Procedure DID-50856.

Complete Sensor
3. Tested according to Test Procedure DID-50858.

Performance test and results from Test Procedure DID-50858

4. Visual Check
- 4.1. Inspection of o-ring grove.
- 4.2. Pressure tested.
- 4.3. Electrical isolation to flange after pressure test.
- 4.4. Communication tested (AiCaP, Rs-232/Rs-422).

5. Current Consumption

5.1.	Quiescent, no ping (maximum 350 µA)	226.00µA
5.2.	Total with one ping each second (20 - 40 mA)	30.60mA

6. Compass and Tilt sensor
- 6.1. Compass and tilt calibrated.

7. Performance test
- 7.1 Climatic tests to control sensor performance over the whole temperature range.
- 7.2 Field test in sea water.

Date: 08 Feb 2019

Sign:
Halvard Skurve
Halvard Skurve, Production Engineer

Figure 13-5 Example of Test and Specification sheet

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CALIBRATION CERTIFICATE

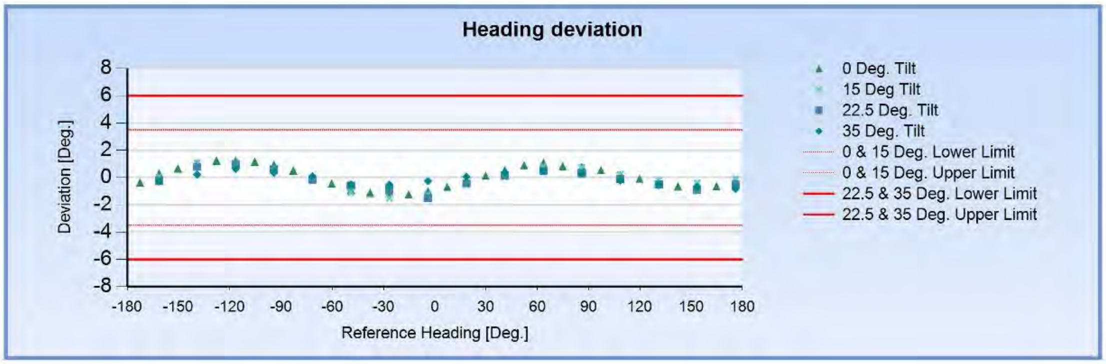
Form No 859, May 2019

Certificate no: 5400_260_00157905	Product: 5400 Calibration date: 16.05.2019	Serial no: 260 Page 1 of 2

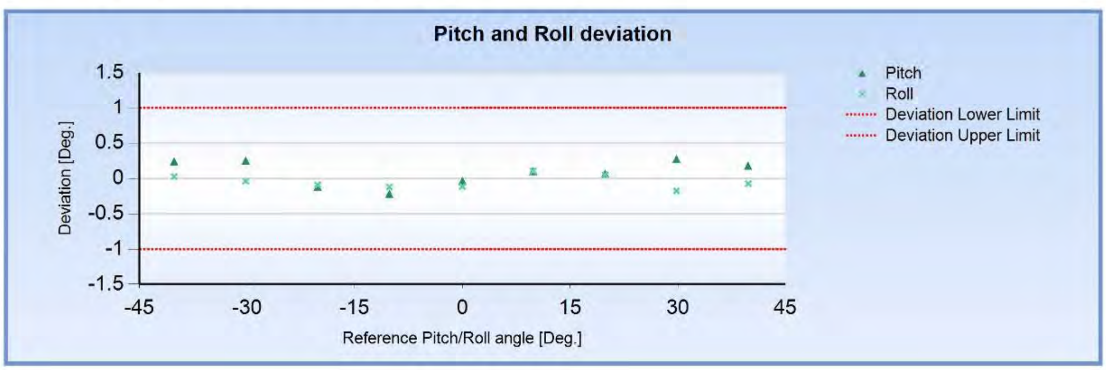
This is to certify that this product has been calibrated and verified using the following reference equipment:

Reference Equipment Description	Serial
Compass HMR3500	13987
Encoder Sendix F3653	1412501654
Encoder Sendix F3653	1412501655
Encoder Sendix F3653	1412501653

Obtained Heading deviation for this product:



Obtained Pitch and Roll deviation for this product:



Page 1

Figure 13-6: Example of Calibration Certificate compass and tilt page 1

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CALIBRATION CERTIFICATE

Form No 859, May 2019

Certificate no: 5400_260_00157905
Product: 5400
Calibration date: 16.05.2019
Serial no: 260
Page 2 of 2

Using these Calibration Coeffisients:

Index	0	1	2	3	4	5	6
Compass Coeffs Up	5.31572E02	-4.95104E01	5.48922E02	-1.02951E02	5.12860E02	1.91816E02	2.16892E00
Compass Coeffs Down	5.28409E02	-6.09271E01	5.50807E02	-1.06035E02	4.95228E02	2.17118E02	-1.89488E00
TiltX Coeffs Up	2.47264E-01	7.44686E-01					
TiltX Coeffs Down	2.53497E-01	7.48688E-01					
TiltY Coeffs Up	2.49805E-01	7.55326E-01					
TiltY Coeffs Down	2.51582E-01	7.53572E-01					

Date:16.05.2019

Helge Soltveit

Helge Soltveit, Production Engineer

Page 2

Figure 13-7: Example of Calibration Certificate compass and tilt page 2

AANDERAA a xylem brand **CALIBRATION CERTIFICATE**

Form No. 726, June 2007

Product: DCPS 5400

Serial No: 13
Calibration Date: 27 Jun 2014

This is to certify that this product has been calibrated using the following instruments:

Calibration Bath model FNT 321-1-40
ASL Digital Thermometer model F250 Serial: 6792/06

Calibration points and readings:

Parameter: Temperature

Calibration points and readings

Temperature (°C)	1.116	11.984	24.011	35.845	0.000	0.000
Reading (LSB)	12460344	10790645	8813782	6949004	0	0

Giving these coefficients

Index	0	1	2	3	4	5
TempCoef	2.66185E01	-5.17975E01	8.06210E00	-1.97612E01	0.00000E00	0.00000E00

Date: 27 Jun 2014

Sign: Tor-Ove Kvalvaag

Tor-Ove Kvalvaag, Calibration Engineer

Aanderaa Data Instruments AS
Sanddalsringen 5b, Postboks 103 Midtun, 5828 Bergen
Tel +47 55 60 48 00 Fax +47 55 60 48 01 aanderaa.info@xyleminc.com www.aanderaa.com

Figure 13-8 Example of Calibration Certificate for optional Temperature Sensor

AADI
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PRESSURE CERTIFICATE

Form No. 667, Sept 2009

Product: DCS 4830R
Serial No: Demo
Date: 02.05.2013

Certificate No: 83053255101

This is to certify that this product has been pressure tested with the following instrument, and we confirm that no irregularities were found during the test:

Autoklav 800 bar – sn: 0210005

Pressure readings:

Pressure (Bar)	Pressure time (hour)
30	1

Date: 02 May 2013

Sign:

Ragnhild Eide Ure

Ragnhild Eide Ure, Production Engineer

AANDERAA DATA INSTRUMENTS AS

5851 BERGEN, NORWAY Tel. +47 55 60 48 00 Fax. +47 55 60 48 01 E-mail: info@aadi.no Web: http://www.aadi.no

Figure 13-9 Example of Pressure Certificate

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

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Aanderaa Data Instruments AS is a member of RENAS

To address environmental concerns Aanderaa Data Instruments AS has joined the industry's own recycling company for electric and electronic waste - RENAS AS. All EE products sold are part of a system for collecting and processing and can be delivered to the dealer or municipal waste treatment plant.

As a member of RENAS we take responsibility for the environment!
More information on return policies can be found at renas.no.

Aanderaa Data Instruments AS
Sanddalsringen 5b, P.O. BOX 103 Midtun
N-5843 Bergen, Norway
Tel: +47 55 60 48 00
E-mail: aanderaa.info@xylem.com • Web: www.aanderaa.com

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