CONDUCTIVITY SENSOR 4319

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Table of Contents

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Introduction

Purpose and scope

This document is intended to give the reader knowledge of how to operate and maintain the AADI Aanderaa Conductivity Sensor 4319.

It also aims to give insight in how the sensor works and how the conductivity measurement of water can be used to determine other important seawater properties.

Whit this revision Aanderaa is releasing a new firmware version to accommodate higher security and future expansion. Both the Smart Sensor Terminal protocols and the AADI Real Time protocol are updated in this version of the Smart Sensor firmware.

AADI 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. These common updates of these protocols are called framework 3, and is released August 2012 for most of the AADI smart sensors. (See appendix 4)

Conductivity Sensor 4319 is designed to fit directly on the top-end plate of SeaGuard or in a string system connected to SmartGuard or SeaGuard String logger using AiCaP. The sensor can also be used as stand-alone sensor using RS-232.

Document overview

Chapter 1 give a short description of the sensors and lists the sensor properties.
Chapter 2 describes the measurement principles and the sensor output parameters.
Chapter 3 describes SEAGUARD® applications; how to install and perform sensor configuration.
Chapter 4 describes sensor configuration using AADI Real-time Collector.
Chapter 5 describes the procedure for Smart Sensor Terminal communication setup.
Chapter 6 gives information about recommended maintenance procedures and sensor calibration.
Appendix 1 describes the mechanical design of the sensor.
Appendix 2 gives the theory of operations.
Appendix 3 covers all available cables.
Appendix 4 holds a copy of Product Change Notification: Framework 3.

Applicable documents

V-8875	Assembly Drawing
V-8700	Sensor Cable 3855, Sensor to PC, Rs-232, laboratory use
V10501	Sensor Cable 4865, Sensor to PC, RS-232, field use
V-10331	Sensor Cable 4762, Sensor to free end, RS-232
Form 750	Test & Specification Sheet, Conductivity Sensor 4319
Form 749	Calibration Certificate, Conductivity Sensor 4319
D369	Data sheet, Conductivity Sensor 4319

References

[1] Fofonoff, Journal of Physical Oceanography JGR, Vol 90 No. C2, pp 3332-3342, March 20, 1985

Abbreviations

ADC	Analog to Digital Converter
AiCaP	Aanderaa Protocol: Automated idle Line CANbus Protocol
ASCII	American Standard Code for Information Interchange
CAN	Controller Area Network - sometimes referred to as CANbus
DSP	Digital Signal Processor
EPROM	Erasable Programmable Read Only Memory
HCL	Hydrochloric acid (Muriatic acid)
MSB	Most significant bit
PSU	Practical Salinity Unit
RTC	Real Time Clock
UART	Universal Asynchronous Receiver and Transmitter
UNESCO	The United Nations Educational, Scientific and Cultural Organization
USB	Universal Serial Bus

CHAPTER 1 Short Description and Spesification

Specific conductivity is a property that describes how well a material can conduct an electrical current. For seawater this property is mostly dependent on the inorganic dissolved solids and the temperature of the water.

Salinity is defined as the concentration of these dissolved solids, and by measuring both the Conductivity and Temperature (the Conductivity sensor 4319 has a built-in Temperature sensor) the salinity of the water can be determined.

Other important properties of seawater can be calculated based on the salinity measurements, e.g. the density and the speed of sound.

For freshwater the conductivity can be used as a quality indicator. Increased conductivity of a stream will often indicate increased pollution, and increased conductivity of groundwater might indicate seawater intrusion.

The Conductivity Sensor 4319 is based on an inductive principle. This provides for stable measurement without electrodes that are easily fouled in the field.

Conductivity Sensor 4319 is available in two versions 4319A and 4319B where 4319B versions have enhanced accuracy compared to 4319A.. See Data Sheet D369 for more information.

Each of these versions is also available in three different depth ratings SW (Shallow Water) is rated to 300meter, IW (Intermediate Water) is rated to 2000meter and DW (Deep Water) is rated to 6000meter.

Two versions of the Conductivity Sensors are available, 4319A and 4319B, where 4319B versions have enhanced accuracy compared to 4319A.

The Conductivity Sensor 4319 interconnects with both RS232 and CANbus (AiCaP).

The Conductivity sensor fits directly on to the Top-end Plate of the Aanderaa SEAGUARD® datalogger. The sensor can also be used as a Stand-Alone RS232 sensor for use with third party data loggers.

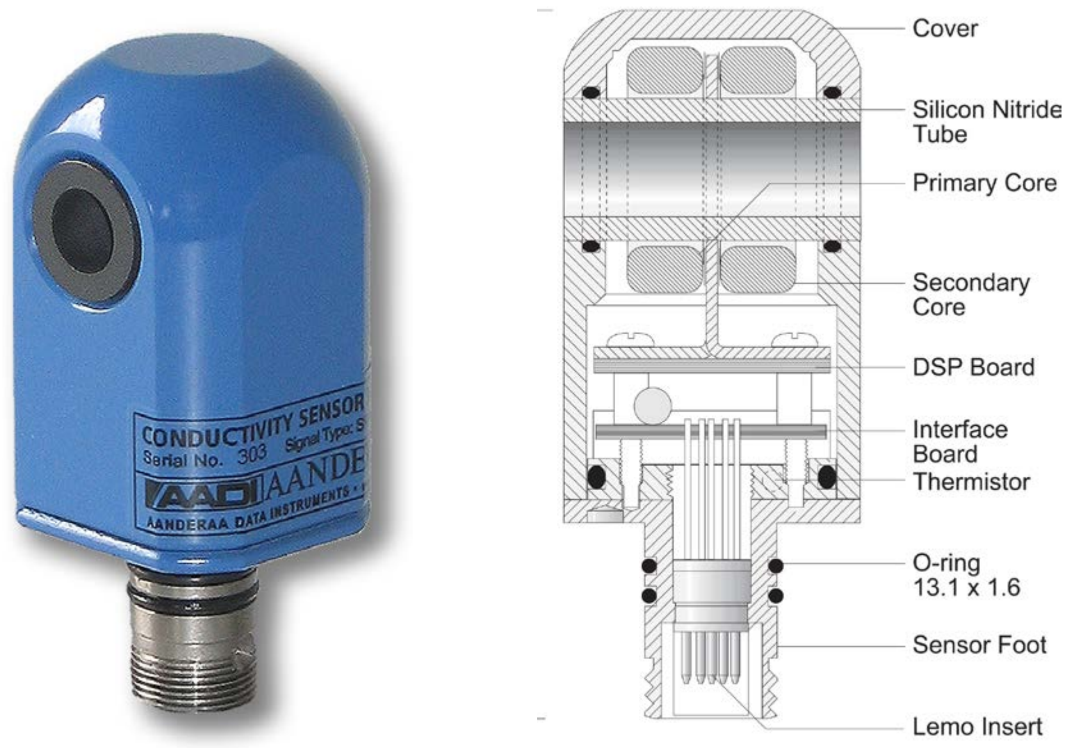


Figure 1-1: Illustration of the Conductivity Sensor 4319

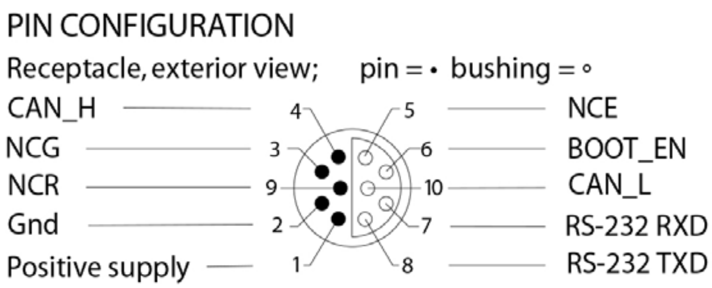


Figure 1-2: Conductivity Sensor 4319 pin configuration.

1.1 Pin Configuration

The Conductivity Sensor 4319 pin configuration is given in Figure 1-2. A description of the receptacle notation is given in Table 1-1

Table 1-1 Description of the Pin Configuration

Signal	Description
CAN_H	CANbus line (dominant high)
NCG	Node Communication Ground
NCR	Node Communication Request
Gnd	Ground
Positive supply	6-14V positive supply.
NCE	Node Communication Enable
BOOT_EN	Boot Load Enable (do not connect)
CAN_L	CANbus line (dominant low)
RS232 RXD	RS232 Receive line
RS232 TXD	RS232 Transmit line

1.2 User Accessible Sensor Properties

All configuration settings that determines the behaviour 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. Table 1-2 lists all user accessible properties for Conductivity Sensor 4319.

Table 1-2 FC = Factory Configuration, DS = Deployment Setting, SC = System Configuration, UM = User Maintenance. ENUM=Enumeration, INT =Integer, BOOL=Boolean('yes'/'no')

Property	Type	No of elements	Use	AiCaP Category	Access Protection
Product name	String	31	AADI Product name	FC	Read Only
Product Number	String	6	AADI Product number		
Serial Number	INT	1	Serial Number		
SW ID	String	11	Unique identifier for internal firmware		
Software Version	INT	3	Software version (Major, Minor, Built)		
HW ID X	String	19	Hardware Identifier, X =1..3		
HW Version X	String	9	Hardware Identifier, X =1..3		
System Control	INT	3	For AADI service personnel only		

Production Date	String	31	AADI production date, format YYYY-MM-DD		
Last Service	String	31	Last service date, format YYYY-MM-DD, empty by default		
Last Calibration	String	31	Last calibration date, format YYYY-MM-DD		
Calibration Interval	INT	1	Recommended calibration interval in days		
Interval	Float	1	Sampling Interval in seconds	DS	Low
Location	String	31	User setting for location		
Geographic Position	String	31	User setting for geographic position		
Vertical Position	Float	1	User setting for describing sensor position		
Reference	String	31	User setting for describing sensor reference		
Pressure	Float	1	Water pressure in kPa	DS	High
Mode	ENUM	1	Sets the sensor operation mode (AiCaP, Smart Sensor Terminal, AADI Real-Time, Smart Sensor Terminal FW2)	SC	High
Enable Sleep	BOOL	1	Enable sleep mode		
Enable Polled Mode	BOOL	1	Enable polled mode (for RS232). When set to ‘no’ the sensor will sample at the interval given by the *Interval* property. When set to ‘yes’ the sensor will wait for a *Do Sample* command.		
Enable Text	BOOL	1	Controls the insertion of descriptive text, i.e. parameter names		
Enable Decimalformat	BOOL	1	Controls the use of decimal format in the output string		
Enable Temperature	BOOL	1	Controls inclusion of Temperature in the output string		
Enable Derived Parameters	BOOL	1	Controls inclusion of Salinity, Density and Speed of sound in the output string		
Enable Rawdata	BOOL	1	Controls inclusion of Conductivity in the output string		
Node Description	String	31	User text for describing node, placement etc	UM	High
Owner	String	31	User setting for owner		
Baudrate	ENUM	1	RS232 baudrate: 4800, 9600, 57600, or 115200. Default baudrate is 9600[1)]		
Flow Control	BOOL	1	RS232 flow control: ‘None’ or ‘Xon/Xoff’		
Enable Comm Indicator	BOOL	1	Enable communication sleep (’%’) and communication ready (‘!’) indicators		
Comm TimeOut	*ENUM*	*1*	*RS232 communication activation timeout: Always On,10 s,20 s,30 s,1 min,2 min,5 min,10 min*		
TempCoef	Float	6	Curve fitting coefficients for the temp measurements.		
R0Coef0	Float	4	Temp Coefficients for Loop reading to Conductance, Range 0		
R0Coef1	Float	4	Temp Coefficients for Loop reading to Conductance, Range 0		
R0Coef2	Float	4	Temp Coefficients for Loop reading to Conductance, Range 0		
R0Coef3	Float	4	Temp Coefficients for Loop reading to Conductance, Range 0		
R0Coef4	Float	4	Temp Coefficients for Loop reading to Conductance, Range 0		

R1Coef0	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef1	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef2	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef3	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef4	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef5	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef6	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef7	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef8	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
R1Coef9	Float	4	Temp Coefficients for Loop reading to Conductance, Range 1		
CellCoef	Float	1	Cell constant for converting mS to mS/cm		
Range	INT	1	Range setting: -1=Auto range, 0=Low range, 1=High range		

1) Baud rates lower than 9600 may limit the sampling frequency.

1.3 Specifications

For product specifications refer Datasheet D369 on our web site http://www.aanderaa.com or contact aadi.info@xyleminc.com

You will always find the latest version of our documentation on the web.

Customers can register to obtain a username and password necessary to gain access to product manuals, technical notes and software. Please contact aadi.info@xyleminc.com for guidance.

1.4 Manufacturing and Quality Control

Aanderaa Data Instruments products have a record for proven reliability. With over 40 years experience producing instruments for user in demanding environments around the globe, you can count on our reputation of delivering the most reliable products available.

We are an ISO 9001 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.

CHAPTER 2 Measurement Principles and Parameters

The Conductivity sensor 4319 measures raw data of Conductivity and Temperature. Engineering data are calculated by software in the sensor (Sensor Firmware) based on these raw data and sets of calibration coefficients stored in the sensor.

All conductivity sensors have a temperature drift. By calibrating the sensor at different temperatures, this drift can be found. The DSP stores the data from the calibration and is thus able to temperature-compensate sampled pressure data, as well as to convert the data into linearly calibrated data in engineering units.

The Sensors can be logged directly by a PC via the RS-232protocol) and by most PLC's DCP's i/o devices, data loggers and systems.

2.1 Sensor Integrated Firmware

The firmware's main task is to sample raw data, compute calibrated temperature compensated and linearized conductivity, and present the result at the different interfaces.

All calibration coefficients and settings are stored in the DSP flash-memory. These properties can be displayed and changed using the RS-232 port (see RS-232 Protocol for how to communicate with the sensor).

2.2 Measured Parameters

- The Conductivity measurements are presented in mS/cm
- The Temperature measurements are presented in °C.

2.3 Calculated parameters

Based on the measured parameters described above and a user selectable pressure setting (in kPa), the senor software also calculates other parameters:

- The Salinity in PSU
- The water Density in kg/m^3
- The Speed of Sound in m/s

These calculations are made according to the UNESCO International Equation of State, IES 80, Unesco 27 [1].

CHAPTER 3 Installation on SEAGUARD®

The sensor is equipped with a CANbus interface supporting the Aanderaa AiCaP(Automated idle line CANbus Protocol). This standard ensures easy plug and play connection to all Aanderaa SeaGuard and SmartGuard dataloggers

When connected to a CANbus network the sensor will report its capabilities and specifications to the datalogger at power up. The datalogger assembles the information and provides the user with the possibility to configure the instrument based on the present node. The solution provides for great flexibility in both use and design of the different elements within the system.

Note! This chapter describes the System Configuration of the Conductivity Sensor. Refer TD262a for a thorough description of configuring the SEAGUARD® Instrument,

3.1 Installation on SEAGUARD® platform

The Conductivity Sensor 4319 can easily be installed on AADI SEAGUARD® data loggers. We recommend that you install the sensor in sensor position 4, refer Figure 3-1. Sensor 4319 can also be installed in position 3 or 6. If mounted in position 6 use patch cable to connect the sensor onto the HUB, refer TD262a SEAGUARD® Platform Operating Manual. If placed next to another sensor, the cell factor calibration performed on the Conductivity sensor might be influenced. It is important that the Conductivity Cell is placed in the same position and with the same sensors surroundings as it was calibrated.

For best accuracy the sensor should be recalibrated after installation on the instrument (refer Test of Conductivity Sensor 4319 with resistor loop, *page* 35*).*

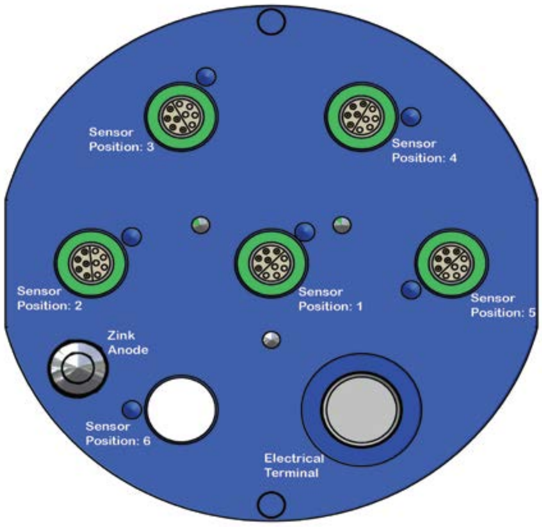


Figure 3-1 Illustration of the SEAGUARD® Top-end plate.

All sensor and sealing plugs except for the centre position are secured by means of a setscrew in the side of the top end plate. Start by unscrewing the setscrew for the wanted position (the setscrew will stop when sufficiently extracted). Pull out the sealing plug (or sensor) by inserting a screwdriver in the slot between the plug and the top end plate, see Figure 3-2.

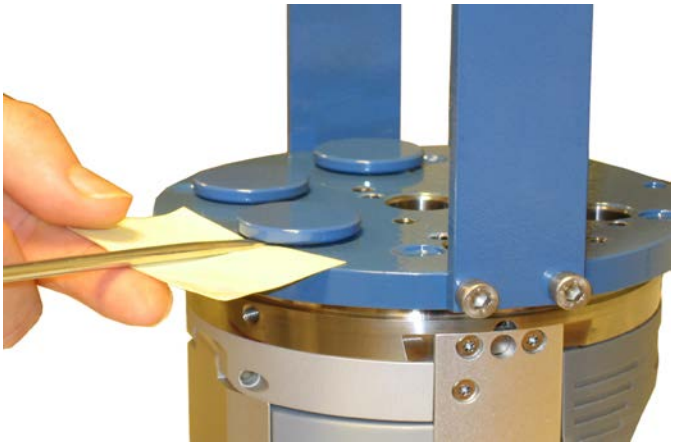


Figure 3-2: Removal of sealing plug. Use a small piece of paper/cardboard to protect the lacquer of the top-end plate

Make sure that the surface in the hole is clean and smooth and check also that the O-rings at the sensor foot are free from dust and particles and greased with silicon grease. Align the orientation pin in the sensor foot with the orientation hole in the top end plate, and carefully insert the sensor.

When fully seated at the top end plate, tighten the set screw with only moderate force.

Note! Always replace O-rings when connecting to a sensor or a sealing plug.

Apply Tectyl 506 (included in maintenance kit) in the slit between the Sensor and the top end plate, refer Figure 3-3. This will prevent crevice corrosion of the top end plate.

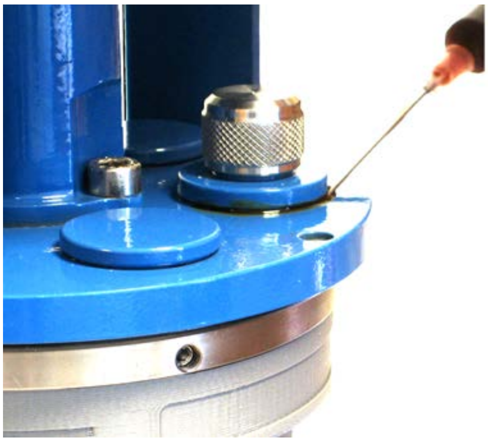


Figure 3-3 Apply Tectyl in the slit between the Sensor and the top end plate. (Example showing tectyl around the electrical terminal).

Figure 3-4 Conductivity sensor 4319 mounted on SEAGUARD® datalogger.

3.2 Sensor Cable

Sensor Cable 4793 is used for remote sensor connection on SeaGuard, See Appendix 3, Figure A10. If sensor used as 6th sensor or top-end plate us Patch Cable 4999, See Appendix 3, Figure A11. A watertight free end cable 4762 and non-watertight free end cable 3880 is available for connection to third part datalogger, See Appendix 3, Figure A8 and A9. For set up and configuration use Sensor Cable 3885 or 4865. 3885 is for laboratory use only, See Appendix 3, Figure A6 and A7

For sensor connection to AADI SmartGuard use cable 5245 or 5236, for further information contact info.aadi@xyleminc.com

3.3 Sensor Configuration

Note! Refer to Chapter 1.2 for a description of the sensor settings and the input parameters.

3.3.1 System Configuration

After installing the sensor turn power on and open the ***System Configuration*** from the ***Menu*** button. Select the folder labelled ***Sensors.*** Select the newly installed ***Conductivity Sensor*** which should appear in the list of ***Sensors***, and tap ***Configure*** in the lower part of the window, refer figure 3-5.

The ***System Configuration*** holds a list of output parameters that can be enabled/disabled by the user. Enabled properties (***Yes***) are stored in the data logger

- ***Enable Temperature*** in engineering units.
- ***Enable Raw data***, of both the Conductivity and Temperature

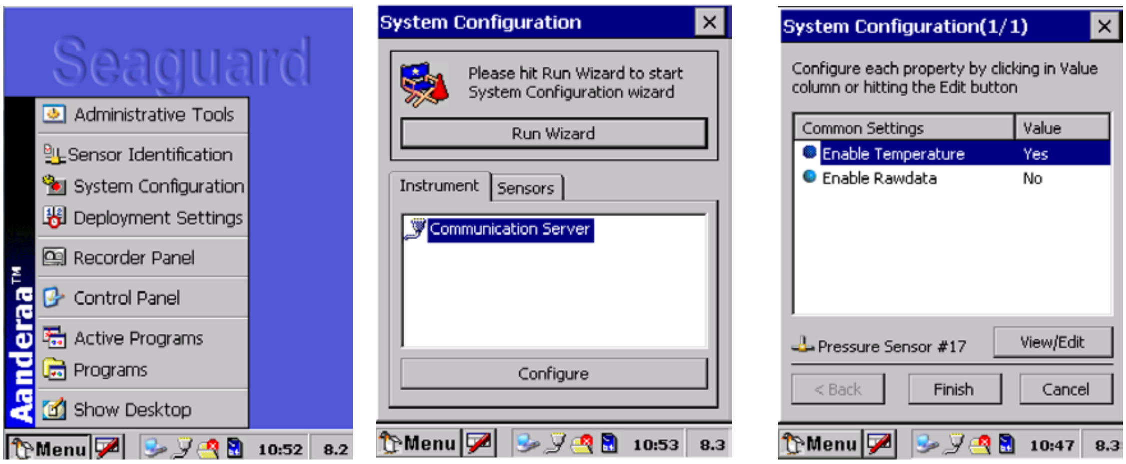


Figure 3-5 System configuration

To enable/disable a parameter:

Select the output parameter from the list, press ***View/Edit*** in the lower part of the window, and change the setting by clicking the box (box is now checked), press ***Save*** to save and close the window.

We recommend that you enable all parameters in case of later use. The memory card storage capacity is normally not a limitation for the SEAGUARD®. Raw data can be used e.g. to control calibration coefficients and perform quality control on the data.

The ***System Configuration*** holds output parameters which can be enabled/disabled by the user, refer Figure 3-5.

Select the property, and press ***View/Edit*** to set the
value. Tap *OK* to return to the System Configuration display, refer Figure 3-5.

Press *Finish* to store the settings when complete.

3.3.2 Deployment Settings

The ***Deployment Settings*** hold a list of user defined inputs: location, geographic position, vertical position and reference. Open ***Deployment Settings*** from the ***Menu*** button Select ***Conductivity*** from the ***sensor list.*** To add information to one of these properties, select the property, press ***View/Edit*** and with the keyboard panel enter the text or numbers. Press ***OK*** and ***Finish*** storing the information.

3.3.3 User maintenance

Node Description, User Information, Cell Coefficient, Calibration Coefficients and Range are found in ***User Maintenance***

Open ***Administrative Tools*** from the ***Menu*** button Select ***User Maintenance*** and then ***Conductivity*** from the ***sensor list.*** Refer Figure 3-6. In ***User Maintenance*** you find properties that are password protected, and are set/altered by the 'advanced user'***, note! the password is: 1000*** The properties in user maintenance are therefore not changed during normal operation. The user maintenance holds three submenus:

- ***Node Descriptions***
- ***Owner***
- ***CellCoeff***
- ***Calibration Coefficients***
- ***Range***

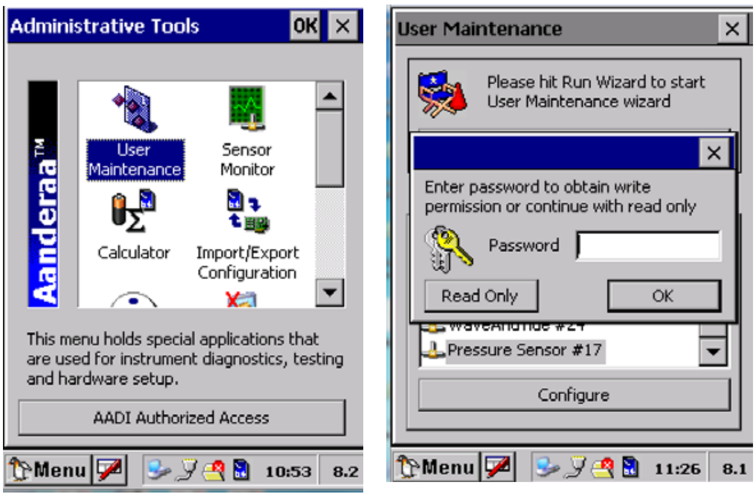


Figure 3-6 User Maintenance.

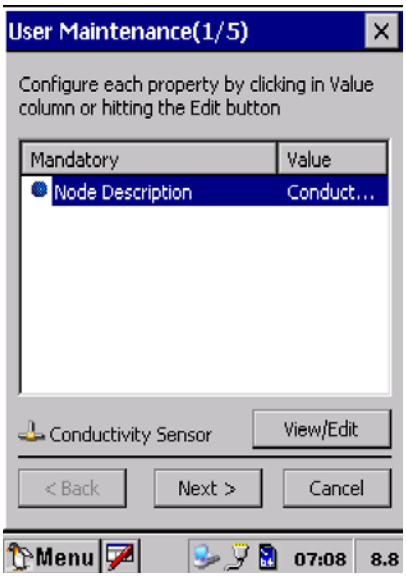


Figure 3-7 Node Description

Select the ***Node Description*** property, press ***View/Edit*** in the lower part of the window, and change the setting. Press ***Save*** to store the setting when completed.

Node Description is a user entered text describing the sensor, placement etc. If using for example a SEAGUARD® sensor string with multiple sensors connected; renaming the sensor can facilitate analyzing data. The text is by default set to the product name followed by product model and serial number, e.g. *Conductivity Sensor 4319#52*.

Press ***Next>*** to continue with the next submenu.

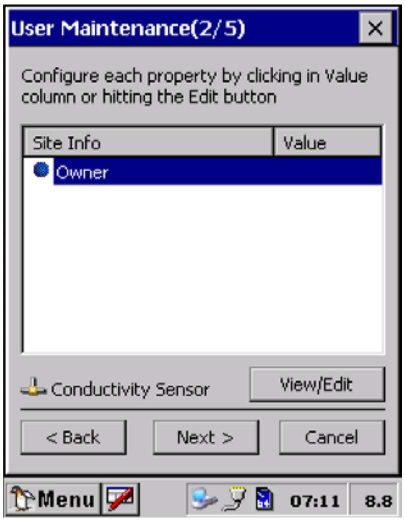


Figure 3-8 Owner

The second submenu is the ***Owner*** property, press ***View/Edit*** in the lower part of the window, and change the text. Press ***Save*** to store the setting when completed.

Owner is a user entered text describing the sensor owner, name and address etc. If using. The text is by default empty

Press ***Next>*** to continue with the next submenu.

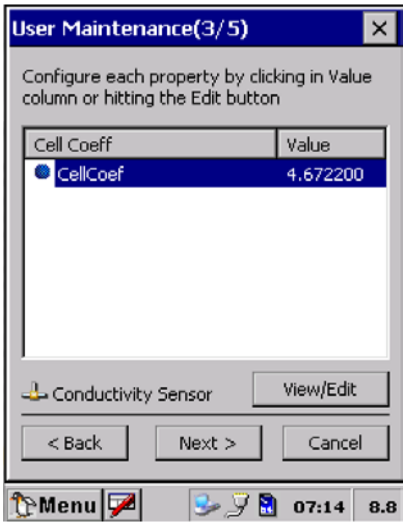


Figure 3-9 CellCoeff

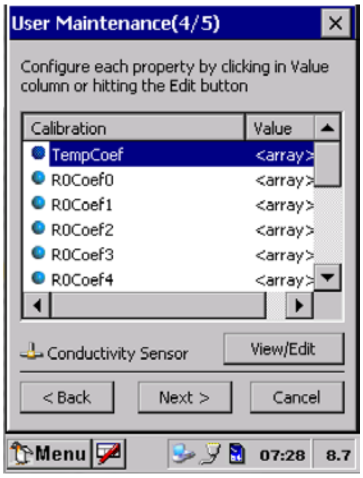
The third submenu is the ***CellCoeff*** property, press ***View/Edit*** in the lower part of the window, and change the text. Press ***Save*** to store the setting when completed.

CellCoeff is a user entered value which describes the relationship between the conductance (mS) in the seawater loop measured by the Sensor and the specific conductivity (mS/cm). A corrected *CellCoef* can be calculated using the procedure in chapter 8.2.

Press ***Next>*** to continue with the next submenu.

Note!

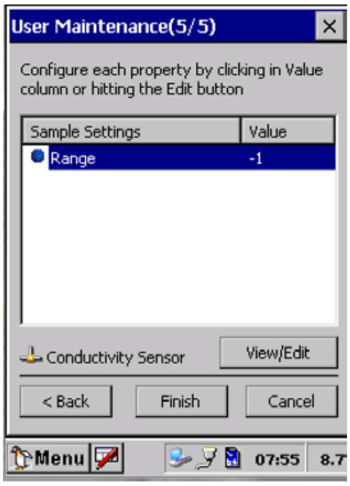
We recommend that you recalculate the CellCoeff when the sensor is shifted between instruments or between sensor positions on the top-end plate (refer chapter 6.2).



The fourth submenu is the ***Calibration Coefficients*** property. For each calibration property to be set, you must first select the property then press ***View/Edit*** and type the correct value. Press ***Save*** to store the settings.

Press ***Finish*** > to complete and exit and store the changes made

Figure 5-10 Calibration Coefficients



The fifth submenu is the ***Range*** property. You must first select the property then press ***View/Edit*** and type the correct value. Press ***Save*** to store the settings.

Press ***Finish*** > to complete and exit and store the changes made

Note! We recommend the default setting -1 for auto range; the sensor will automatically choose High or Low range depending on the measurement conditions

Figure 5-11 Range

Always press ***Finish*** to complete, exit and store the changes made in the Pressure Sensor User Maintenance. Selecting ***Cancel*** or clicking on the '***X***' in the top right corner to close the screen exits the menu without saving any of the changes.

CHAPTER 4 Sensor configuration using AADI Real-Time Collector

The sensors that are updated with Sensor Framework version 3 can be configured as stand-alone sensors using AADI Real-Time Collector.

Open the sensor connection as described in TD 268 AADI Real-Time collector operating manual.

When the connection is established you can start and stop recordings or configure the device, refer Figure 4-1. Open Device Configuration and press Get Current Configuration. Check Include User Maintenance to view maintenance settings. The password is 1000.

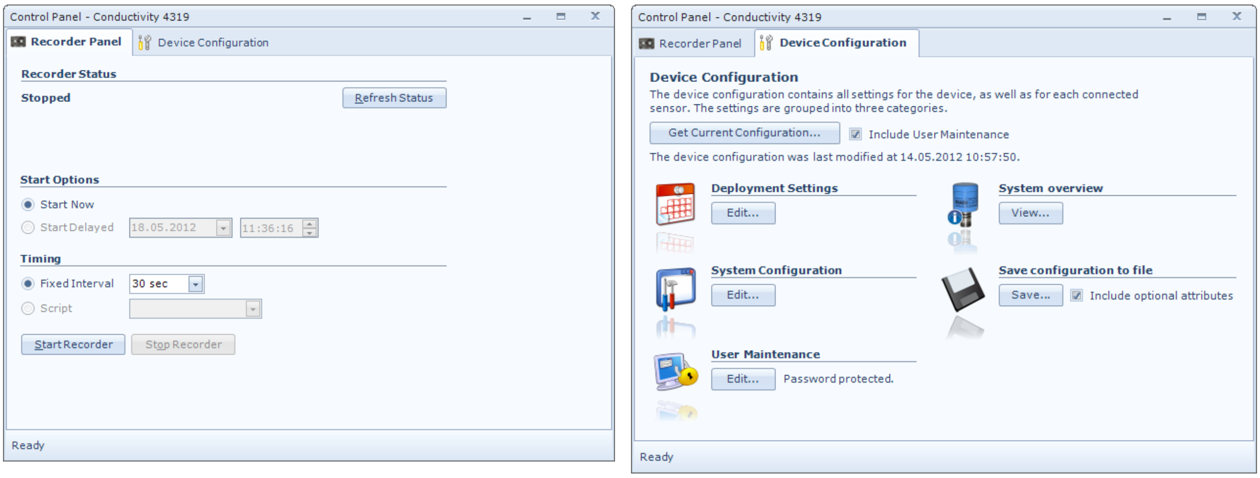


Figure 4-1 AADI Real-Time Collector screen views

User accessible sensor properties are found in Deployment settings, System Configuration and User Maintenance. Refer Table 1-2 in chapter 1.2 for an overview of the properties. To edit the configuration, click in the value-field and enter new value. Press *Next* to update sensor flash and store changes.

Figure 4-2, Figure 4-3, and Figure 4-4 presents screen views of AADI Real-Time Collector.

Note! These screen shots might show minor discrepancies compared to screen shots taken from your sensor due to sensor updates.

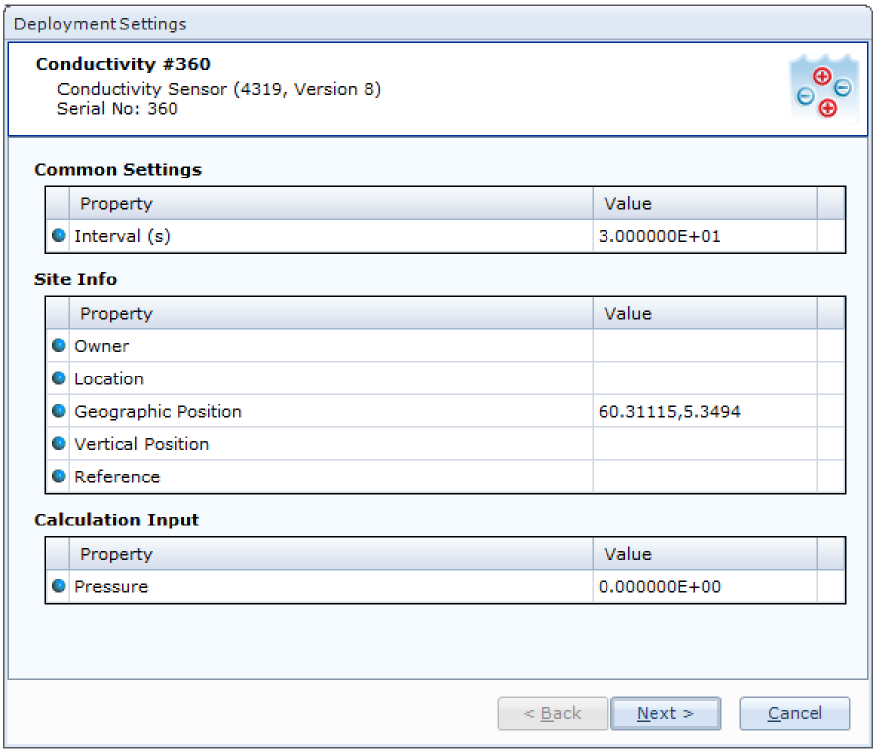


Figure 4-2 Sensor deployment settings

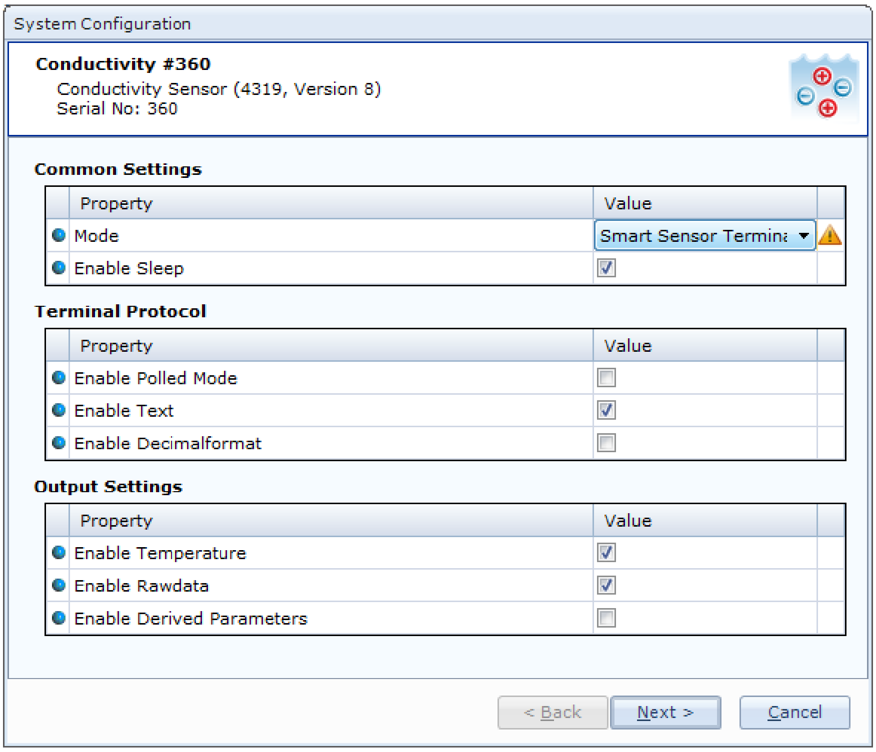


Figure 4-3 Sensor system configuration

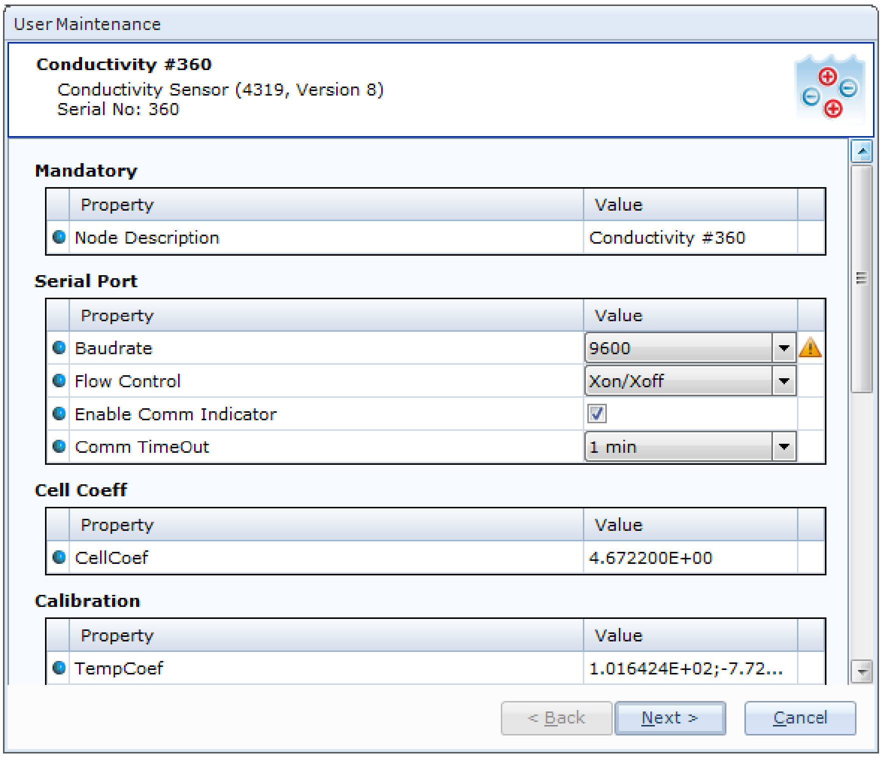


Figure 4-4 Sensor user maintenance

CHAPTER 5 Smart Sensor Terminal operation

This chapter describes how to connect and communicate with the Conductivity Sensor 4319 using the RS232 Smart Sensor Terminal protocol. Sensor configuration is described in chapter 3 and 4.

Sensor Cable 3855 (1.5m) is not intended for in water use, it is for sensor setup in an office environment only, for laboratory or in water use Sensor Cable 4865 to connect sensor to a PC.

Note! The connector on Sensor Cable 3855 is made of Aluminium, due to risk of corrosion it is not recommended for use in saltwater. Same pin configuration as Cable 4865.

Either connect the additional USB plug in a USB port for providing power to the sensor (the USB port normally gives 5V power), or connect the USB plug to an included extension of the USB and connect to external power (5-14V), refer Figure 5-1.

Note! If power cannot be obtained from an USB port a practical solution is to use a 9V alkaline battery (6LF22) to set the sensor up or log data in the laboratory.

Sensor Cable 4865 is also available in other lengths. The cable has a titanium plug, and can be used in applications that require a direct connection to a PC in RS232 operations.

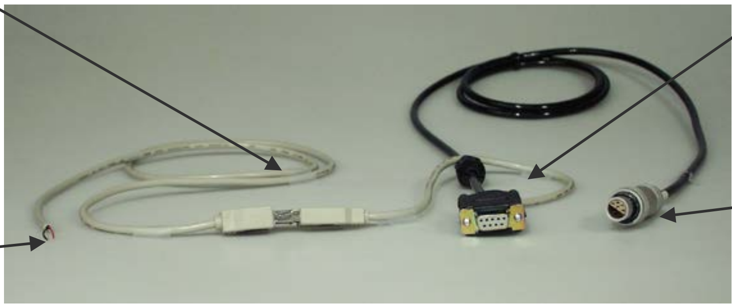


Figure 5-1 Sensor Cable 3855.

See Appendix 3 for illustrations of all available cables.

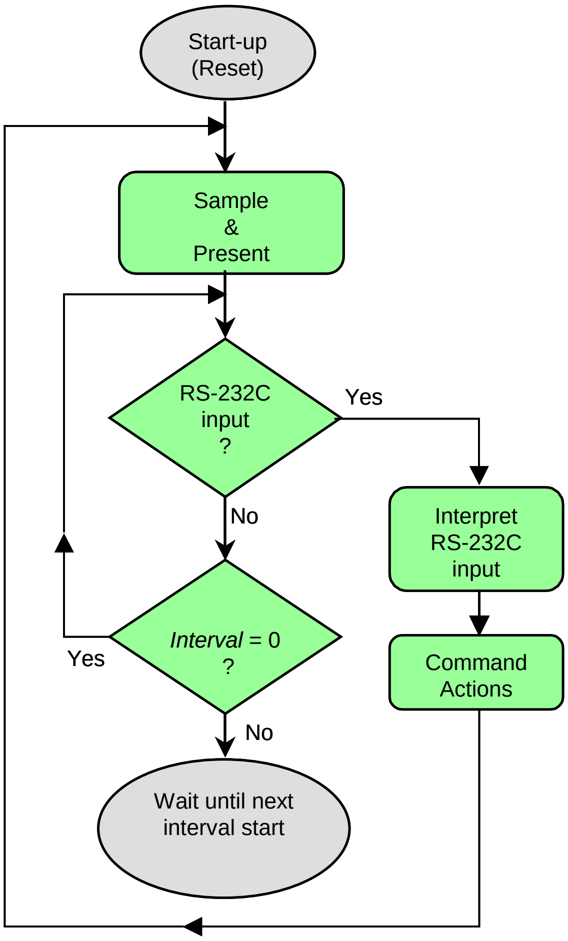


Figure 5-2 Software, RS232 operation sequence

When used in Smart Sensor Terminal mode the sensor will always start by doing a sample. If the output is enabled this data will be presented within 2 seconds from powering the sensor.

In order to minimize the current consumption the sensor normally enters a power down mode after each sampling; the sensor can be awakened by any characters on the RS232 interface, and will stay awake for approximately 1 minute at a time. Refer page 27 for details regarding the Smart Sensor Terminal protocol.

5.1 Sensor configuration

The Sensor Configuration consists of *Interval Setting*, *Enabling/disabling Sensor Parameters*, and a *Mode* property for sensor operation. Other sensor configurations are e.g. *Enable Sleep* and *Enable Text*, refer Table 1-2 in page 10.

The *Interval* property configures the sensors regular recording interval; the sensor will perform repeated sampling and data presentation at regular intervals. This is called non-polled mode. When configured to non-polled mode the sensor can be used in systems with one-way communication.

An output string is presented after each sample. The properties *Enable Temperature, Enable Derived Parameters, Enable Rawdata* control the content of this string and also the parameters that are collected in AiCaP operation. These properties requires the Boolean *true* (to enable) or *false* (to disable) as input.

Set the *Enable Sleep* to *'true'* for the sensor to go to sleep between recordings, or *'false'* for the sensor to stay continuously switched *on* between recordings.

Set the *Enable Text* to *'true'* for the sensor to output a detailed text string with the measurements, or *'false'* to output the measured values without the descriptive text. Refer *Output control* on page 31 for examples.

The *Mode* property is used to set the sensor operation mode of the sensor. Set the mode property to *AiCaP*, *Smart Sensor Terminal*, *AADI Real-Time*, *Smart Sensor Terminal FW2* to enable the different sensor operations. *Note! The mode Smart Sensor Terminal FW2 brings the sensor into an operation mode that is compatible with AADI framework 2.*

The *Comm TimeOut* property controls how long the sensor will wait for the next command before it shuts down the transceiver (indicated by the communication sleep indicator '*%*'). In this time period the sensor is not allowed to enter communication sleep. If set to *Always On*, the sensor will not need a wakeup character and is always ready to read incoming commands. This setting will not allow the sensor to enter communication sleep, and is not recommended for battery operation. In AiCaP mode the setting is overridden to 1 minute when configured using the RS232 line.

The *Pressure* setting in kPa is used in calculation of salinity, the density of water and speed of sound.

5.2 Smart Sensor Terminal protocol

The Smart Sensor Terminal protocol describes how to communicate with the sensor.

For connection to a Personal Computer (PC) the 1.5-meter Sensor Cable 3855 can be used.

Most terminal programs, such as the HyperTerminal*) by Hilgraeve Inc (included in Microsoft's operating systems), can be used for manual communication.

The following RS-232 setup should be used:

9600 Baud

8 Data bits

1 Stop bit

No Parity

Xon/Xoff Handshake

**) Note! The options "Send line ends with line feeds" and "Echo line ends with line feeds" in the HyperTerminal ASCII setup must be selected.*

When property *Enable Text* is set to *Yes*, *StartupInfo* is displayed at sensor power up or after reset. *StartupInfo* contains this information about product number, serial number, current mode setting, Protocol version for RS232 operation and Config Version.

When used in RS232 interface the sensor will start by doing a sample that will be presented within 2 seconds from powering the sensor.

In order to minimize the current drain the sensor normally enters a power down mode after each sampling; the sensor can be awakened by any characters on the RS232 input, and will stay awake for a time set by the *Comm TimeOut* property after receiving the last character, refer chapter 1.2.

The character '%' indicates that communication with the sensor is not possible (communication sleep).

Any character will cause the electronics to return to normal operation; when the sensor has responded with the communication ready indicator, '!', 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 (controlled by the *Comm TimeOut)* since the last command.
- If the sensor is in communication 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.

The communication sleep indicator '%' and the communication ready indicator '!' are not followed by Carriage Return and Line Feed.

All communication is ASCII coded with following syntax rules:

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

  MainCmd_SubCm or MainCmd_Property(Value.., Value)

- 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 underscore character '_' or a space ' ' character.
- When entering new settings the *Property* is followed by parentheses 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).
- A valid command string is acknowledged with the character '#' while the 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.

The commands listed in Table 5-1 are available in the Conductivity Sensor.

Table 5-1 Available Commands for the Conductivity Sensor

Command	Meaning
Start	Start a measurement sequence according to configuration
Stop	Stop a measurement sequence
Do Sample	Execute Sampling, present enabled parameters
Get *Property*	Output value(s) of one *Property*
Get All	Output all property values
Get All Parameters	Output all parameters
Get ConfigXML	Outputs info on available properties on XML format
Get DataXML	Outputs info on available(enabled) parameters on XML format
Set Property(*Value,..Value*)	Set *Property* to *Value*,.. *Value*
Set Passkey	Set passkey to change access level
Save	Store current settings
Load	Load stored settings
Reset	Resets the node(sensor), loads stored setting
Help	Print help information
;	Comment string, following characters are ignored
//	Comment string, following characters are ignored

The *Get* command is used for reading the value/values of a property.

The command name Get, is followed by *Property* and returns a string on following format:

Property ProductNo SerialNo Value, ..Value

#

The string starts with the name of the property (*Property*), continues with the product number and serial number of the sensor, and finally the value or values of the property.

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).

Example:

```
          Get Interval
Returns:  Interval    4319    116   30
          #
```

A special version, *Get All*, reads out all available properties in the sensor.

The *Set* command is used for changing a property.

Example:

```
          Set Interval(30)
Returns:  #
```

Float values may be entered in normal decimal form or exponential form, either with 'e' or 'E' leading the exponent. Extra spacing in front or after a value is allowed.

See Table 1-2 on page 10 for a description of available properties.

After changing one or more of the sensor properties, the *Save* command will store the new configuration in the internal flash memory. If a *Load* command is executed instead, the previous stored settings will be reloaded, and any changes to the configuration will be disregarded.

To avoid accidental change, most of the properties are write-protected. There are five levels of access protection, refer Table 5-2. 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 5-2 Access protection levels

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 give read access to factory properties that usually are hidden
Read Only		The user have only read access, no passkey needed
Factory Write	XXXX	Sensor specific code for factory level access

The *Passkey* property is changed using the *Set* command:

Example:

```
Set Passkey(1000)
```

Returns: `#`

5.3 Output control

Sampling is initiated either by the *Do_Sample* command or the internal interval timer. The resulting data are calculated, and presented as an output string. Enabled parameters are included in the string.

Example of output from the sensor when *Enable Text* is set to *'true'*:

```
MEASUREMENT	4319	104	Conductivity:	56.853	Temperature:	34.563
	Salinity:	30.805	Density:	1021.195	Soundspeed:1567.15
```

The *Enable Text* property controls whether or not the text is included in the output string.

When enabled (true) the output string always start by the keyword MEASUREMENT followed by the node's (sensor's) product number and serial number. By disabling this property (false), this keyword and all parameter names are excluded from the string.

Example of output from the sensor when *Enable Text* is set to *'false'*:

```
4319	104	56.853	34.563	30.805	1021.195	1567.15
```

All words and numbers are followed by a tabulator spacing (ASCII code 9).
The string is terminated by Carriage Return and Line Feed (ASCII code 13 & 10).

5.4 Scripting

Often it may be useful to collect more than one command in a text file e.g. the following text can be written in an ordinary text editor and saved as a text file.

```
// Set sampling interval to 30 seconds
Set Passkey(1)
Set Interval(30)
Save
Get All
```

This file can then be sent to the sensor in one operation. The first line is a user comment line that is disregarded by the Conductivity Sensor. Strings starting with either '//' or ';' are ignored by the software, and do not produce any errors or acknowledge.

5.5 Sleep

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 character 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 (10 s,20 s,30 s,1 min,2 min,5 min,10 min).

The Communication Sleep Indicator, '%', will be transmitted when the serial communication is deactivated, and the Communication Ready Indicator, '!' is outputted subsequent to activation.

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.

CHAPTER 6 Quality Assurance, Maintenance and Calibration

Aanderaa Data Instruments have Proven Reliability. With over 40 years of producing instruments for the scientific community 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 required tests and the result of these tests and checkpoints.

For performance check please refer *Test of Conductivity Sensor 4319 with resistor loop* on page *35*.

6.1 Maintenance

Compared to conductivity measurements with electrodes, the inductive principle of the 4319 is less sensitive to fouling. However when used in the upper water region, fouling in the bore of the Sensor is usually what limits the long term accuracy of the Sensor. To avoid this the Sensor must be cleaned regularly depending on the local fouling conditions, and the required accuracy. The Sensor can also be painted with anti-fouling paint to extend the deployment time.

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

Be sure to follow the safety precaution for such acids.

6.2 Calibration

Each conductivity Sensor is linearized and temperature compensated by use of precision resistor loops. The temperature measurement is also calibrated in the same process. Each Sensor is then calibrated in a seawater bath with a reference sensor.

The reference sensor is calibrated against I.A.P.O. standard seawater using a National Ocean Technology Center's Model 5YA2-2 Laboratory Salinometer.

Even though most of the conductance of the seawater loop is determined by the water inside the center bore of the Sensor, large objects closer than 0.25m to the Sensor will influence the measurement.

Note! We recommend that you recalculate the CellCoeff when the sensor is shifted between instruments or between sensor positions on the top-end plate.

To obtain optimum accuracy the Sensor should be calibrated in the geometrical configuration it is to be used in. This can be achieved by placing the instrument in a stirred seawater-bath (minimum 0.5m diameter x 0.6m depth) with stable salinity and temperature.

The conductivity of the water must be measured by use of a reference i.e. Autosal 8400. This calibration only involves a correction of the sensitivity of the Sensor. A 'one point' calibration is therefore sufficient.

An internal setting in the Conductivity Sensor called *CellCoef* describes the relationship between the conductance (mS) in the seawater loop measured by the Sensor and the specific conductivity (mS/cm). A corrected *CellCoef* can be calculated using the following equation:

$$CellCoef_C = CellCoef \frac{C_{ref}}{C_{read}}$$

where:

CellCoef uncorrected Sensor factor

C_{ref} reference reading (mS/cm)

C_{read} uncorrected conductivity reading (mS/cm)

6.2.1 SEAGUARD application: setting the CellCoeff

Refer TD 262 for operating the SEAGUARD Instrument.

Procedure for setting the new calculated CellCoeff:

1. Open *Menu* - *Administrative Tools* - *User Maintenance*.
2. Select the *Conductivity* sensor from the list. You must type correct password to enter these pages: *1000.*
3. Select the *CellCoeff* property, and press *View/Edit* to type the new CellCoeff, referFigure 3-9..
4. Press *Next* to view the other sensor calibration coefficients.

Note! Do not change the calibration settings. We recommend that a full recalibration of the sensor is performed at the factory.

5. Press *Next* next and Finish to store the settings.

6.2.2 Smart Sensor Terminal application: setting the CellCoeff

Connect the conductivity sensor to your PC via Sensor cable 3855/4865. Refer chapter 5. for sensor connection and Smart Sensor Terminal operation of the sensor.

Commands for setting the updated CellCoeff:

1. Set Passkey(1000)
2. Set CellCoeff(CellCoeff$_c$)
3. Save

6.3 Test of Conductivity Sensor 4319 with resistor loop

Connect the Resistor 3719 to the Conductivity sensor, refer Figure 6-1, while the sensor is connected to the SEAGUARD instrument or the PC via sensor cable 3855/4865.

Resistor set 3719 has 4 ohm settings, refer Table 6-1. Perform one measurement series for each ohm setting; refer page 36 and page 37 for a test procedure of the sensor in AiCaP mode and Smart Sensor Terminal mode, respectively. Perform the sensor readings and check that the conductance readings correspond with the values given in Table 6-1.

Note!

The sensor and resistor loop should be stabilized in room temperature for one hour prior to the test.

Figure 6-1 Let the resistor wire go through the sensor hole and connect it in the 4 inlets on the other end of the resistor.

Table 6-1 Loop Resistance test; Readings

Loop Resistance (Ohm)	Loop Conductance (mS)
70	14.29 ± 0.08
150	6.67 ± 0.08
680	1.47 ± 0.08
2000	0.50 ± 0.08

6.3.1 SEAGUARD application

Refer TD 262 for operating the SEAGUARD Instrument.

Procedure for function test of the Conductivity sensor 4319:

1. Open *Menu* - *Sensor Configuration*. Enable Rawdata, refer chapter 3.
2. Open *Menu* - *Administrative Tools* - *Sensor Monitor*. Select the *Conductivity* sensor from the list, and press *Start,* refer *Figure 6-2,* leftmost screen dump.
3. Set the *monitoring interval*, and press *Start,* refer Figure 6-2, the rightmost illustration.

Note! We recommend the default monitoring interval of 500ms.

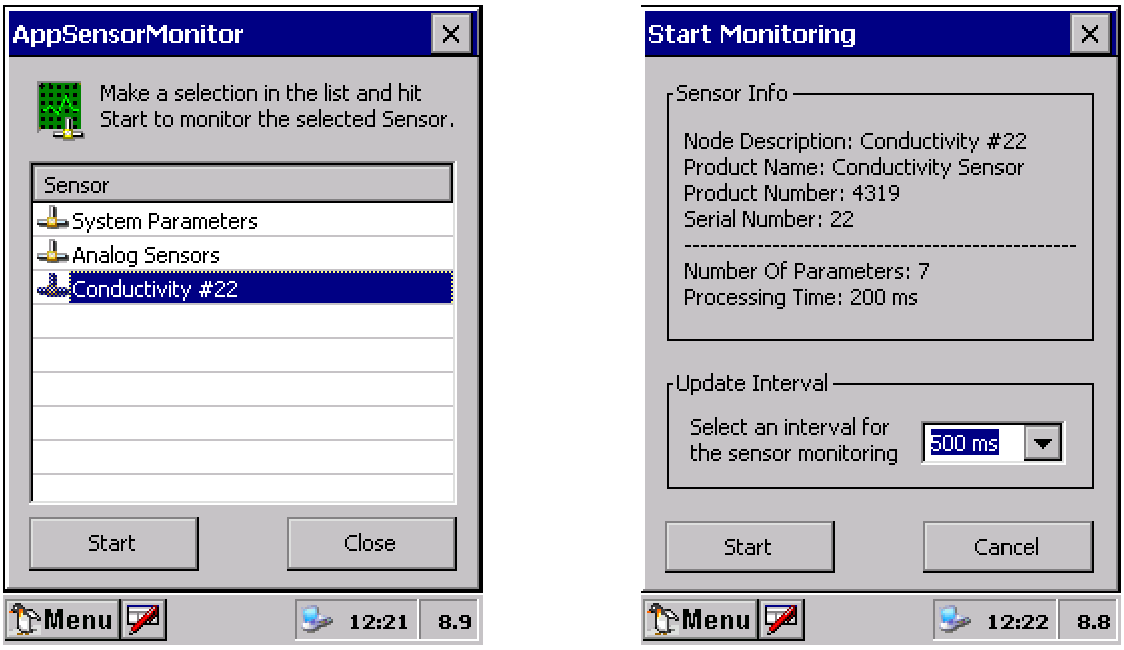


Figure 6-2 Select the Conductivity sensor and set the monitoring interval.

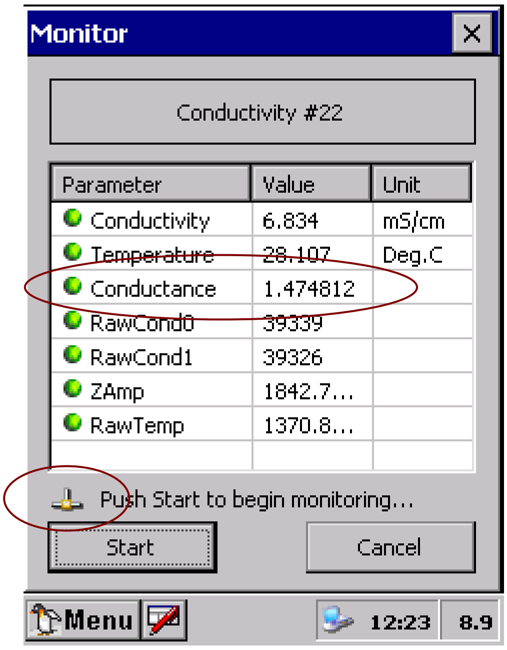


Figure 6-3 Conductance readings

The last sensor readings are shown. Press *Start* to monitor sensor readings. Let the sensor perform several measurements. Ensure that the conductance readings are according to Table 6-1.

4. Perform a measurement series for each ohm setting.

The node icon will flash at sensor readings.

6.3.2 Smart Sensor Terminal application

Connect the conductivity sensor to your PC via Sensor cable 3855/4865. Refer chapter 5 for connecting the sensor and Smart Sensor Terminal operation of the sensor.

Procedure for function test of the Conductivity sensor 4319:

1. Set Passkey(1)
2. Set Enable Rawdata(yes)
3. Set Interval(2)

Note! We recommend a 2 seconds interval.

The Sensor starts measuring, and data are output on the screen, refer Figure 6-4. Let the sensor perform several measurements. Ensure that the conductance readings are according to Table 6-1.

4. Perform a measurement series for each ohm setting.

condivity rs232 output.txt - Notepad

File Edit Format View Help

```
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.324861E+00    Temperature(Deg.C)    2.764941E+01    Conductance    5.017503E-01
4487    ZAmp    6.981079E+02    RawTemp 1.384483E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.320504E+00    Temperature(Deg.C)    2.765786E+01    Conductance    5.008100E-01
4463    ZAmp    6.972267E+02    RawTemp 1.384231E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.327222E+00    Temperature(Deg.C)    2.764941E+01    Conductance    5.022598E-01
4500    ZAmp    6.967231E+02    RawTemp 1.384483E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.324861E+00    Temperature(Deg.C)    2.764941E+01    Conductance    5.017503E-01
4487    ZAmp    7.002983E+02    RawTemp 1.384483E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.329220E+00    Temperature(Deg.C)    2.766631E+01    Conductance    5.026911E-01
4511    ZAmp    6.940796E+02    RawTemp 1.383980E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.324863E+00    Temperature(Deg.C)    2.766969E+01    Conductance    5.017508E-01
4487    ZAmp    6.983345E+02    RawTemp 1.383879E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.329947E+00    Temperature(Deg.C)    2.766631E+01    Conductance    5.028479E-01
4515    ZAmp    6.961945E+02    RawTemp 1.383980E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.324863E+00    Temperature(Deg.C)    2.767138E+01    Conductance    5.017508E-01
4487    ZAmp    6.970756E+02    RawTemp 1.383829E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.324136E+00    Temperature(Deg.C)    2.766293E+01    Conductance    5.015939E-01
4483    ZAmp    6.969749E+02    RawTemp 1.384080E+03
MEASUREMENT    4319    22    Conductivity(mS/cm)    2.326680E+00    Temperature(Deg.C)    2.768152E+01    Conductance    5.021429E-01
4497    ZAmp    6.971260E+02    RawTemp 1.383526E+03
```

Figure 6-4: Example of Conductance readings when performing a function test of the sensor.

Note! Type save *if you want to store the interval settings and to enable rawdata readings for your next measurement. If you do not type* save*, these settings are not stored.*

6.4 Example of Test & Specification sheet and Calibration certificate

AADI
a xylem brand

TEST & SPECIFICATIONS

Form No 722, July 2007

Layout No:
Circuit Diagram No:
Program Version: 4.3.2

Product: Conductivity Sensor 4319A
Serial No: 440

---

1. **Visual and Mechanical Checks:**
   1.1. Soldering quality
   1.2. Visual surface
   1.3. Galvanic isolation between housing and electronics

2. **Current Drain and Voltages:**

2.1. RS232 average current drain at 0.5Hz sampling (max: 25mA)	16.0 mA
2.2. RS232 peak current drain at 0.5Hz sampling	148.0 mA
2.3. RS232 current drain in sleep (max: 180μA)	108 μA
2.4. CANBus average current drain at 0.5Hz sampling (max: 25mA)	15.0 mA
2.5. CANBus peak current drain at 0.5Hz sampling	137 mA
2.6. CANBus current drain in sleep (max: 180μA)	93.0 μA
2.7. DSP voltage, (3.3 ±0.15V)	3.29 V
2.8. Excitation driver voltage, (3.3 ±0.15V)	3.30 V
2.9. Flash/RS232 driver voltage,(1.8 ±0.05V)	1.81 V

3. **Electronic performance test:**

3.1. Average of Receiver readings (0 ±400mV)	22 mV
3.2. Standard Deviation of Receiver readings (max: 60mV)	7 mV
3.3. Cross-talk voltage with open loop (max: 550mV)	-13 mV
3.4. Amplification (ZAmp) with 0.2mS loop/5000 Ω (1200-2000)	1598 mV
3.5. Reading (CompValue) with open loop/0mS (1000 – 2000)	1574 lsb
3.6. Reading (CompValue) with 14.286mS loop/70Ω (50000 – 60000)	51968 lsb
3.7. CANBus Output test with 1 mS loop/1000	

4. **Temperature cycling test:**
   4.1. Temperature cycling test in chamber (0-50°C)

5. **Temperature test (2 – 35°C):**

5.1. Raw data temperature drift with 14.286mS loop/70Ω loop in High Range (max 500)	28 lsb

6. **Pressure test (0 – 60MPa):**
   6.1. Raw data drift with 14.286mS 70Ω loop in High Range (max 8)

Date: 23 Apr 2010

Sign:
Ingemar Nerhus, 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 6-5: Example of Test and Specification Sheet

CALIBRATION CERTIFICATE

Form No. 723, June 2007
Page 1 of 2

Calibration Date: 20 May 2010
Product: Conductivity Sensor 4319A **Serial No:** 440

This is to certify that this product has been calibrated using the following instruments:

ASL Digital Thermometer model F250	Serial No.06792/06
Platinum Resistance Thermometer	Serial No.2H1072/1
Calibration Bath model FNT 321-1-40	1
Aanderaa Active Loop	23

Parameter: Temperature

Calibration points and readings:

Temperature (°C)	1.159	12.110	24.109	36.077
Reading (mV)	2.26638E+03	1.92114E+03	1.53400E+03	1.18097E+03

Giving these coefficients

Index	0	1	2	3
TempCoef	9.89936E01	-7.64010E-02	2.49328E-05	-4.53109E-09

Parameter: Conductance linearization and temperature compensation

Giving these coefficients

Index	0	1	2	3
R1Coef0	9.00871E00	2.65748E-05	-8.33059E-06	1.29771E-07
R1Coef1	9.00871E00	2.65748E-05	-8.33059E-06	1.29771E-07
R1Coef2	8.40406E-03	-8.32517E-04	6.00276E-05	-1.16347E-06
R1Coef3	6.88042E-03	-3.21820E-03	3.56389E-04	-6.90212E-06
R1Coef4	-2.54657E-01	4.22205E-03	-3.80411E-04	7.87145E-06
R1Coef5	-2.35682E-01	2.08831E-02	-2.10733E-03	4.01839E-05
R1Coef6	5.34748E-01	-6.40275E-03	6.11730E-04	-1.38772E-05
R1Coef7	5.50311E-01	-4.25088E-02	4.15810E-03	-7.91421E-05
R1Coef8	-3.40777E-01	2.29525E-03	-2.43856E-04	6.59428E-06
R1Coef9	-3.38135E-01	2.73318E-02	-2.61871E-03	4.97518E-05

Error graph:

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Figure 6-6: Example of Calibration Certificate page 1 of 2

CALIBRATION CERTIFICATE

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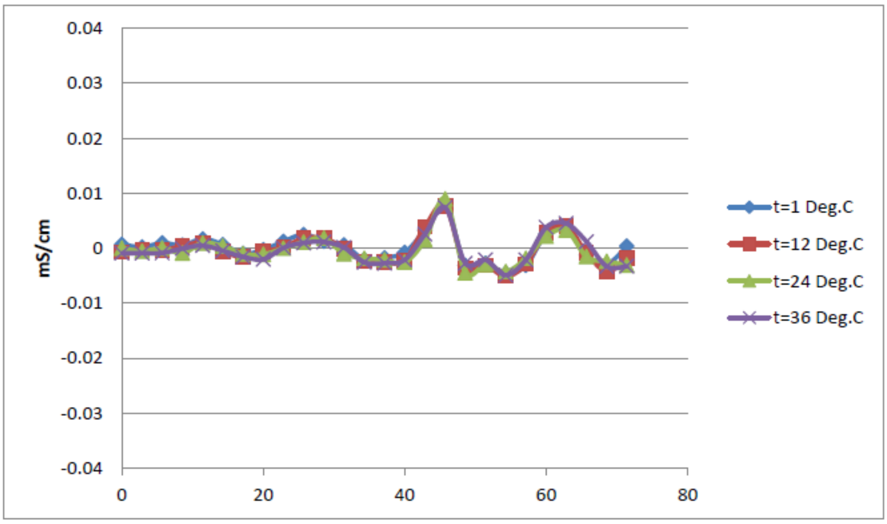
Form No. xxx, June 2007
Page 2 of 2



Product: Conductivity Sensor 4319A **Serial No:** 440

Parameter: Conductivity

Reference reading (mS/cm)	4.88650E+01
Conductance reading (mS)	1.07032E+01

Giving following cell coefficient

CellCoef	4.618

Date: 20 May 2010

Sign:

Tor-Ove Kvalvaag, Calibration 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 6-7: Example of Calibration Certificate page 2 of 2

Appendix 1 Mechanical design

Figure A 1 Conductivity Sensor 4319 Internal Components

The Conductivity Sensor 4319 has a titanium housing with a bore tube made of silicon nitride. This provides a compact and stable pressure protection for the internal magnetic cores and the electronics.

The non-conductance and low temperature expansion coefficient of the silicon nitride tube are features that ensure accurate conductivity measurement.

The titanium foot holds the electrical connector and O-rings for bulk head mounting.

IMPORTANT! Do not open the Sensor. The photo is for information only and shows the internal components.

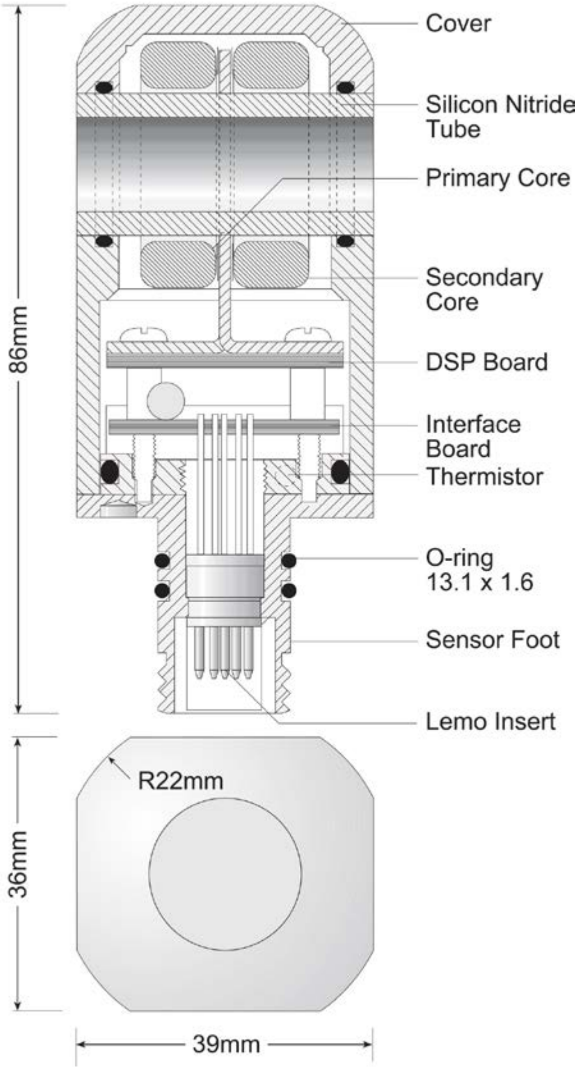


Figure A 2 Drawing of Conductivity Sensor 4319

Appendix 2 Theory of operation

The Conductivity Sensor 4319 is based on an inductive principle. This means that setting up an alternating magnetic field produces the electrical current in the water. The magnetic field induces a current to flow through the hole in the Sensor.

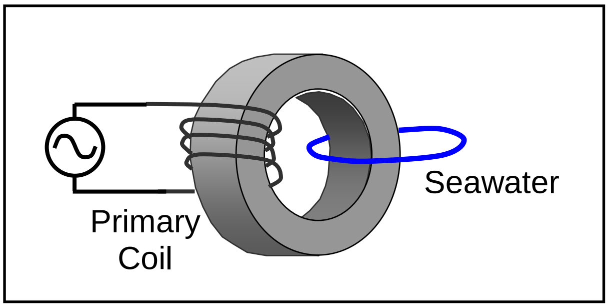


Figure A 3 Transmitter Transformer

The magnetic field is generated using a ring transformer.

Since the core centre is open to the water, the water acts as a coil of one turn in the transformer.

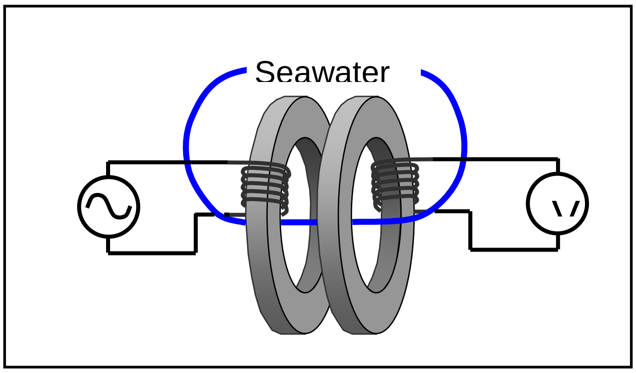


Figure A 4 Transmitter and Receiver Transformer

A second transformer, called the receiver transformer is used for sensing the current in the seawater loop.

The voltage from the transformer relates directly to the conductivity in the seawater loop.

The voltage will however also be dependent on transformer properties such as core permeability etc.

To minimize this dependency the Conductivity Sensor utilizes a special balancing method.

By introducing a coil called the compensating loop that works contrary to the seawater loop, it is possible to balance the Sensor so that the current in this loop equals the current in the seawater loop. The voltage from the receiver coil will then be zero, and the conductance in the compensation loop will equal the conductance in the seawater loop.

In the Conductivity Sensor 4319 the current in this compensation loop is controlled by a precise digital to analogue converter (DAC). The primary compensation coil is used as a source for the compensation current. To obtain impedances that are more adequate for the electronics to work with the compensation loop also has more than one winding.

An advanced Digital Signal Processor (DSP) controls the balancing of the Sensor. When a sample is taken, the DSP generates the frequency for the transmitter. The DAC is set to the midpoint and the signal from the receiver is analysed. Depending on the phase of this signal, the DSP adjusts the DAC. This is repeated for each approximation step so that the Sensor is balanced. The DAC value will then reflect the conductance in the seawater loop. To improve the accuracy this value is compensated for temperature drift and linearized.

By use of internal calibration coefficients that reflect the geometry of each Sensor the conductance measurement can be converted to specific conductivity.

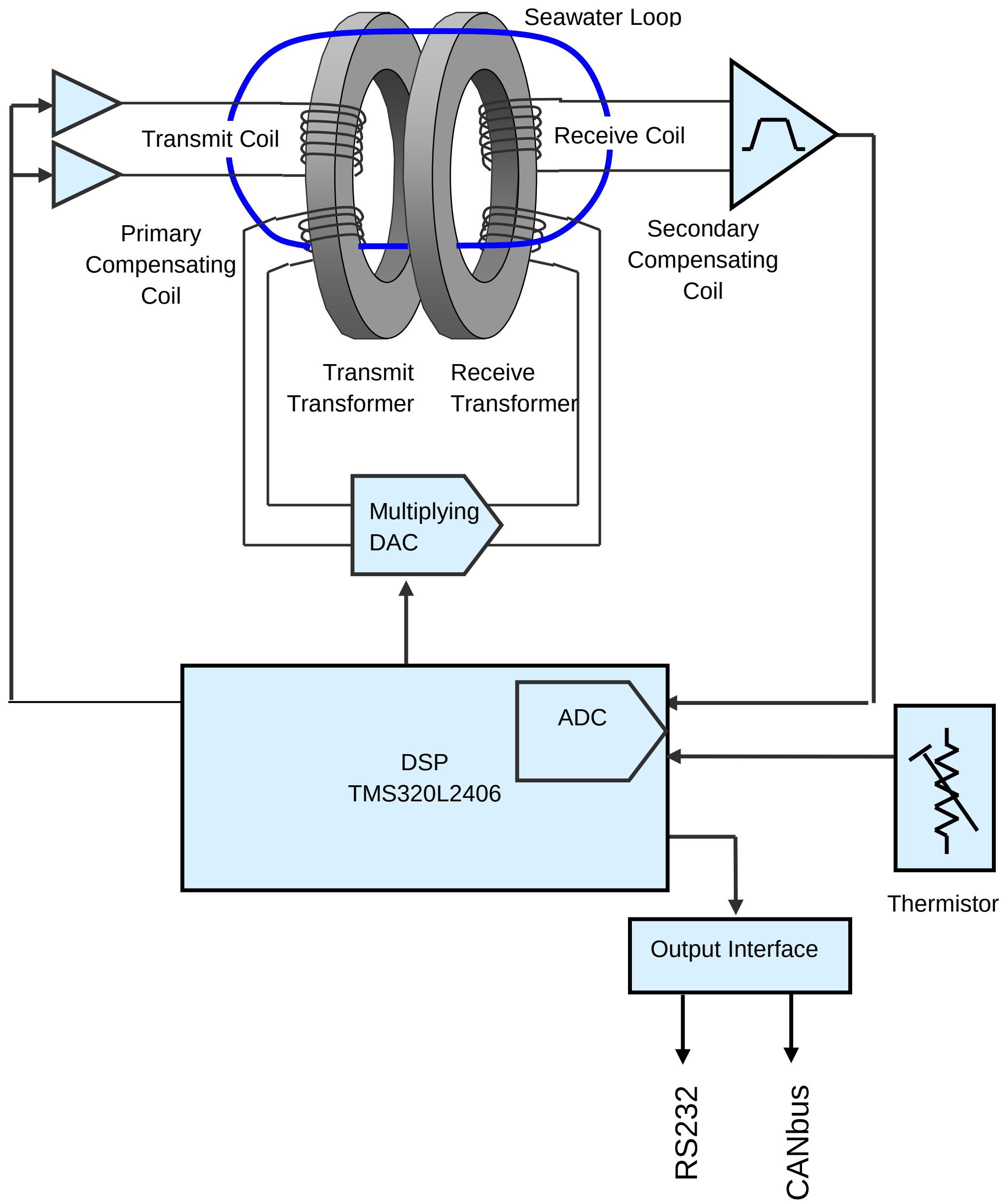


Figure A 5 Functional Diagram

Appendix 3 Illustrations

Figure no.	Description
Figure A 6	Set up and configuration Cable 3855, RS-232
Figure A 7	Set up and configuration Cable 4865, RS-232
Figure A 8	Free end Cable 4762, Rs-232
Figure A 9	Free end Cable 3880
Figure A 10	Remote Sensor Cable 4793, AiCaP
Figure A 11	Patch Cable 4999, AiCaP

Table A1 Available cables

Signal name	Color	Sensor Plug	9 pind D-Sub	USB
TXD	RED	1	2	
RXD	BROWN	2	3	
Boot Enable	GREEN	3		
BV	BLUE	4		
GND	WHITE	7	5	4 (black)
Positive Supply	YELLOW	8		1 (red)
RTS short to CTS			7-8	
DSR short to DTR			6-4	

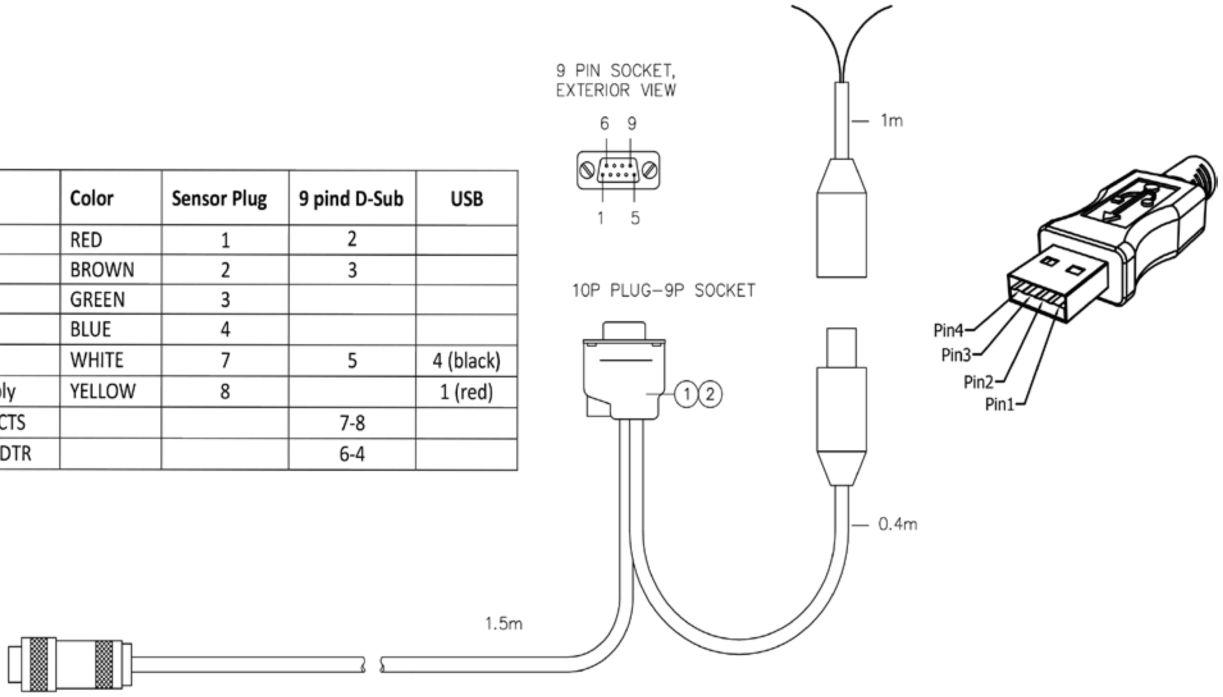
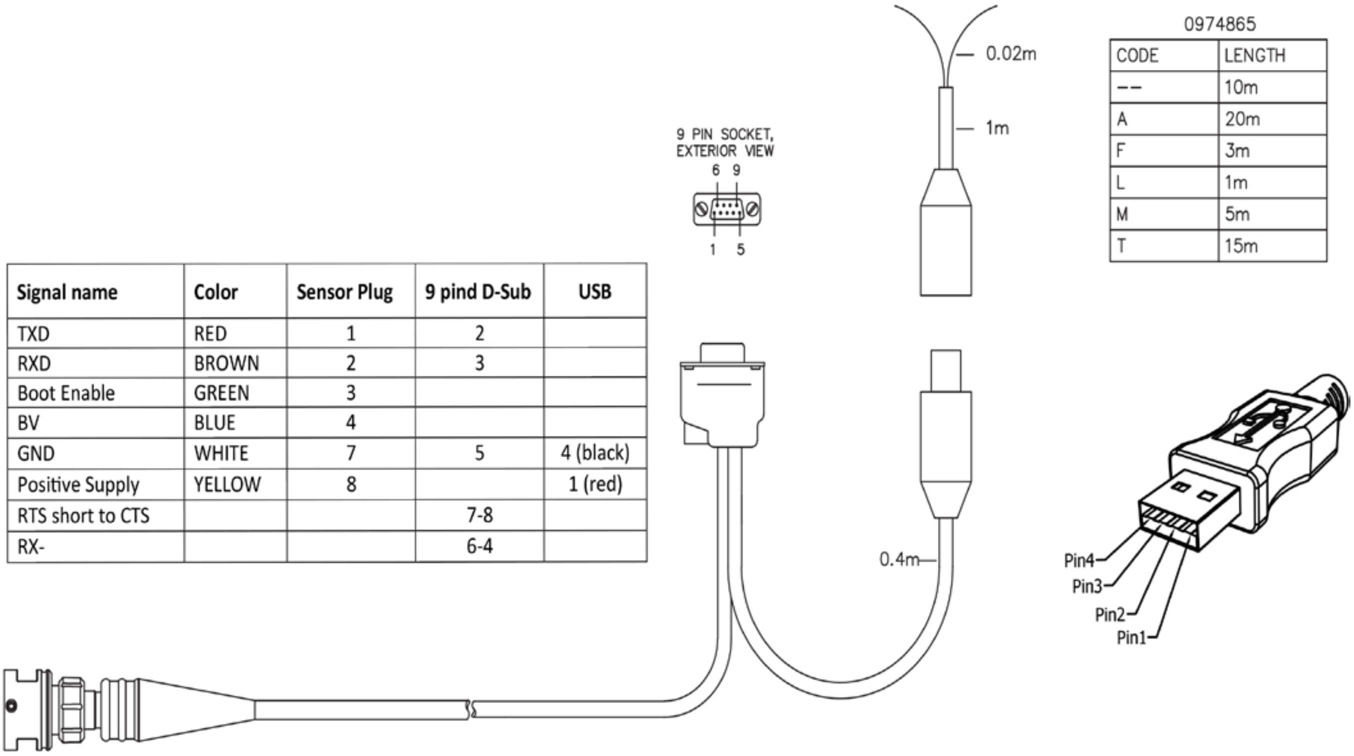


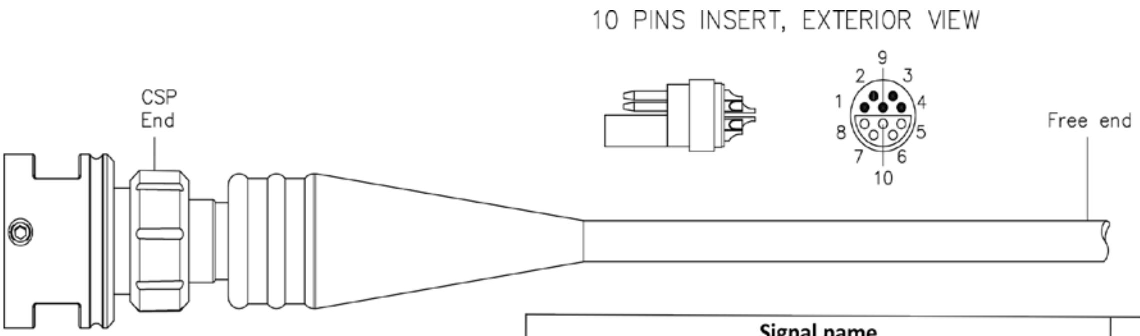
Figure A 6 Set up and configuration cable 3855, for laboratory use.



CODE	LENGTH
--	10m
A	20m
F	3m
L	1m
M	5m
T	15m

Signal name	Color	Sensor Plug	9 pind D-Sub	USB
TXD	RED	1	2	
RXD	BROWN	2	3	
Boot Enable	GREEN	3		
BV	BLUE	4		
GND	WHITE	7	5	4 (black)
Positive Supply	YELLOW	8		1 (red)
RTS short to CTS			7-8	
RX-			6-4	

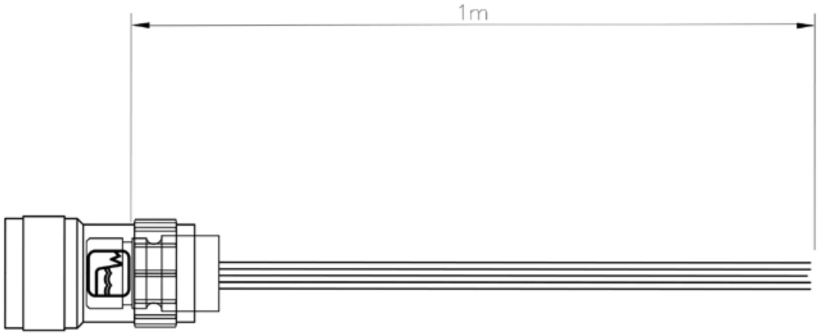
Figure A 7 Set up and configuration cable 4865, RS-232 for field use.



Length	Code
1m	L
3m	F
5m	M
10m	--
20m	A

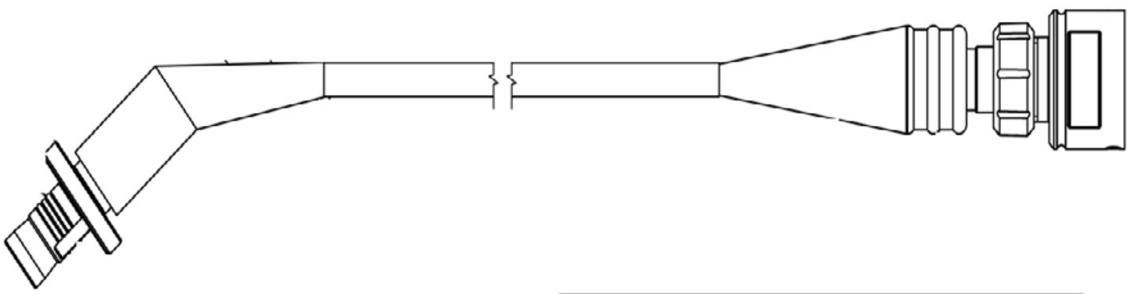
Signal name			CSP End	
SR10	Analog	RS-232+ DigOut	Lemo pin no.	Color
Not used	TXD	TXD	1	Grey
Not used	RXD	RXD	2	Brown
Not used	Analog 2Gnd	Not used	3	Yellow
Bridge Voltage	Analog 2	Not used	4	Purple
Output 2 (SR10 CH2)	Analog 1Gnd	Not used	5	Blue
-9V	Analog 1	DigOut Gnd	6	White
Not used	GND	GND	7	Black
System Ground	Positive Supply	Positive Suppkly	8	Green
Output 1 (SR10 CH1)	Not used	Not used	9	Orange
Control Voltage	Not used	DigOut	10	Red

Figure A 8 Drawing Free end Cable 4762, RS-232



Signal name	Color	10F
Control Voltage	GREEN	
TXD	BLUE	
RXD	VIOLET	
BV	GREY	
GND	WHITE	
Positive Supply	BLACK	

Figure A 9 Drawing Free end Cable 3880



Wiring			
CSP Side (7-14)	Receptacle Side (1)	Function	Colour code
8	1	Positive supply	White 1+2
7	2	Gnd	White 3+4
5	4	CAN_H	(1.pair) White/blue
9	10	CAN_L	(1.pair) Blue
4	5	NCE	(2.pair) White/orange
6	3	NCG_1	(2.pair) Orange
10	9	NCR	(3.pair) White/green
6	3	NCG_2	(3.pair) Green

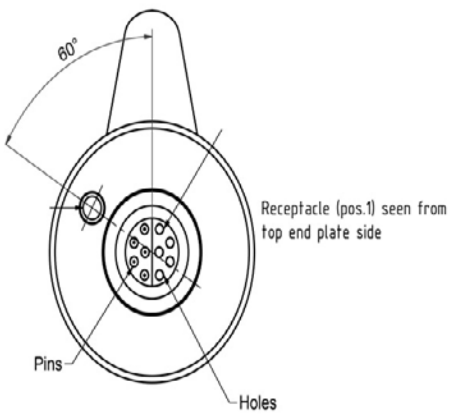
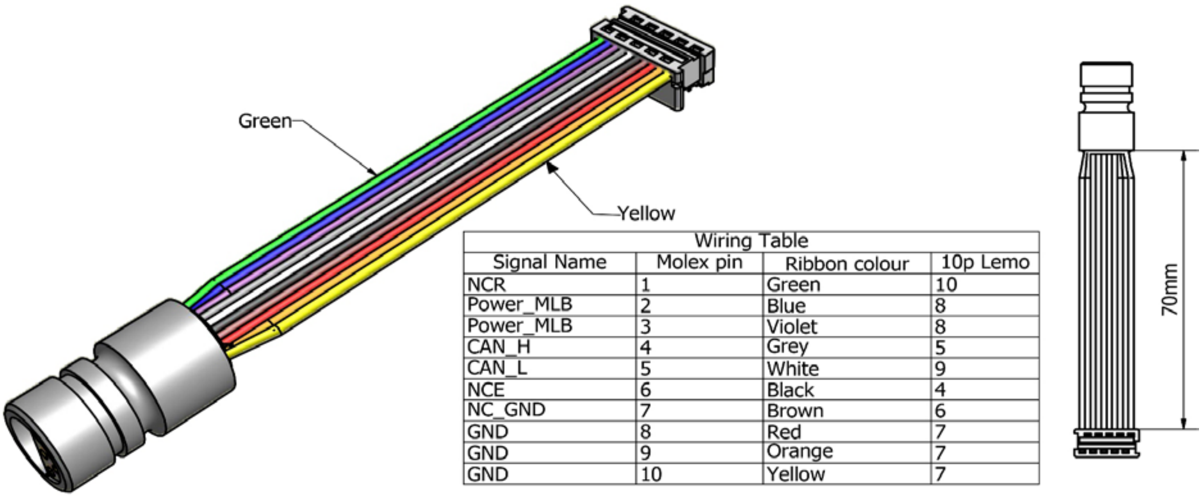


Figure A 10 Drawing Remote Sensor Cable 4793, AiCaP



Wiring Table			
Signal Name	Molex pin	Ribbon colour	10p Lemo
NCR	1	Green	10
Power_MLB	2	Blue	8
Power_MLB	3	Violet	8
CAN_H	4	Grey	5
CAN_L	5	White	9
NCE	6	Black	4
NC_GND	7	Brown	6
GND	8	Red	7
GND	9	Orange	7
GND	10	Yellow	7

Figure A 11 Drawing Patch Cable 4999, AiCaP

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Appendix 4 Product change notification: Frame Work3

Copy of content in Product Change Notification Document ID: DA-50009-01 of date 09 December 2011:

Product(s) Affected:

Product Number	Product Name	From Serial No.
4050	Temperature Sensor	300
4060	Temperature Sensor	500
4017	Pressure Sensor	700
4117	Pressure Sensor	600
4319(A/B)	Conductivity Sensor	800
4330(F/A)	Oxygen Optode	1000
4420	ZPulse® Doppler Current Sensor	500
4520	ZPulse® Doppler Current Sensor	600
4646(R)	Pressure Sensor	600
4647(R)	Tide Sensor	600
4648(R)	Wave and Tide Sensor	600
4830	ZPulse® Doppler Current Sensor	100
4835	Oxygen Optode	300
4930	ZPulse® Doppler Current Sensor	100
4880(R)	Temperature Sensor	200
4930	ZPulse® Doppler Current Sensor	100

General Change Description:

Most of AADI's Smart Sensors utilized common communication protocols for use at the RS232 and RS422 interface. Two protocols are available; Smart Sensor Terminal protocol and the AADI Real Time protocol, where the Smart Sensor Terminal protocol is a simple ASCII command string based protocol and the AADI Real Time is an XML based protocol. To accommodate for higher security and future expansions both protocols will be updated when releasing Sensor Framework version 3 (common software for the above sensors). This notification aim to give an overview of the changes in the Smart Sensor Terminal protocol. Please refer to the specific Operating Manuals for further details and to Technical Description TD267a for updates in the AADI Real Time protocol.

Specific Changes:

1. Input command line termination is changed from line feed (LF) with optional carriage return to line feed and mandatory carriage return (LF+CR).
2. 'Do Stop' and 'Do Start' command changed to 'Stop' and 'Start'
3. All units in output string changed from '(' and ')' type parenthesis to '[' and ']' type, example [hPa].
4. The Sleep indicator ('%') and the Wakeup indicator ('#') is replaced by a Communication Sleep ('%') indicator and a Communication Ready ('!') indicator. A property called 'Enable Comm Indicator' can be used for enabling/disabling of these characters.
5. Polled mode is no longer enabled by setting the interval to zero (Set Interval(0) is now illegal). A property called Enable Polled Mode is now used for controlling polled/non-polled mode.
6. The 'Output' property is substituted by a 'Mode' property for changing the operation mode, for example; 'Set Mode(Smart Sensor Terminal)'. Specific properties control the formatting of the output string, for example 'Set Enable Text(no)'.
7. The startup notification (at power up) is changed from 'Mode <Mode name>' to the following format: 'StartupInfo <Product No.> <Serial no.> Mode <Protocol Name> Version <Version No.> Config Version <Version No.>', for example; 'StartupInfo 4330 83 Mode AADI Smart Sensor Terminal Protocol RS232 Protocol Version 3 Config Version 6'
8. The startup notification will be switched off when the 'Enable Text' property is set to 'no'.
9. A '*' will precede the parameter name if an error status related to the specific parameter occur. This applies for example to the tide parameter of the Wave an Tide Sensor before the sample base is complete : '*Tide Pressure[kPa] 0.000000E+00'

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