Smart CTD

User Manual

Document Version 1.1 **Dated: 14th January 2011**

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General Description of the Instrument

The AML Oceanographic Smart CTD is a high speed, high resolution, high accuracy instrument for measuring sound velocity and pressure in water. The Smart CTD provides real-time conductivity data in milliseimens per centimetre and pressure data in decibars when connected to a computer and DC power supply.

Which Manual do I Start With?

AML Oceanographic instruments may be shipped with several manuals:

- An instrument manual (ie. This Smart CTD manual) which provides an overview on how to use and maintain the instrument;
- A software manual (ie. The SeaCast manual) which provides instructions on how to use the software to configure the instrument and review instrument data; and

If you are configuring an instrument for field use or lab test, we recommend you begin with the SeaCast software manual.

If you are focussed on instrument maintenance, we recommend you read this instrument manual.

Shipping & Receiving

Receiving an Instrument

When an instrument is received at a new location it is prudent to perform the following steps to ensure the instrument is capable of performing when required.

- Check the shipping container for signs of damage. This could indicate damage to the instrument inside.
- The shipping package should include all of the following items
    - Smart CTD instrument
    - Data/Power cable
    - CD with Manuals
- Check for damage
    - Check the cable for slices or gouges
    - Check the connector for corrosion in the sockets and salt deposits
    - Check the pressure case for dents and scrapes
    - Check the sensors for corrosion, cracks, bends or dents
- Connect the instrument to a computer with the data cable and perform a scan or monitor if using SeaCast.

Returning an Instrument to the Factory

- If shipping for repair or recalibration obtain an RMA number from the service centre.
- Perform all the steps listed above for Receiving
- Pack the instrument in its original shipping box, if possible, to prevent damage during shipping

An RMA number can be requested using any of the following contact options:

Service Department:
Email: service@AMLoceanographic.com
Phone: 1-250-656-0771
Fax: 1-250-655-3655

Website:
http://www.AMLoceanographic.com

Customer Portal:
RMA requests may also be submitted through the customer portal on the AML Oceanographic website.

To access the Customer Portal, please navigate to the 'Support' button, located on the top right hand side of AML Oceanographic home page, select the 'Customer Centre' from the options on the drop down menu and follow the instructions provided.

Mailing and Shipping Address:
AML Oceanographic.
2071 Malaview Ave.
Sidney, BC, Canada
V8L 5X6

Using the Instrument

Pre-Deployment Procedures

- 4 to 6 weeks ahead
  - Use the receiving checklist to verify the instrument is in good working order
  - Verify the calibration is valid for the duration of the deployment. If it is not, ship the instrument back to an authorized service centre for re-calibration.
  - Lubricate the connector with silicone spray
- Before leaving the jetty
  - Connect the instrument to a computer and power supply using the data cable
  - Place the instrument in fresh water ensuring no bubbles are trapped on the SV transducer or reflector plates. The instrument should return sound speed readings in agreement with the chart on page 3.

Configuring Sampling Parameters using SeaCast

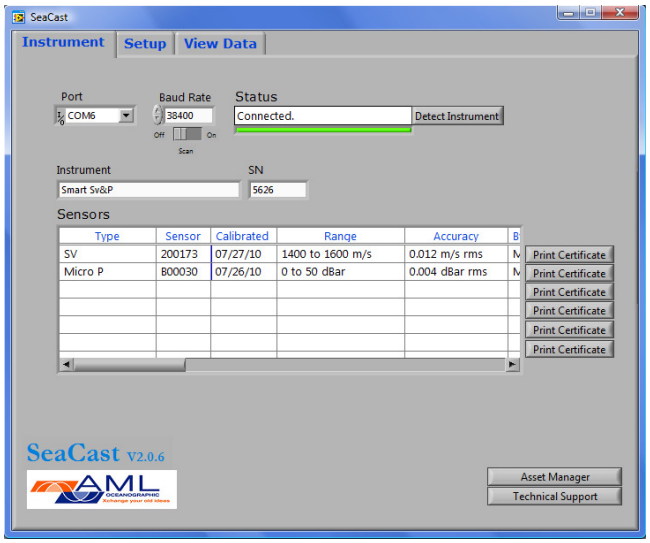
AML Oceanographic's SeaCast application software greatly simplifies the process of setting up an instrument to collect data. SeaCast does not require instrument configuration files and is able to generate copies of sensor calibration certificates on demand.

Note: Instruments set to output data on power up will not communicate with SeaCast. Refer to page 10 for details on disabling data output on power up.

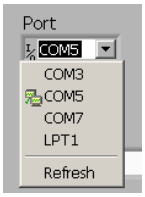
Full details on the instrument configuration process can be found in the SeaCast manual. Below please find a quick summary of that process:

Selecting an Instrument for Configuration

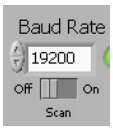
On the Instrument Tab, the first row of fields 'Port', 'Baud Rate' and 'Status' control and display the communications with the instrument.



The 'Port' field allows the user to select the port to which the instrument is connected. If uncertain about the port the user can check the ports in the Device Manager or Hardware Manager found in the control panel in the Windows operating system. The 'Refresh' selection at the bottom of the list allows the user to force a new detection of available ports. This is useful if a USB connection is made after SeaCast is launched.

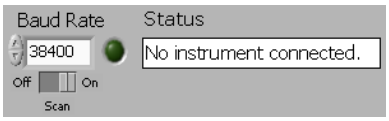


The 'Baud Rate' field is used to select the baud rate the user wishes to use while communicating to the instrument. Lower baud rates allow longer cables to be used if using RS-232/485/422. Higher baud rates shorten the data transfer times. Choose 38,400 baud whenever possible.

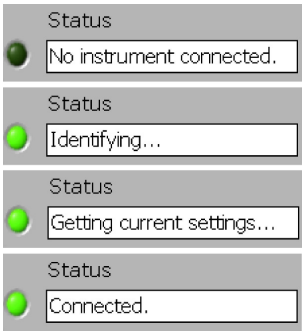


If an instrument is set to autobaud (default setting) it will detect the baud rate chosen in SeaCast and communicate at that baud rate. If the baud rate is changed in SeaCast the power to the instrument must be cycled to re-establish communications at the new baud rate.

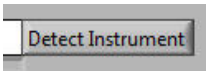
Some instruments are set up to communicate at fixed baud rates. In this case the baud rate in SeaCast must be set to the same baud rate as the instrument. If the instrument baud rate is unknown, the 'Scan' switch below the 'Baud Rate' field can be used to have SeaCast cycle through all the baud rates to try to detect the instrument baud rate.



The "Status" field shows the status of the communications with the instrument. The green light indicates that communications have been established with the instrument. During the identification process, SeaCast is determining the type and serial number of the instrument and any connected sensors. During the settings process, SeaCast is determining the latest sampling and logging settings that were programmed into the instrument. When all the required handshaking has been completed, the 'Status' field will show "Connected" and the user may now use the instrument.

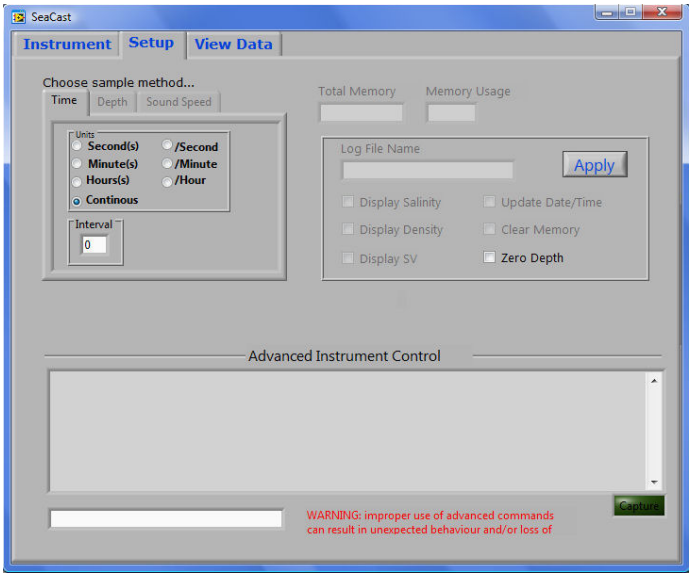


The Detect Instrument button forces SeaCast to re-detect and re-identify the instrument and its sensors.

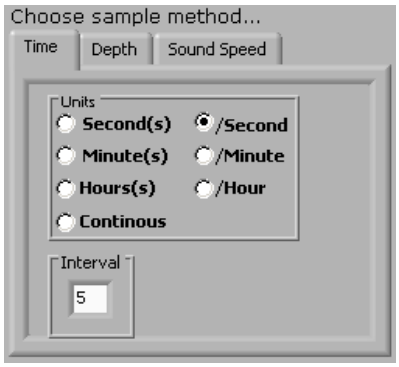


Configuring the Selected Instrument

After the instrument has been detected by SeaCast, select the Setup tab at the top of the SeaCast window.



The box in the upper left of the Setup page controls the sampling of the instrument. The Smart CTD can be programmed to sample at various sampling rates (ie. sample 25 times per second, 10 times per hour, every 5 seconds, etc.)



Configuring Sampling Parameters with HyperTerminal

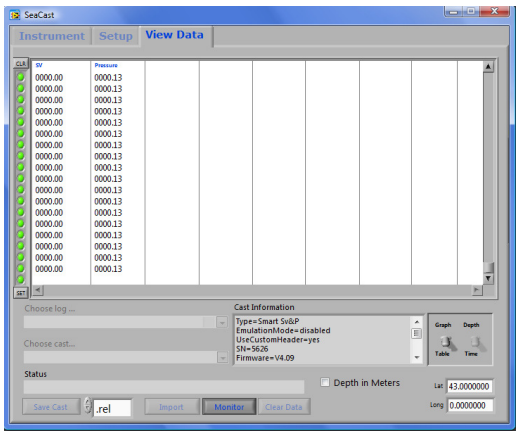
Instruments can also be configured for deployment using HyperTerminal or other terminal emulation programs. As with SeaCast, communications with the instrument must be established. The following steps must be completed by issuing text commands.

Please consult the Commands section of the Appendix for full syntax details on how to issue commands. The following are typical commands issued using HyperTerminal:

- S (scan, sample 1 sound velocity reading)
- M (monitor, sample at the programmed sampling rate)
- SET S 2/S (set the sample rate to two per second)
- SET S 1M (set the sample rate to 1 minute)
- SET DETECT A7 (set 10 autobaud attempts then default to 38400 baud)
  SET DETECT ab
  - a is the number of autobaud attempts before switching to the fixed baud rate. Values range from 0 to F (hex). 0 sets the instrument to a fixed baud rate only.
  - b is the fixed baud rate if autobaud is not used. Values are:
    - 1=300 baud,
    - 2=600 baud,
    - 3=2400 baud,
    - 4=4800 baud,
    - 5=9600 baud,
    - 6=19200 baud,
    - 7=38400 baud.
- SET STARTUP MONITOR (set the instrument to monitor on power up)
- SET STARTUP PROMPT (set the instrument to wait for a command on power up)

Monitoring Real Time Data

- Ensure the pre-deployment procedures have been done.
- Ensure that the sampling rate desired has been selected.
- Plug the data/power cable into the instrument. If you power the instrument over a long cable, please note the following:
  - The longer the cable the higher the voltage drop on the cable. The voltage drop on a standard AML Oceanographic cable, with a Smart CTD, is about 1 volt per 100m of cable while sampling.
  - The instrument's minimum voltage is 8 volts
  - The voltage at the instrument, while sampling, must be above this level for the instrument to operate
  - The instrument's maximum voltage is 24 volts
- Lower the instrument until it is just submerged. Keep the instrument at this depth for 2 minutes prior to beginning the cast. This allows the sensors time to wet and the pressure case to shed heat.
- Begin monitoring data using SeaCast or HyperTerminal.



Post-Deployment Procedures

- When the instrument is pulled from the water it should be rinsed in fresh water
- Dry the area around the connectors with a clean cloth or compressed air prior to disconnecting the cable
- Remove the cable.
- Dry the instrument and stow it, preferably in the shipping container for protection.

Configuring the Instrument for Data on Power Up

Perform the following steps:

- Open a terminal emulation program, such as HyperTerminal, and ensure the serial port has been selected in the program.
- Connect the instrument to the computer using the data/power cable supplied with the instrument.
- Connect the power leads on the cable to a 12V DC power supply or battery.
- Using the terminal emulation program issue the following commands to the instrument:
    - SET STARTUP NOHEADER (disables the power up header information)
    - SET STARTUP MONITOR (enable data output on power up)
    - SET DETECT 07 (set fixed 38400 baudrate)
    - SET SAMPLE RATE 10/S (set the desired sampling rate)
- Turn off the power to the instrument.
- Turn on the power to the instrument.

Disabling Data on Power Up

Perform the following steps:

- Open a terminal emulation program, such as HyperTerminal, and ensure the serial port has been selected in the program. The terminal emulation program must be configured for the baud rate the instrument was programmed for.
- Connect the instrument to the computer using the data/power cable supplied with the instrument.
- Connect the power leads on the cable to a 12V DC power supply or battery.
- Turn off the power to the instrument.
- Hold down the 'Enter' key.
- Turn on the power to the instrument.
- After several seconds release the 'Enter' key. This will interrupt the data on power up mode for this power cycle.
- Using the terminal emulation program issue the following commands to the instrument:
    - SET STARTUP HEADER (enables the power up header information)
    - SET STARTUP PROMPT (disable data output on power up)
    - SET DETECT A7 (set 10 autobaud attempts then default to 38400 baud)
    - SET SAMPLE RATE 10/S (selects the desired sampling rate)
- Turn off the power to the instrument.

Maintaining the Instrument

Periodic Maintenance

Periodic maintenance will prolong the life of the instrument. The following is recommended:

- If the instrument is very dirty or oily use warm soapy water and allow the instrument to soak before cleaning with a rag or soft brush. Rinse with fresh water.
- Before each use
    - Check for debris on, or damage to, the sensors
    - Check for nicks and cuts on the cable
- After each use
    - Clean and rinse the instrument using fresh water
    - Dry and safely store the instrument
- Monthly
    - Lubricate the connector contacts with a silicone spray
    - Lubricate the retainer rings and o-rings with silicone grease
- Yearly
    - Send the instrument to a service centre for diagnostics and re-calibration
- Long term storage preparation
    - Ensure the instrument has been thoroughly cleaned and dried.
    - Lubricate the instrument connector contacts with a silicone spray.
    - Lubricate the retainer rings and o-rings with silicone grease.
    - Install dummy plug in the connector.

Communications

PC Settings

The Smart CTD will communicate via RS-232 ASCII unless configured otherwise at the time of purchase. The computer to which the instrument is connected must be set up as follows:

- 8 data bits
- No parity
- 1 stop bit
- No hardware handshaking
- Baud rate of 600, 1200, 2400, 4800, 9600, 19,200 or 38,400 baud

After power up, the Smart CTD will wait for an ASCII carriage return. The instrument will automatically detect the baud rate unless specifically programmed for a fixed baud rate.

Output Formats

Standard Smart CTD

Power-up header output

On power up the Smart CTD will output a header identifying the instrument, followed by a prompt.

```
Smart CTD Version 4.13 SN:5555
AML Oceanographic Ltd.
```

The power up header can be disabled and enabled using the following commands:

SET STARTUP NOHEADER
SET STARTUP HEADER

Data output formats

The data output format for the standard Smart CTD is conductivity followed temperature and then by pressure. The characters are space, 4 digits, decimal point, 2 digits, space, sign (space for positive, - for negative), 4 digits, decimal point, 2 digits. The conductivity output is in units of mS/cm, the temperature output is in units of degrees Celcius and the pressure output is in decibars. The number of pressure decimal places can be changed by entering TALK 2 mode, using the SET PFOR command, then pressing Ctrl C to exit the TALK 2 mode, then cycling the instrument power.

Scan output (SCAN then Enter or S then Enter)

```
>s
 00.005 -0000.17  19.541 00.096
>scan
 00.005 -0000.16  19.509 00.096
```

Monitor output (Monitor then Enter or M then Enter)

```
>m
 00.005 -0000.16  19.501 00.096
 00.005 -0000.15  19.502 00.096
 00.005 -0000.15  19.502 00.096
 00.005 -0000.16  19.502 00.096
```

Display options output (DIS O then Enter)

```
>dis o
[Instrument]
Type=Smart CTD
EmulationMode=disabled
UseCustomHeader=yes
SN=5555
Firmware=V4.13
SampleUnits=continuous
SampleInterval=0
PressureInc=0.00
SoundInc=0.00
LogFile=test.raw
Date=01/01/00
Time=00:00:00
MemorySize=0.0 MB
MemoryUsed=0.0 MB
```

```
DisplayTime=no
DisplayDate=no
DisplaySalinity=yes
DisplayDensity=no
DisplaySoundVelocity=no
DisplayBattery=no
RelayMode=RS232 mode
RealtimeLogging=no
LoggingTimeout=0
StartupDelay=10
DisplayHeader=yes
StartupMode=prompt
CharacterReception=yes
LoggingBreakMode=no
DetectionMode=A3
BatteryACoefficient=+3.500000E-01
BatteryBCoefficient=+2.500000E-02
ShutDownVoltage=6.5
WarningVoltage=not applicable
PressureOffset=0.00
UsePressureOffset=no
SoundVelocityThreshold=1375.00
DelimterMode=Space
SensorDetectionMode=Once
Traceability=no
SkipPowerOff=no
AnalogChannels=disabled

[Slot 1]
SensorName=Micro C
BoardSN=01981
SensorSN1=500098
CalDate1=01/15/10
CalBy1=DTD
CalRange1=0 to 70ms/cm
CalAccuracy1=0.004ms/cm
SensorSN2=
CalDate2=00/00/00
CalBy2=
CalRange2=
CalAccuracy2=

[Slot 2]
SensorName=Micro P&T
BoardSN=02092
SensorSN1=E00025
CalDate1=01/22/10
CalBy1=DTD
CalRange1=0 to 1000 dBar
CalAccuracy1=0.02 %FS
SensorSN2=400223
CalDate2=01/18/10
CalBy2=DTD
CalRange2=-2 to 32 C
CalAccuracy2=0.002C
>
>
```

Customer Support

Troubleshooting

Instrument fails to communicate:

- Check the cables
    - Is the data power cable connected to the instrument and computer?
    - If using a cable other than an AML Oceanographic cable, it should be configured as a null modem cable
    - If using multiple cable lengths, the extensions should not be configured as null modem cables
    - Are there any cuts in the cable?
- Is power applied? Power should be 8 to 24 volts DC at 95 mA.
- If using external power over a long cable, check the voltage drop over the cable. Measure the voltage across a ¼ watt, 59Ω, resistor across pins 1 and 4 of the cable. The voltage must be above 8 volts.
- Are the communication settings in the program used on the computer correct?
    - Comm port selection
    - 8 bits
    - 1 stop bit
    - No parity
    - No hardware handshaking
    - Baud rate between 2400 and 38,400 baud
- Are the communication settings in the instrument correct?
    - Was the instrument set to a fixed baud rate last time? If so, the user must use that baud rate to resume communications
    - Was the instrument set to RX OFF last time? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode. This is most easily done by holding down the enter key as soon as power is applied. Character reception on power up can be re-enabled using the SET RXON command. Refer to page 10 for details.
    - Was the instrument set to monitor on power up mode? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode. To disable monitoring on power up use the SET STARTUP PROMPT command. Refer to page 10 for details.
- Is the connector damaged?

Instrument generates erroneous conductivity data:

- Does the conductivity sensor have a bubble in the glass tube? Shake the instrument to clear the bubble.
- Is the conductivity sensor completely dried out and has not been allowed to fully wet before use? Rinse the conductivity sensor with a dilute solution of water, alcohol and dish

soap then rinse the sensor with fresh water and let it sit in the water sample for 5 minutes before taking a reading.

- Is the conductivity sensor faulty? Examine the conductivity cell for cracks in the glass. If the glass is cracked the sensor must be repaired and re-calibrated. Examine the sensor for deposits of dirt or marine growth within the glass. Clean the glass tubes as described in the section 7.2.
- Have the platinum electrodes been damaged? The electrodes must be re-plated and the instrument re-calibrated.

Instrument generates noisy pressure data:

- Is there noise on the power supply? Transient noise on the power supply lines should be less than 20 mV in amplitude.
- Is there noise on the com lines? Transient noise on the communication lines should be less than 20 mV in amplitude.
- Are there close sources of electromagnetic interference, such as switching power supplies, inverters, radios, electric motors with brushes? Separate the sensor and data/power cable from the interference source.
- Are the flow induced vortices impinging on the pressure sensor? The smoother the water flow over the pressure sensor the lower the noise.

Instrument generates noisy temperature data:

- Is there noise on the power supply? Transient noise on the power supply lines should be less than 20 mV in amplitude.
- Is there noise on the com lines? Transient noise on the communication lines should be less than 20 mV in amplitude.
- Are there close sources of electromagnetic interference, such as switching power supplies, inverters, radios, electric motors with brushes? Separate the sensor and data/power cable from the interference source.

AML Oceanographic Contact Info

Service:
To request an RMA or technical support
Email: service@AMLoceanographic.com
Phone: 1-250-656-0771
Fax: 1-250-655-3655

Sales:
For all general sales inquiries
Email: sales@AMLoceanographic.com
Phone: 1-250-656-0771
Fax: 1-250-655-3655

Website:
http://www.AMLoceanographic.com

Customer Portal:
The Customer Portal allows AML Oceanographic customers to download calibration certificates and other related instrument documentation, view instrument details and diagnostic reports. It also allows AML Oceanographic customers to gather technical documentation, troubleshooting guides etc. RMA requests or technical support queries may also be submitted through the portal

To access the Customer Portal, please navigate to the 'Support' button, located on the top right hand side of AML Oceanographic home page and select the 'Customer Centre' from the options provided in the drop down menu.

Mailing and Shipping Address:
AML Oceanographic.
2071 Malaview Ave.
Sidney, BC, Canada
V8L 5X6

Appendices

Commands

Command	Short form	Uses TALK mode	Description
DISPLAY OPTIONS	DIS OPT		Displays a listing of the instrument configuration and settings
SCAN	S		Takes a single data sample
MONITOR	M		Repeatedly takes samples at the programmed sampling rate. This can be interrupted by pressing the ENTER key.
VERSION	V		Displays the instrument header information
SET SAMPLE RATE n/u	SET S C SET S 10/s SET S 2m		Changes the sampling rate in numbers and units. I.e. Continuous (25 per second), 10 per sec, 2 minutes, 1 hour, etc. The range is 25/s to 1 hour.
DISPLAY SAMPLE RATE	DIS S		Displays the current sampling rate
SET STARTUP HEADER	SET ST H		Enables the instrument header on power up
SET STARTUP NOHEADER	SET ST NOH		Disables the instrument header on power up
SET STARTUP MONITOR	SET ST M		Instrument will start monitoring on power up.
SET STARTUP SCAN	SET ST S		Instrument will take one scan on power up and then return a prompt.
SET STARTUP PROMPT	SET ST P		Instrument will issue a prompt on power up and wait for a command
DISPLAY STARTUP	DIS ST		Displays the current startup conditions
DISPLAY COEFFICIENTS	DIS C		Displays the current calibration coefficients
SET DETECT ab	SET DET ab		Set the baudrate auto detection parameters. a is the number of detection attempts (0=fixed baudrate, 1= 1 attempt, up to F=15 attempts) and b is the baudrate to default to if autobauding is not successful (1=600, 2=1200, 3=2400, 4=4800, 5=9600, 6=19200, 7=38400, 8=57600 SV.X only, 9=115200 SV.X only)
SET EMU SVP	SET EMU SVP		Changes the output channel order to P then SV
SET EMU OFF	SET EMU OFF		Returns the output channel order to SV then P
DISPLAY DETECT	DIS DET		Displays the current autobaud detection parameters
SET PFOR nn	SET PFOR nn	•	Sets the number of digits before and after the decimal point for the pressure sensor. TALK 2 required
SET ECHO	SET EC		Enables the echoing of characters
SET NOECHO	SET NOEC		Disables the echoing of characters
SET RXON	SET RXON		Enables the reception of commands at next power up
SET RXOFF	SET RXOF		Disables reception of characters at next power up. To exit the RXOFF mode, hold down the carriage return key and power up the unit, then from the prompt, issue the SET RXON command.
TALK 2	TALK 2	•	Talk mode 2. Enters direct communications with the sensor board in slot 2. Use Cntrl C to exit talk mode.

Technical Specifications

Sensors

Conductivity Sensors						
Status	Type	Accuracy	Range	Precision	Resolution	Response Time
Standard	4 Electrode Conductive Cell	±0.01 mS/cm	Up to 70 mS/cm	±0.005 mS/cm	0.001 mS/cm	25 ms at 1 m/s flow

Temperature Sensors						
Status	Type	Accuracy	Range (Other ranges on request)	Precision	Resolution	Response Time
Standard	Aged Thermistor	±0.005°C	-2°C to 32°C	±0.003°C	0.001°C	100 ms
Optional	Aged Thermistor	±0.005°C	-2°C to 32°C	±0.003°C	0.001°C	350 ms
Optional	Aged Thermistor	±0.05°C	-2°C to 32°C	±0.003°C	0.001°C	1 sec

	Pressure Sensors					
Status	Type	Range	Accuracy	Precision	Resolution	Response Time
Standard	Strain gauge	50, 100, 200, 500, 1000, 2000, 4000, 5000 & 6000 dbars	±0.05%FS	±0.003%FS	0.002%FS	10 ms
Optional	Pressure•Xchange	50, 100, 200, 500, 1000, 2000, 4000, 5000 & 6000 dbars	±0.05%FS	±0.003%FS	0.002%FS	10 ms

Electronics

- Standard
  - Composed of 3 boards
  - Smart mother board
  - Smart C – conductivity board
  - Smart P/T – pressure/temperature board

Communication Protocols

Communication Protocols				
Status	Type	Communication	Baud Rate	Serial Ports
Standard	RS-232	Direct with computer or data logger	Automatic (2400 to 38,400)	Own port on host machine
Optional (Factory set)	RS-485	Multiple instruments communicate through 1 port	Factory Set (2400 to 38,400)	Single port for all units

Power Requirements

External Power Supply			
Status	Type	Power	Capacity
Standard	External	Via data/power connector	95mA at 8 to 24 volts DC

Mechanical Materials

Housing						
Status	Type	Depth Rating	Diameter	Length	Weight (in water)	Weight (in air)
Standard	Delrin	500m	45.7mm (1.8")	419.5 mm (16.52")	0.05 kg (0.11 lb)	0.40 kg (0.88 lb)
Optional	Titanium	6,000m	45.7mm (1.8")	419.5 mm (16.52")	0.67 kg (1.47 lb)	1.02 kg (2.2 lb)

Connectors

Bulkhead Connectors					
Type	Status	Pins	Sex	Material	Manufacturer
Micro	Standard	6 Pin	Female	SS316	Impulse
Micro	Standard	6 Pin	Female	Titanium	Impulse
Circular	Optional	4 Pin	Female	Brass	Subconn
IE55	Optional	6 Pin	Male	Titanium	Impulse
Micro	Optional	8 Pin	Female	SS316	Impulse
Micro	Optional	8 Pin	Female	SS316	Subconn
Micro	Optional	8 Pin	Female	Titanium	Subconn

Sampling Capabilities

- Samples up to 25 times per second

Software

- SeaCast
  - No separate instrument configuration files required,
  - print sensor calibration certificates on demand,
  - easy-to-use instrument set-up tab,
  - view casts in table or graph format,
  - export / import casts from text format

Accessories

- Comes Complete With
  - Software & Manuals

- Optional Accessories
  - 2m Data/Power Pigtail
  - Instrument Suspension Bar
  - Instrument Protection Frame

Warranty

AML Oceanographic warrants the instrument for a period of one year from the date of delivery. AML Oceanographic will repair or replace, at its option and at no charge, components which prove to be defective. The warranty applies only to the original purchaser of the instruments. The warranty does not apply if the instrument has been damaged, by accident or misuse, and is void if repairs or modifications are made by other than authorized personnel.

This warranty is the only warranty given by AML Oceanographic. No warranties implied by law, including but not limited to the implied warranties of merchantability and fitness for a particular purpose shall apply. In no event will AML Oceanographic be liable for any direct, indirect, consequential or incidental damages resulting from any defects or failure of performance of any instrument supplied by AML Oceanographic.

Wiring Diagram

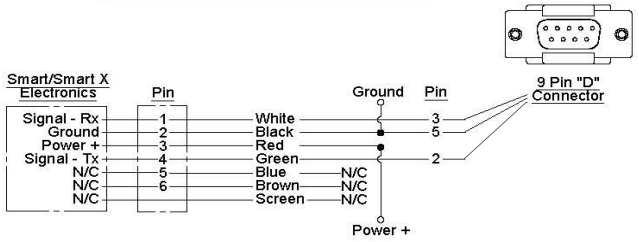
RS-232 Communications

REVISION TABLE

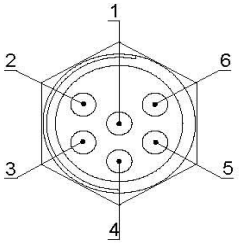
REV	DESCRIPTION	BY	DATE

SMART AND SMART-X ELECTRICAL INTERFACE SPECIFICATION

RS-232 COMMUNICATIONS



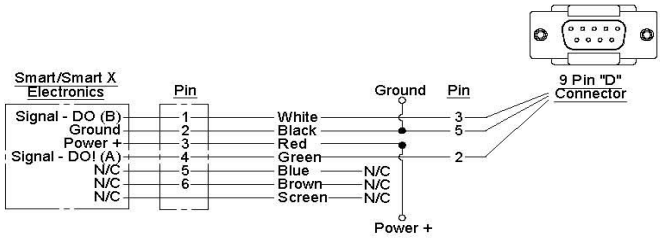
MCBH-6-FS
Bulkhead Face View



NOTE:

SMART INSTRUMENTS ARE CONFIGURED AT THE FACTORY FOR RS-232 OR RS-485. CONSULT THE SMART OR SMART X USER MANUAL FOR INSTRUCTIONS ON MAKING CHANGES TO YOUR INSTRUMENT'S COMMUNICATION PROTOCOL.

RS-485 COMMUNICATIONS



AML OCEANOGRAPHIC
Xchange your old ideas
2071 Malaview Avenue W., Sidney B.C. Canada V8L 5X6 (250) 656 0771 Fax: (250) 655 3656

TITLE: Smart Communications Overview

DRAWN	DRAWING NO.:	REV	AML NO.
I.L.	MC2-GA-03318		N/A

TOLERANCES:
ANGLES: ± 1°
FRACTIONS: ± 1/32
HOLE SIZES: ± 0.005(0.13)
0.00: ± 0.015(0.38)
0.000: ± 0.005(0.13)

UNLESS OTHERWISE SPECIFIED:
ORIGINAL SCALE:1:4
DIM'S ARE IN INCHES (MM)
SURFACE FINISH: 63

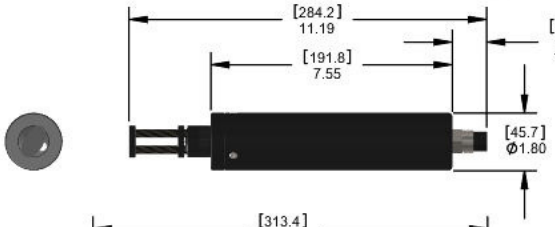
DATE: OCT 14/09
MATERIAL:
3rd ANGLE PROJECTION
SIZE B
SLD FILE NO.: 9-pin D-sub Female
SHEET NO.: Sheet 2 of 2

Mechanical Drawings

REVISION TABLE

REV	DESCRIPTION	BY	DATE

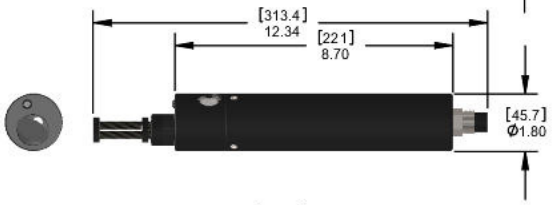
NOTE:
The optional SV Xchange sensor adds .96 inches (24.5mm) to the overall length of an instrument relative to the shown dimensions.



Smart SV
AML Part Number: PDC-A0100

Materials:
- Delrin - 500m Pressure Rating
- Titanium - 6000m Pressure Rating

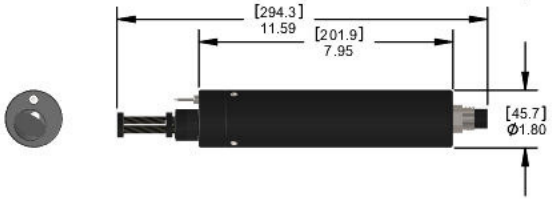
Compatible Xchange Sensors:
- SV Xchange



Smart SV&P
AML Part Number: PDC-A0200

Materials:
- Delrin - 500m Pressure Rating
- Titanium - 6000m Pressure Rating

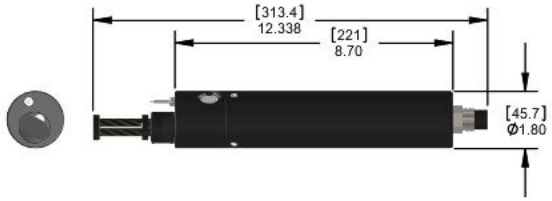
Compatible Xchange Sensors:
- SV Xchange
- P Xchange
  - Requires Smart X Housing - see Sheet 2



Smart SV&T
AML Part Number: PDC-A0300

Materials:
- Delrin - 500m Pressure Rating
- Titanium - 6000m Pressure Rating

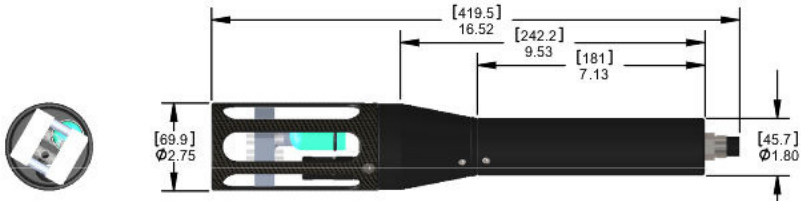
Compatible Xchange Sensors:
- SV Xchange
- T Xchange
  - Requires Smart X Housing - see Sheet 2



Smart SVP&T
AML Part Number: PDC-A0400

Materials:
- Delrin - 500m Pressure Rating
- Titanium - 6000m Pressure Rating

Compatible Xchange Sensors:
- SV Xchange
- P Xchange & T Xchange
  - Requires Smart X Housing - see Sheet 2



Smart CTD
AML Part Number: PDC-B0300

Materials:
- Delrin - 500m Pressure Rating
- Titanium - 6000m Pressure Rating

Compatible Xchange Sensors:
- C Xchange
- P Xchange
- T Xchange

	Mass	
Model	Delrin	Titanium
Smart SV	.75lbs (.34 kg)	1.86 lbs (.84 kg)
Smart SV&T	.81 lbs (.37 kg)	2.02 lbs (.92 kg)
Smart X SV&T (Flared)	1.79 lbs (.81 kg)	4.19 lbs (1.90 kg)
Smart SV&P	.89 lbs (.40 kg)	2.24 lbs (1.02 kg)
Smart X SV&P (Flared)	1.77 lbs (.80 kg)	4.17 lbs (1.89 kg)
Smart SVT&P	.90 lbs (.41 kg)	2.24 lbs (1.02 kg)
Smart X SVT&P (Flared)	1.873 lbs (.85 kg)	4.28 lbs (1.94 kg)
Smart CTD (Flared)	1.74 lbs (.79 kg)	4.14 lbs (1.88 kg)

AML OCEANOGRAPHIC
Xchange your old ideas
2071 Malaview Avenue W., Sidney, B.C. Canada V8L 5X6 (250)656-0771 Fax: (250)656-2655

TOLERANCES:
ANGLES: ± 1°
FRACTIONS: ± 1/32
HOLE SIZES: ± 0.005(0.13)
0.00: ± 0.015(0.38)
0.000: ± 0.005(0.13)

UNLESS OTHERWISE SPECIFIED:
ORIGINAL SCALE:1:5
DIM'S ARE IN INCHES (MM)
SURFACE FINISH: 63

TITLE: Smart Mechanical Overview

DRAWN	DRAWING NO.:	REV	AML NO.
I.L.	MC2-GA-03318		N/A
DATE: OCT 14/09	MATERIAL: Delrin or Titanium		
3rd ANGLE PROJECTION	SIZE B	SLD FILE NO.: MC2-GA-03318	SHEET NO.: Sheet 1 of 2