Deep-sea Redox Micro-electrode System
DSRX-DS4

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Contents:

Introduction

The Deep-sea redox micro-electrode system DSRX-DS4 consists of the following elements (see Figure 1):

- electronics cylinder (see
- Appendix A: Electronics cylinder)
- microsensor/electrode amplifier units
- software to control data acquisition and communication (see Lander2 software manual)
- cables to connect the units (*not provided by Unisense*)

The user must provide an IBM-compatible PC with the following minimum specifications: Pentium class processor, 133 MHz clock frequency, 32 MB RAM, 600 x 800 display, 50 MB free space on the harddisk, Windows 95, 98, 2000, or XP.

General description

The Deep-sea micro-elecrtrode system consists of a 6000 m rated cylinder containing signal conditioning electronics. Microsensor/electrode amplifier units with micro-electrodes attached connect to this cylinder. The cylinder takes an input of 6-26V DC and each amplifier gives an analog output between -5V and +5V.

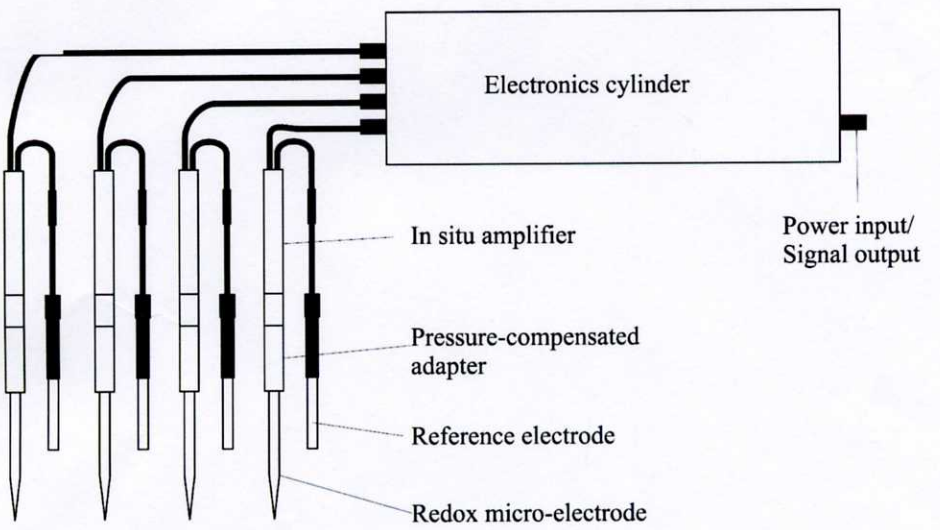

Figure 1. Schematic overview of the Deep-sea Redox Micro-electrode system DSRX-DS4.

Getting started

1. Prepare micro-electrodes

a) Check that each electrode is ready to be connected: for electrotrodes with electrolyte, the electrolyte level should be almost up to the top of the outer glass casing. If not, refill the electrolyte. The electrodes are pressure-compensated by making holes in the seal between electrolyte and exterior. The electrolyte might partially evaporate through these holes. If the electrolyte casing dries out it must be refilled with electrolyte. The electrolyte is filled in the outer casing (with the blue and the yellow cables) through the small holes with a 0.4 mm needle. Electrolyte may not enter the inner casing (with the black cable) of the electrode (electrolyte can be purchased from Unisense).
b) Mount the micro-electrodes in the in situ adapters/connectors (see separate instruction)
c) Mount the micro-electrodes on the in situ amplifiers, and in situ reference electrodes on the small cable that comes out of the amplifier (see Figure 1).

2. Calibrate the electrodes

Apply power to the electronics cylinder (6-26V DC) using pins 6 and 7 on the bulkhead (see Appendix C: Connections). Monitor the micro-electrode signals on pins 2-5 versus pin 1.
Expose a redox electrode and its corresponding reference electrode to a solution with a defined redox potential (see separate redox electrode manual regarding redox standards) and note the signal. Change to a new standard solution and note the signal. Check that the signal output changes as expected.
Redox electrodes are temperature sensitive, so calibration solutions should be at in situ conditions.

Power consumption

It is important to make sure that there is sufficient power on the battery/power source before a deployment, as the system may behave in an unintended manner if the power runs out.
Total consumption of Arctica controller
+ power circuit analog circuitry
+ in situ amplifiers
+ galvanic isolation
+ output circuits:
Approx. 75 mA

Appendix A: Electronics cylinder

Cylinder

The electronics cylinder contains the electronics which make the interface between the external power supply and the external data-acquisition on one side and the micro-electrode amplifiers on the other side.

Specifications:

The electronics cylinder and its bottom disk are made of anodized aluminum (7075-T6)/ALMG SI 1.5) and can tolerate prolonged exposure to extremely corrosive environments and is rated to withstand full ocean pressure of 600 bars (6000 meter water column). The cylinder and the bottom disk are held together with two buckles and sealed with a terminal 132.94 x 3.53 (Parker 2-252 NBR 70) mm O-ring and an internal 120.24 x 3.53 (Parker 2-248 NBR 70) mm O-ring.
All penetrations of the cylinder and bottom disk are made with Subconn® connectors tested to withstand 600 bar pressure (see below).
Size: 150 mm o.d., 125 mm i.d., length 430 mm.

Operation

Cleaning: Clean the surfaces of the cylinder with soap water.

Opening the cylinder: Do not open the bottom disk with the cylinder in upright position, as it is very difficult to remove it at a controlled speed in that position, which may cause wiring and the electronics to be seriously damaged. Instead: un-mount cables and un-mount the entire cylinder from the Lander. Place the cylinder horizontally on a soft surface on a tabletop. The soft surface protects the cylinder surface and stabilizes the cylinder. Release the bottom disk buckles and wait for a few minutes to allow the O-rings to loosen. Gently pull out the bottom disk. If this cannot be done by gentle hand force, use

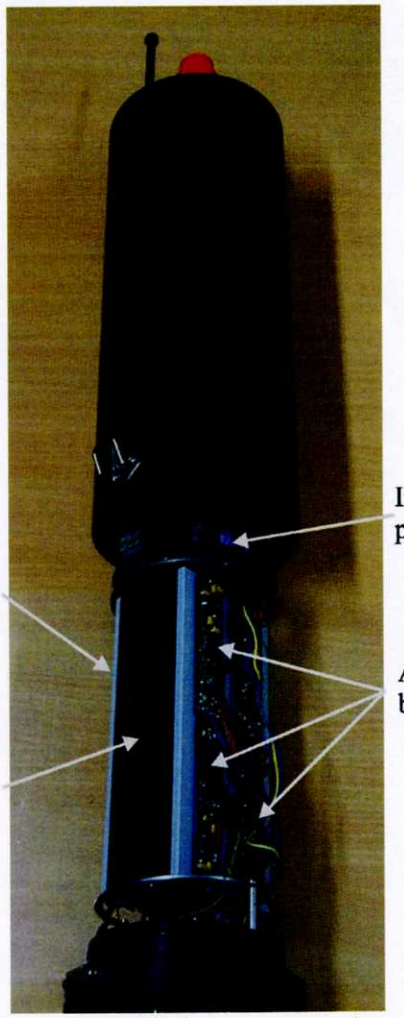

Figure 2. Electronics cylinder open and electronics pulled out.

two plastic prying tools to force the disk the first 5 cm out. DO NOT USE METAL OBJECTS TO FORCE THE DISK OUT, as this will damage the cylinder surface. Pull the disk out gently, and the Arctica controller comes out with it. Do not pull any further when the wires connecting to the Subconn® connectors are stretched. For further disassembly, the wire connectors must be released from the interface board.

Closing the cylinder:
Clean the sealing surfaces with a cloth or paper.
NOTE: Make sure that the sealing surfaces are completely clean and that the sealing O-rings are undamaged and lubricated lightly with silicon. Defective or un-lubricated O-rings may cause water to enter the cylinder during submergence, which will terminate operation and destroy the electronics.
Gently push the electronics into cylinder. Before closing completely, flush the inside of the cylinder vigorously with dry non-corrosive gas (e.g. dinitrogen gas) to prevent moisture from precipitating inside the cylinder during deployment in cool environments. To further dry the atmosphere, a drying element can be stored inside the cylinder. Such element must be non-corrosive and not release dust. Push the bottom disk slowly but forcefully until the buckles are able to finally close the disk. Do not use excessive a hammer or other object to beat on the disk.

Cable ties through the housing clips are a good indication of a cylinder that is "ready for immersion" and hasn't been opened since last deployment.

Maintenance:
Rinse with water after use and allow drying. Store the cylinder in a dry place.

Appendix B: Sensor/electrode amplifiers

Unisense amplifier circuit boards

The amplifier circuit boards inside the amplifier housings perform the delicate amplification of the minute signals of the sensors and transfer the signal to the signal conditioning electronics via the cables.

Amperometric (O2 or H2S) amplifier

Potentiometric (pH) amplifier

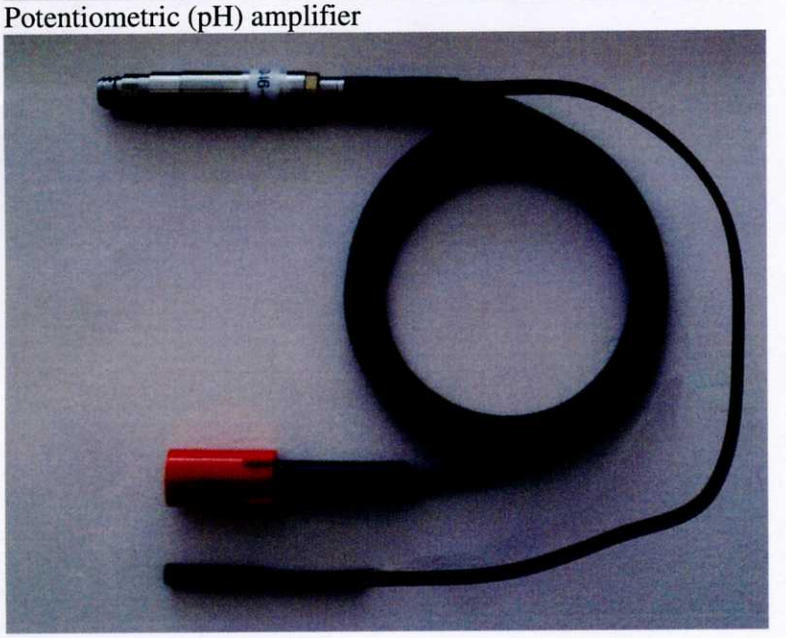

Figure 3. In situ sensor/electrode amplifiers

When using pH micro-electrodes, an external reference is needed. Attach the reference electrode to the signle-pin connector on the wire coming out of the pH amplifier. To measure the reference electrode and pH electrodes must be in the same liquid.

Specifications

The amplifier housing (Figure 3) are made of stainless steel and pressure tested to 600 bar. It contains the sensor preamplifiers and interface to the Unisense deep sea sensor connector.

Power input: +/- 5V
Power consumption: 100µA
Out put: +/-5V

Polarisations and units

Sensor type	Measuring unit	Polarisation
pH	mV	N/A
O2	pA	–800 mV
H2S	pA	+85 mV

Appendix C: Connections

Connection	Function	Pin	Cylinder bulkhead	Dummies:
Power/Signal connector Position: cylinder end	Analog GND	1	MCBH8M	MCDC5F
	Analog 1	2		
	Analog 2	3		
	Analog 3	4		
	Analog 4	5		
	Power GND	6		
	Power +	7		
	not used	8		
Amp 1 connection Position: lid	**Galvanic.GND**	1	MCBH5F	MCDC5M
	+5V	2		
	-5V	3		
	SIGNAL	4		
	E.GND	5		
Amp 2 connection Position: lid	**Galvanic.GND**	1	MCBH5F	MCDC5M
	+5V	2		
	-5V	3		
	SIGNAL	4		
	E.GND	5		
Amp 3 connection Position: lid	**Galvanic.GND**	1	MCBH5F	MCDC5M
	+5V	2		
	-5V	3		
	SIGNAL	4		
	E.GND	5		
Amp 4 connection Position: lid	**Galvanic.GND**	1	MCBH5F	MCDC5M
	+5V	2		
	-5V	3		
	SIGNAL	4		
	E.GND	5		

Appendix D: Connectors, cables and wiring

Function

The components of the Deep-sea Chamber Lander system are connected with cables with Subconn (r) connectors for the parts that will be submerged in water. Subconn connectors constructed to connect electrical components down to full ocean depth.

Maintenance.

To get maximum lifetime of the cables, keep the metal pins of the connectors out of contact with water when possible. If a connector gets wet, rinse it with distilled water and dry the water off.

The connectors should be lubricated with a fine layer of silicone grease (Dow Corning, Molykote 44) to keep water out. If for some reason the bulkhead connector on any of the units needs to be un-mounted, check the O-ring before re-mounting the connector and replace the O-ring if it shows any signs of wear or damage.

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