

# ROV-II™ CP PROBE OPERATION MANUAL



Twin reference electrodes for online calibration

Can be used with ROVs or as a diver-held probe

Works as either a contact or proximity probe

## Table of contents

<b>1. ROV-II components</b>	4
<b>2. Reference documents</b>	5
2.1 MSDS sheets	5
<b>3. Health and safety</b>	5
<b>4. Installation procedure</b>	5
4.1 Dive spread	5
4.2 ROV installation	6
4.3 Cautionary notes	7
<b>5. Calibration</b>	8
5.1 General	8
5.2 Using calibration for troubleshooting	8
5.3 Topside/bucket calibration	9
5.4 Subsea calibration	10
5.5 Proximity mode ground check	12
<b>6. Operation</b>	12
6.1 Wet check	12
6.2 Recording cathodic protection potentials	13
<b>7. Taking cathodic protection potential readings</b>	13
<b>8. Data interpretation</b>	14
<b>9. Maintenance and repair</b>	15
9.1 Tip replacement	15
9.2 Reference electrode element replacement	15
<b>10. Troubleshooting</b>	16

## List of figures

<b>Figure 1</b> Soft-splicing the whip onto the comms cable	6
<b>Figure 2</b> RMG-3FS connector pin diagram	10
<b>Figure 3</b> Identifying a failed reference electrode	12
<b>Figure 4</b> Calibration vs. zinc coupon	18
<b>Figure 5</b> Calibration cell to cell	19

<b>Figure 6</b> Wiring schematic for Deep C Meter™ readout.....	20
<b>Figure 7</b> Wiring schematic for diver-assisted platform survey.....	20

## List of tables

<b>Table 1</b> Normal cathodic protection ranges for bare carbon steel in seawater.....	9
<b>Table 2</b> Troubleshooting quick guide.....	11

## ROV-II™ Components





An offshore case is provided with the ROV-II™. The case can be filled with seawater so that the probe can be calibrated.



T-handle probe mounts are available for use with ROVs. They are stainless steel with a shock absorber to protect the probe during stabbing, and another version with an electrically isolated mount that holds the EFG probe as well. Both are available with fish-tail handles.



The Deep C Meter™ LED readout can be used with the ROV-II™ to record readings without utilizing the ROV's umbilical.

## 2. Reference documents

### 2.1 MSDS sheets

**2.1.1** Dow Corning – 4 Electrical Insulating Compound MSDS – connector sealant

<http://www.dowcorning.com/applications/search/products/details.aspx?prod=01903128&type=prod>

**2.1.2** Parker Seals - Parker O Lube MSDS – O-ring lubricant <http://www.parker.com> (search for: MSDS Super O-Lube)

**PLEASE CONTACT YOUR POLATRAK REPRESENTATIVE FOR ANY QUESTIONS AND/OR ISSUES REGARDING THIS MANUAL.**

## 3. Health and safety

It is the intention of Deepwater Corrosion that all test and inspection procedures are carried out in a safe manner in accordance with the Health and Safety At Work Act and any other relevant legislation. If required by the client, Deepwater personnel will attend any site safety induction courses before carrying out work on-site.

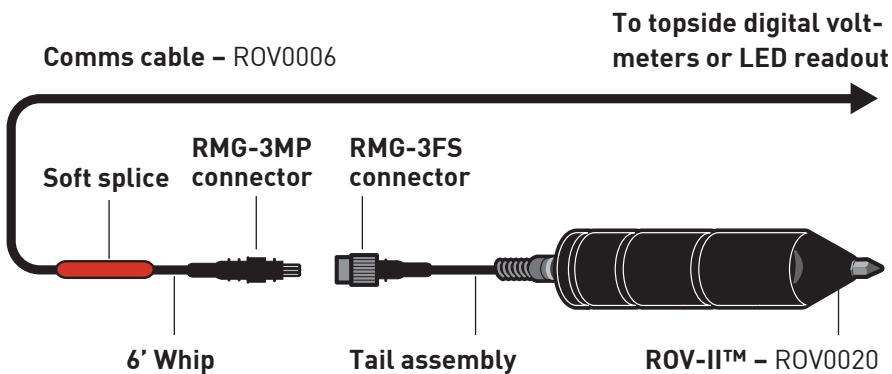
## 4. Installation procedure

### 4.1 Dive spread

**4.1.1** When used with diving operations, assemble a cable with an RMG-3MP connector at the sub-sea end. In our experience, the most suitable cable is the four (4) conductor armored spiral comms

cable used by most divers for diver communications; it has two twisted pairs and is very rugged. A whip with this connector is provided with the probe and should be soft-spliced onto the end of the comms cable (see Fig. 1). Ensure that the connection is taped back to the armored wire to provide strain relief to the subsea connector.

**Figure 1** - Soft-splicing the whip onto the comms cable



**4.1.2** If required, Deepwater Corrosion can provide a complete assembly on a 500-foot-long umbilical cable.

**4.1.3** The appropriate length of cable should be married into the dive hose, leaving 4-6 feet (1.2m – 2m) of slack at the subsea end and at least 50 feet (15m) at the topside end. **Always install the dummy plug on the connector when the probe is not attached.**

**4.1.4** The topside end of the cable will be run to the dive control area along with the platform ground cable and any ground from the structure or pipeline risers as appropriate. The connections can be made to a pair of digital multimeters (refer to fig. 6, wiring schematic for diver-assisted platform survey.)

## 4.2 ROV installation

**4.2.1** The probe is best installed in or on a manipulator but may be attached directly to the ROV frame if there is no manipulator available. (This should be done when only proximity readings are required).

**4.2.2** The recessed grooves in the probe body may be used to accommodate stainless steel hose clamps for attachment. We recommend installing neoprene rubber pads between the probe and the mounting surfaces and attaching a safety line to the probe. This will provide a better attachment and some degree of compliance.

**4.2.3** A male RMG-3MP connector on a 6' (1.83m) whip is provided to facilitate splicing into the ROV junction box.

**4.2.4** Routing the two reference electrode wires in a shielded twisted pair in the ROV umbilical is recommended. The tip wire can be connected to a coaxial cable or any other cable that is straight-through to the control van with no breaks.

**4.2.5** Topside, the system can be wired directly to a pair of digital multimeters (Fig. 7) or a Polatrak Deep C Meter™ (Fig. 6). It can also be wired directly into a video annotator with an input impedance of at least 1.0 MΩ.

**4.2.6** Consult the Deep C Meter™ manual for use with a Deep C Meter™ readout.

### 4.3 Cautionary notes

Polatrak® sintered silver / silver chloride reference electrode elements are designed to be rugged, but they are consumables that have a given operational life. The life of these electrodes can be extended to several seasons if the following care is taken:

**4.3.1** Never allow the electrode elements to be directly shorted to ground or any other metallic object when immersed in seawater.

**4.3.2** Never use the electrode subsea with the underwater connector un-mated.

**4.3.3** Never read the ROV-II™ probe with an analog voltmeter. Ensure that high-input impedance digital equipment is used.

**4.3.4** Never handle the bare reference electrode element (small gray pellet) with bare hands.

**4.3.5** Do not use any type of solvent or detergent on the probe. Rinse only in fresh water after every operation.

**4.3.6** Never immerse the electrode in anything but fresh water

or seawater.

**4.3.7** Never allow a connector or bulkhead to be immersed unless it is mated or has a sealing dummy plug inserted.

**4.3.8** Never read the electrode on a multimeter setting other than DC Volts.

**4.3.9** When not in use, store the probe in the provided container filled with seawater or tap water. Probe can be stored dry between jobs but should be soaked in fresh water for at least one hour before storage.

**4.3.10** Do not attempt to field-repair any wires on the probe or inside the probe and never attempt to modify the probe tip in any way.

## 5. Calibration

### 5.1 General

As with any subsea measurement device, it is important to calibrate the ROV-II™ probe to ensure that the reference electrodes are working properly and that there is no damage to the probe.

The probe comes calibrated from the factory. Calibration should be checked before and after each dive. If the probe is not calibrated, readings may be incorrect and the dive may have to be repeated.

Since the ROV-II™ probe uses two reference electrodes, the user always has two independent voltage readings of the tip contact. This provides an advantage over probes that use a single reference electrode because the cell-to-cell value can be checked at any time during operation to verify the probe is calibrated and working properly. The **cell-to-cell value** is simply the difference in voltage between the two readings; this value should never exceed **5 mV topside (submerged in a bucket)** and **10mV subsea**. For example, if both voltage readings are the same, the cell-to-cell value is 0 (zero) mV.

### 5.2 Using calibration for troubleshooting

Certain problems could cause the probe to be out of calibration. A common cause, particularly on diver surveys, is damage to the cable insulation. This causes an offset in the voltage readings, which would usually be interpreted as inadequate protection levels.

Other causes include one or more defective reference cell electrodes, wire damage within the probe or mud that has gotten inside the probe. Calibration can be used to quickly diagnose a defective reference electrode or cable damage and should be performed before, during, and after every use.

**NOTE:** Company calibration specifications must be met, but we strongly advise also using the attached procedures.

### 5.3 Topside/bucket calibration

There are two types of bucket calibrations that can be performed:

- Zinc coupon calibration
- Cell-to-cell calibration

Wiring schematics for these two bucket calibrations are shown in Figures 4-5.

**CAUTION:**

**Never use a metallic container for storage or for performing calibrations.**

**5.3.1** Fill a non-metallic bucket or container approximately 18 in. (45 cm) deep with seawater or simulated solution with specific gravity between 1.021 and 1.028 (if you're able to measure it).

**5.3.2** Place the probe in the bucket, allowing the body to fill with seawater. The entire probe, including the tip, must be immersed. Agitate the probe to ensure all air has escaped.

**CAUTION:**

**DO NOT immerse the Seacon RMG-3FS connector in water unless it is mated with the dummy plug.**

**5.3.3** Wait 30 minutes for the electrode elements to reach equilibrium (first time use only).

**5.3.4** To perform a zinc coupon calibration:

- Immerse the zinc calibration coupon. Stab the probe tip firmly onto the zinc coupon.

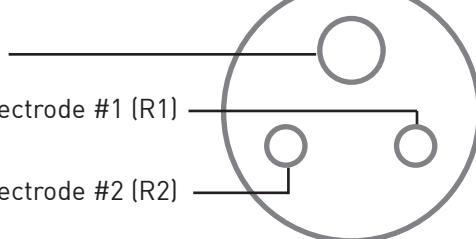
- Using a digital voltmeter set on 2.00 V DC scale, contact pin socket #1 (the large socket; refer to Figure 2) with the positive voltmeter lead. This pin socket measures the probe tip.
- At the same time, contact pin socket #2 (first clockwise of the large pin socket) with the negative lead and note the reading. Then take the negative lead and contact pin socket #3; note the reading.
- Figure 4 shows the correct wiring schematic and the expected results. The two readings should not be more than 5 mV apart.
- Remove the probe tip from the zinc coupon. The reading should revert to a voltage within the range of (-) 0.200 to (-) 0.400 V DC.

### 5.3.5 To perform a cell-to-cell calibration:

- Using a digital voltmeter set on 200 mV DC scale, contact pin socket #2 with the positive voltmeter lead and pin socket #3 with the negative voltmeter lead. Note the reading.
- Figure 5 shows the correct wiring schematic and the expected results. The reading should be between  $\pm 5$  mV.

**Figure 2 -** SEA CON® RMG-3FS connector pin diagram

**Pin socket 1:** Contact tip



**Pin socket 2:** Reference electrode #1 (R1)

**Pin socket 3:** Reference electrode #2 (R2)

### 5.4 Subsea calibration

The cell-to-cell value can be checked at any time while the ROV-II™ probe is deployed subsea. Subsea calibration should be performed with the entire cable immersed, as it will quickly

detect any cable damage. Diver surveys using the ROV-II™ probe should have two topside multimeters connected to the dive cable. ROV-assisted surveys should have the Polatrak® Deep C Meter™ alongside the probe to provide a subsea LED readout of the voltages. Wiring schematics for these two options can be seen in Figures 6-7.

## CAUTION

**NEVER submerge any unmated Seacon connectors.**

**5.4.1** While the probe is free-flying subsea without contacting any metal, the voltage readings will vary depending on ROV/diver speed, time of immersion and whether the tip contact has recently stabbed a structure or pipe. Normally, the voltage readings will be in the range of (-) 200 to (-) 400 mV.

**5.4.2** Both voltage readings should never be more than 10 mV apart while the probe is subsea. Remember, this difference between voltage readings is the cell-to-cell value. If the cell-to-cell value is greater than 10 mV, the cause may be:

- Lead wire is damaged, exposing copper to seawater.
- A connection is not properly mated or is leaking.
- One or more reference electrode elements is contaminated or has failed.

**5.4.3** If it becomes apparent in the middle of an operation that one reference electrode element has failed, it is possible to complete the dive. Follow these steps to identify the bad reference electrode:

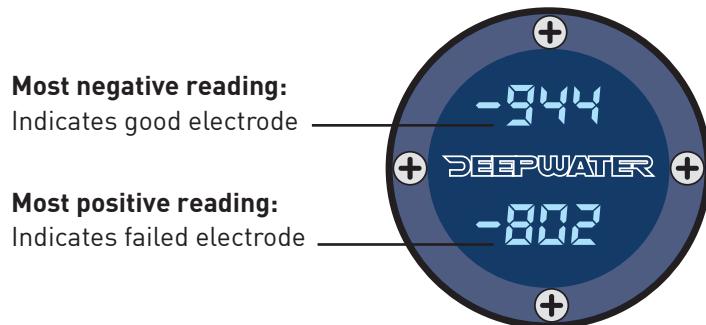
• Stab the probe onto the structure and determine which reading displays the most positive voltage; this is normally the failed reference electrode. The good reference electrode will have the most negative reading.

For example, (-) 900 mV is more negative than (-) 500 mV. (-) 900 mV would indicate the good reference electrode; (-) 500 mV would indicate the failed reference electrode.

- Record the cell-to-cell value.

- Only use the voltage readings from the good reference cell for the rest of that dive.

**Figure 3 - Identifying a failed reference electrode**



## 5.5 Proximity mode ground check

When the probe is being used in proximity mode, the user needs to verify that the platform ground wire and probe tip will yield the same reading at any point on the main structure.

- Stab the steel structure with the probe and record the voltage reading.
- Take the reading again using the platform reference ground wire instead of the probe tip. The readings should be identical.

If the readings vary by more than 3 mV, check the platform ground wire connection.

## 6. Operation

Most companies have their own survey procedures to follow. The following guidelines are given as guidance only.

### 6.1 Wet check

**6.1.1** When interfaced to an ROV, it's important to perform a wet check before every dive. Signal errors caused by umbilical power cable interference could introduce reading errors.

**6.1.2** With the probe wired to the ROV, immerse the system to a depth of at least -30 feet (-10 m), and with the vehicle still in its Tether Management System (TMS), bring up one electrical system at a time and note the potential of the tip. (It will vary depending on immersion time). If there is a problem, the potential will change rapidly or will spike when the circuit is powered. Repeat for all electrical and hydraulic systems. If a problem is detected, it should be fixed. Usually, the cause is a poor ground connection or a faulty leaking underwater connector. The system at fault can be switched off if it will not hinder operation.

## 6.2 Recording cathodic protection potentials

If wired correctly, the cathodic protection potentials should have a negative polarity. Accurate readings will be steady as long as the probe is not moving. If readings are erratic, this is a sign of a connection problem and the cause should be isolated and fixed.

## 7. Taking cathodic protection potential readings

Stab the tip-contact probe onto the point on the structure where the reading is required. When a good contact is made, the displays will show a steady reading.

### CAUTIONS

- **Avoid stabbing painted or coated surfaces whenever possible. Try to take readings on bare steel or on spots specially designated for cathodic protection measurement.**
- **If necessary, anodes can be stabbed. However, it is best to stab the anode core if possible. After stabbing an anode, it may take some time for the probe tip to depolarize due to anode material stuck on the tip.**
- **Avoid trying to stab through heavy, hard marine growth.**
- **The probe unit should be kept out of the mud, which will contaminate the electrodes.**

- If the readings are not steady or do not match the criteria in Table 1, the cause is probably due to a high-resistance contact. **DO NOT RECORD THESE NUMBERS.** Continue to stab until readings are within the range specified in Table 1. See troubleshooting section if problems persist.

## 8. Data interpretation

For carbon steel structures in seawater, the readings obtained should be within the ranges in Table 1. Exceptions may occur if the probe is stabbed onto an isolated section of a corrosion-resistant alloy such as stainless steel, copper or nickel. In these cases, readings less negative than the indicated range may be noted. If so, ensure that the readings are steady and within the  $\pm 5$  mV allowable tolerance.

**Table 1** - Normal cathodic protection ranges for bare carbon steel in seawater

Range (mV)	Interpretation	Action
<b>-500 or more positive</b>	Error	Remake contact & verify Measure two other points around the component Abort & refer to troubleshooting section
<b>-501 to -649</b>	Isolated from cathodic protection	Remake contact & verify Record data
<b>-650 to -799</b>	Not cathodically protected	Remake contact & verify Record data
<b>-800 to -849</b>	Marginal cathodic protection	Remake contact & verify Record data
<b>-850 to -1049</b>	Cathodically protected	Remake contact & verify Record data
<b>-1050 to -1149</b>	Anode potential for Al or Zn	Remake contact & verify Record data
<b>-1150 or more negative</b>	Overpolarized or error (unless Mg anode or energized ICCP system)	Remake contact & verify Measure two other points around the component Abort & refer to troubleshooting section

## 9. Maintenance and repair

This section covers general operational maintenance. Do not attempt any task not described in this section, as it may damage the system.

### 9.1 Tip replacement

From time to time it will be necessary to replace tips. Remove the old tip with a 7/16 in. wrench (flats are best). Avoid using an adjustable wrench if possible. Ensure that the new tip is tight.

**CAUTION: The contact tip has been machined to a very sharp point to enable easier readings through coatings. This point can also easily cut or poke through human skin. Please handle with care.**

### 9.2 Reference electrode element replacement

Spare plug-in electrode elements are available for the ROV-II probe. These elements will also work in the Polatrak® CP Gun™. If one element or more needs to be changed, follow this procedure:

- 9.2.1** Remove the probe from the ROV and un-mate the connector. Install the provided dummy plug onto the exposed flying lead connector.
- 9.2.2** Perform a zinc coupon bucket calibration as described in section 5.3.4. The faulty electrode will be the one that gives the more positive reading.
- 9.2.3** Ensure that the probe is drained of seawater.
- 9.2.4** Take the probe unit to a clean area.
- 9.2.5** **DO NOT** handle the small electrode pellet with bare hands.
- 9.2.6** Remove the two screws securing the tail unit and gently pull out the tail unit to expose the electrode elements. Try to avoid un-mating the tip connector.
- 9.2.7** Visually inspect to ensure that the wire is not damaged and the connector is properly mated.

**9.2.8** Remove the bad electrode and discard according to appropriate local environmental procedures.

**9.2.9** Take the new electrode and carefully place a **small** amount of insulating compound on the sealing section of the electrode connector. Please refer to the MSDS in section 2.1 before handling sealant. All appropriate Personal Protective Equipment (PPE) shall be worn, including safety glasses, as a minimum.

**9.2.10** Plug in the new electrode.

**9.2.11** Check that all connectors are fully mated, then carefully put the electrodes back into the housing and re-attach the tail unit and nose cone.

**9.2.12** Repeat calibration check as described above. (Note that a new dry element may take 30 minutes or more to reach equilibrium)

**Caution: NEVER immerse an electrode element in water with the connector pin exposed.**

## 10. Troubleshooting

### 10.1 The cell-to-cell value is greater than 5 mV topside or 10 mV subsea

The problem could be one of the following:

- **One reference electrode has failed.**

Repeat the bucket calibration (section 5.3). The electrode with the more positive reading is probably in error. Replace the reference electrode element (section 9.2).

- **There is damage to the tail assembly cable or umbilical cable.**

When recovering the ROV-II™ probe from the dive, any cable damage can be quickly located and repaired. Monitor the cell-to-cell value as the cable comes out of the water. If the problem is cable damage, the cell-to-cell value will revert to the acceptable range (10 mV or less) as soon as the damaged area of cable clears the water.

### 10.2 Both displays reading low (more positive) voltages

If both electrodes read low during a stab (more positive than (-)500 mV), the problem is probably with the contact tip wire attached to the nose cone assembly. If the tip wire is damaged, a temporary soft-splice repair can be made using ScotchKote® sealant (not included) and splicing tape. However, prolonged operation in this manner is not recommended. Order a new nose cone assembly as soon as possible.

### 10.3 Recalibration

After any replacement or repair, recalibrate the instrument by performing a bucket calibration as described in section 5.3.

**Table 2 -** Quick troubleshooting guide

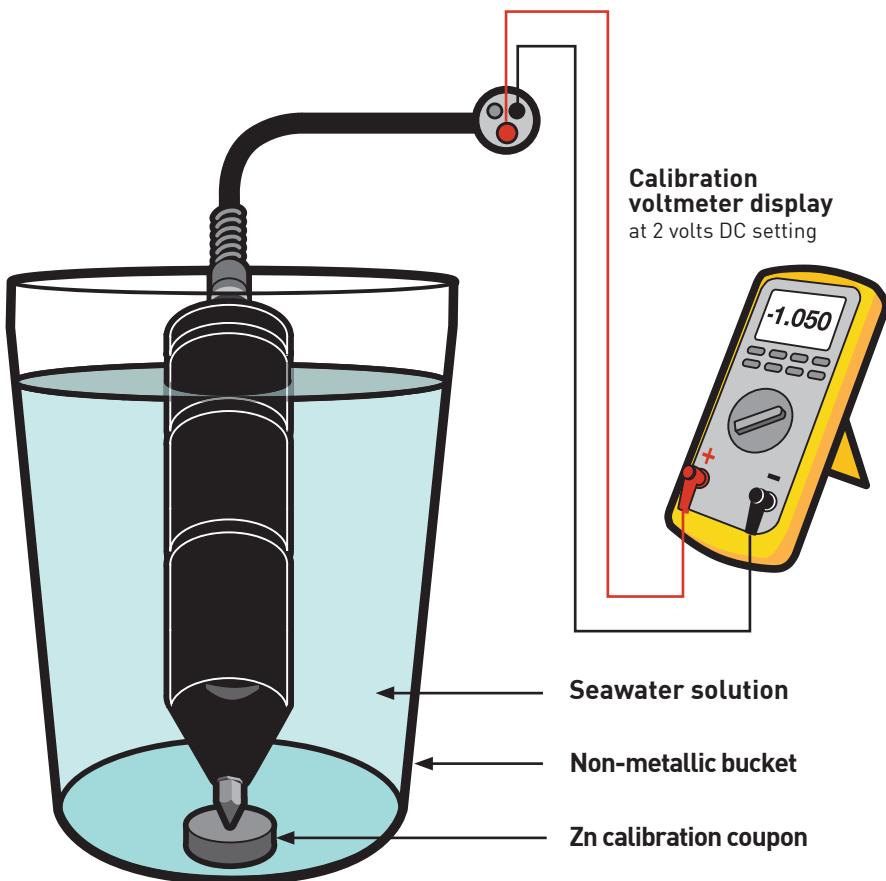
Symptom	Possible problem	Action
<b>Instrument will not calibrate</b>	One electrode is bad Zinc coupon is passivated (formed an oxide coating) Electrodes are dry	See section 9.1.2 Brighten zinc coupon Soak in seawater for 30 minutes and retry
<b>Both electrodes reading low</b>	Tip wire damaged	Remove probe element housing, unplug tip wire, remove nose cone, inspect tip wire and repair with ScotchKote as temporary measure. Order replacement nose cone.
<b>Readings are not steady and continue to change.</b>	Voltmeter batteries are low Poor structure contact	Replace voltmeter batteries Re-stab to ensure contact.
<b>One reading suddenly reads less negative</b>	Connector is flooded.	Check connectors
<b>LED readouts are blank</b>	Switch not in position Batteries are dead Pressure housing is flooded	Verify switch position (Forward: on, Rear: off). Replace batteries Go to backup; return unit to Polatrak.

**10.4** If a problem persists or is not listed, please call our hotline at (713) 983-7117 and ask for Polatrak® technical support.

Figure 4

# CELL TO ZN COUPON

## DC-II™ CALIBRATION WIRING SCHEMATIC



Step	+VE	-VE	DC scale	Expected result
01	Tip / Pin 1	Reference electrode 2 / Pin 3	2 V	-1.030 to -1.070
02	Tip / Pin 1	Reference electrode 1 / Pin 2	2 V	-1.030 to -1.070

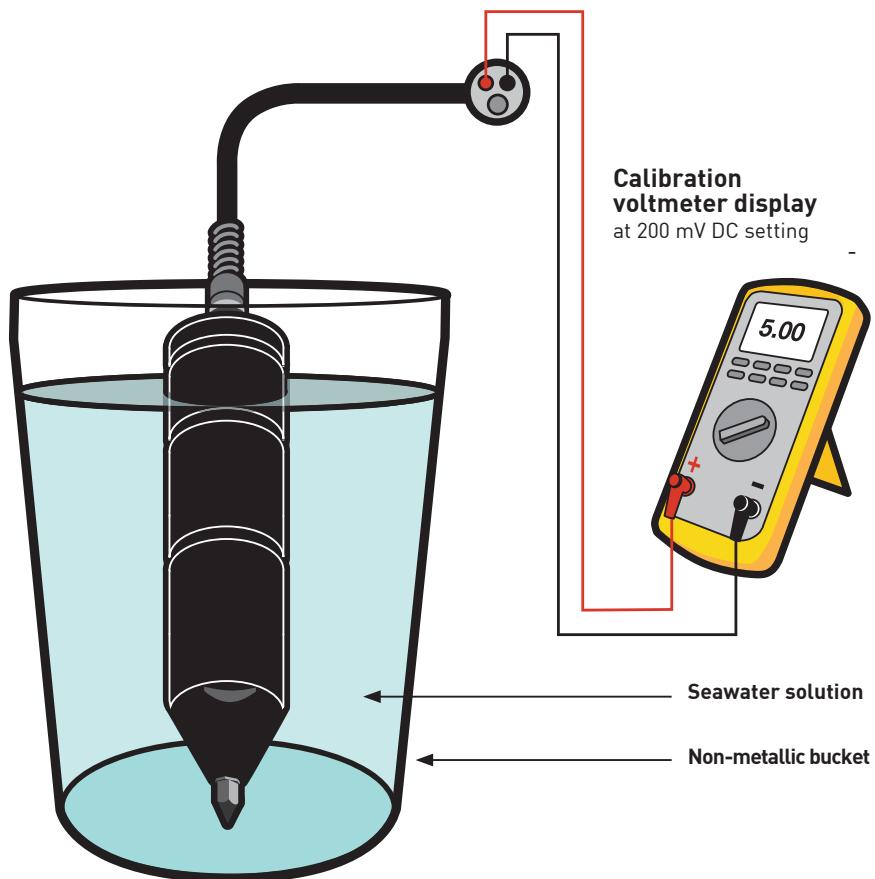
**Note:** Clean the Zn coupon with a file or sandpaper before using.

(Readings should be within 0.005V of each other)

Figure 5

# CELL TO CELL

## ROV-II™ CALIBRATION WIRING SCHEMATIC



Step	+VE	-VE	DC scale	Expected result
01	Pin 3	Reference electrode 1 / Pin 2	200 mV	±5.0 mV

Figure 6

# WIRING FOR DEEP C METER™ READOUT

## ROV-II™ WIRING SCHEMATIC

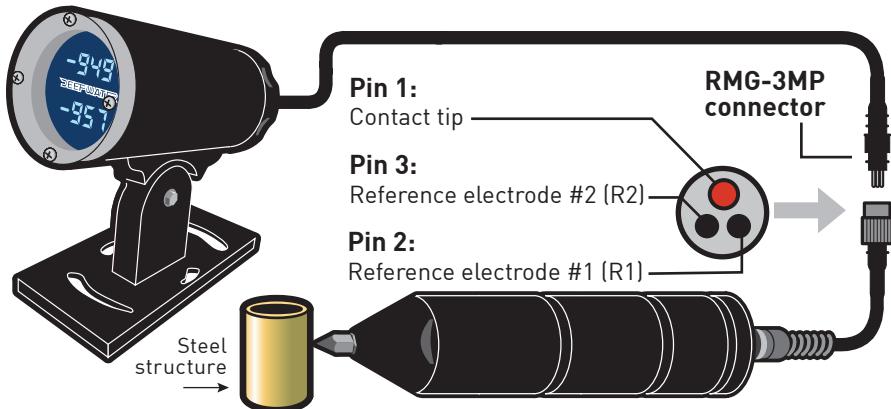


Figure 7

# WIRING FOR DIVER-ASSISTED PLATFORM SURVEY

## ROV-II™ WIRING SCHEMATIC

