Instrument Manual

MicroRider–1000LP

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Revision 5.3

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Revision History

Revision	Date	Description
0	2009-04-16	First Release
1	2009-04-22	Added details on microstructure sensor installation.
2	2009-10-04	Added details on instrument ON setup
3	2010-07-27	Expanded software and electronics hardware sections. Added Section on Power Supply.
4	2011-12-27	Added schematic of Power Supply LP board.
5	2013-08-27	Updated for MCBH and Low Power design; Corrections
5.2	2014-09-25	Corrected images and text for MCBH connectors
5.3	2016-07-07	Updated nomenclature to ‘test probes’

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1 Introduction

This document describes the operation and maintenance of the Rockland Scientific International (RSI) MicroRider-1000LP internally recording microstructure instrument.

The MicroRider-1000LP is an internally recording instrument designed to be mounted to an external platform, such as a CTD rosette, AUV, or glider. Its maximum depth is 1000 meters. It is powered by any 12VDC supply and can be turned On and Off remotely.

Shortly after the MicroRider-1000LP is turned on, it starts data collection and places the information into a new file. Shortly after the instrument is signaled to turn off, it updates a log-file by recording the time and the reason for the termination of data acquisition, then closes all files, and shuts itself down. This makes the instrument well suited to operating autonomously with data collection controlled by a simple ON-OFF signal. Power consumption is approximately 1W when on and 0W when it is off.

Other documents and software that are useful for operating and understanding the MicroRider-1000LP are listed below. All of these are available from our Web site for registered users.

- The ODAS5IR User Manual, for the data acquisition software.
- The ODAS Matlab Library, for functions used in data processing.
- ODAS5-IR Software installation using Motocross, which is used to update software in the Persistor processor in the MicroRider-1000LP.
- ODAS5-IR Utilities & Documentation
- FTDI VCP Driver, which is required for USB communication and is usually installed automatically with the ODAS5-IR Utilities.
- Application note AN-001, A Quick Method for Calibrating Accelerometers, which is useful if you wish to calibrate the accelerometers.
- AN-002, Digital signal processing to enhance oceanographic observations, which explains the theory behind using signal pre-emphasis on critical channels to maximize the signal to noise ratio.
- AN-005, Converting Shear Probe, Thermistor and Micro-conductivity signals in to physical units, which gives a detailed explanation of this process.
- AN-010, Design and Optimization of Anti-Aliasing Filters for Ocean Turbulence Measurements, which gives a detailed explanation of the filtering required to produce sampled data that is free from aliased components.
- AN-011, Serial Instrument Buss, which explains how digital data is transferred within the MicroRider-1000LP. Useful only to those that want deeper knowledge of the workings inside of the MicroRider-1000LP.
- AN-015, Modeling the spatial response of the air foil shear probe using different size probes, which is a paper describing the wavenumber response of the shear probe.

2 Receipt of Goods

Promptly after you receive your MicroRider-1000LP you should:

- Inspect the instrument.
- Confirm packing list.
- Confirm the tools.
- Confirm instrument communication.

2.1 Inspect the Instrument

- The MicroRider is typically shipped in one case.
- Remove the instrument from its shipping case.
- Inspect the instrument and all ancillary equipment/packages; check to be sure that no damage has occurred during shipment. If damage is found contact the shipper immediately to start the claims process. Most shippers have a time limit on claims, so start the process promptly.

2.2 Confirm Packing List

Check the contents of the shipping cases against the packing list. Confirm that all items on the list are in the crate(s).

2.3 Tool List

Assembling and maintaining the MicroRider 1000 requires the following tools:

- Probe wrench
- 1/2” [13 mm] wrench or socket and a 6 inch extension
- 13/16” wrench (MHDG connectors)
- Slot screwdriver

2.4 Confirm Instrument Communication

Proceed to section 3 to install the software on your host computer (which is usually a Notebook computer) and then on to section 4 to confirm that you can communicate with your MicroRider-1000LP.

3 Software to Install

Your MicroRider-1000LP acquires its data with a Persistor CF2 processor using the ODAS5-IR software. User communication with the MicroRider-1000LP is accomplished using Motocross terminal software. Files are up- and down-loaded via a USB connection using USBL.

The ODAS5IR Software User Manual provides a full description of communication, file transfer and gives all details regarding the data acquisition software, including user configuration files. The software manual can be downloaded from the Rockland Scientific web site by all registered users. Effective use of the MicroRider-1000LP requires a full understanding of the ODAS5IR software.

There is usually no need to install any software on the Persistor computer in your MicroRider-1000LP because this will be done at RSI before the instrument is shipped. However, you must install two programs on your host computer (which is usually a Notebook computer). One is Motocross which provides terminal emulation and serial communication with the instrument and permits the transfer of files, including executable software files. The other is a USB link utility that permits the bi-directional transfer of files between the host and the MicroRider-1000LP. Transfer speed is approximately 200 k-bytes per second and is limited by the speed of the Persistor processor. The installation process is simple and explained in the ODAS5-IR User Manual.

4 Instrument Communication

Items Required:

- Microstructure Instrument
- Computer
- Instrument Deck Cable with Deck Unit (power supply and On switch)

1. There is one deck cable with two underwater connectors for connecting with the instrument:
    a) Impulse MCIL-4-FS connector for the USB serial data download connection
    b) Impulse MCIL-8-MP connector for RS232 serial connection, 12VDC power and the ON switch.
2. Connect the deck cable to the instrument (Figure 1).

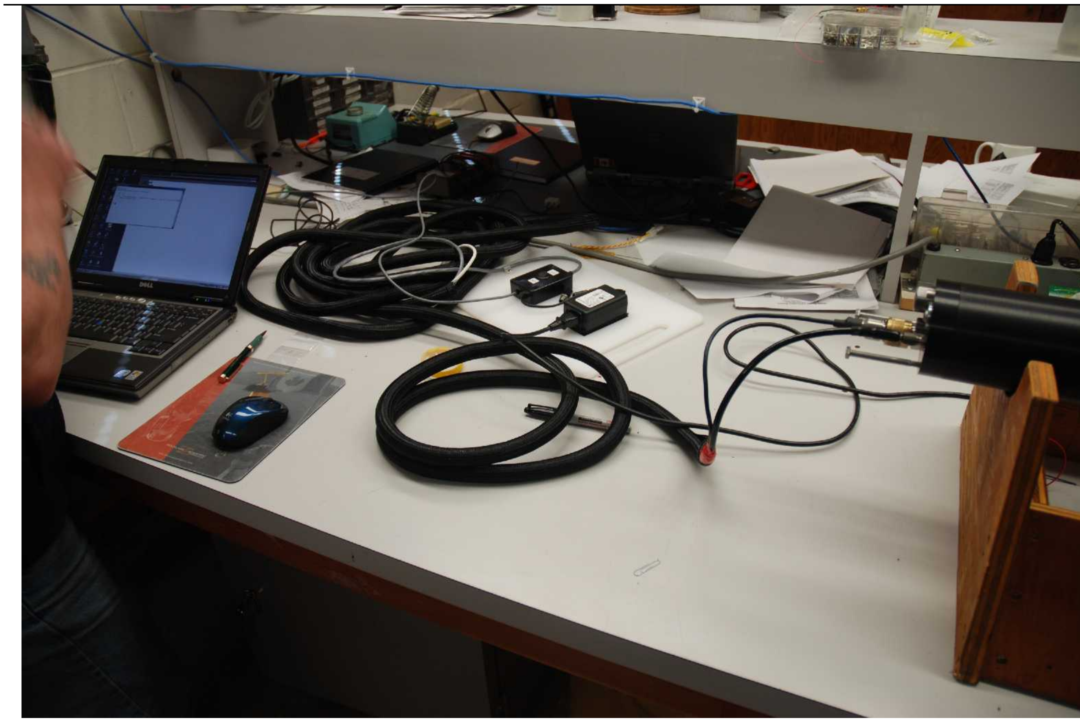


Figure 1: Deck Cable connecting MicroRider to Computer and AC Power.

3. Turn on your host computer (if it isn't on already) and start the Motocross terminal emulation software (refer to the ODAS5-IR User Manual for details).
4. Connect the Deck Cable 9-pin D-sub connector to the RS-232 Serial port on your computer. Connect the USB connector to a USB port on your computer. Note that you can use a Serial to USB adaptor to connect the RS-232 D-sub to a USB port on your computer.
5. Turn the instrument ON using the ON switch on the Deck Cable.
6. Refer to the ODAS5-IR Software User Guide for instructions on how to connect and talk to the onboard computer.

7. When you are finished communicating with the MicroRider-1000LP, turn the instrument OFF and disconnect the Deck Cable(s) from the instrument, replace the watertight caps on the Deck Cable connectors and the MicroRider.

5 Matlab Software Installation

Data viewing and processing requires the Matlab ODAS Library of functions. The software and its User Guide can be downloaded from the Rockland Scientific Web Site by all registered users.

The Matlab ODAS Library, which is common to all instruments made by RSI, provides the functions needed for routine processing of data files including, but not limited to, file conversion to Matlab format, conversion to physical units, data visualization, spectral estimation and examples of the calculation of the rate of dissipation of kinetic energy.

The Matlab Library should be installed within your search path so that the functions are available in all directories of the computer used for data processing.

6 MicroRider-1000LP Overview

The MicroRider-1000LP is a 1000 meter rated, internally recording, microstructure instrument. It is intended to be mounted on user supplied platforms such as an ocean glider, AUV or CTD rosette. Up to 6 microstructure sensors can be installed. Typically these are two shear probes, two FP07 thermistors, one micro-Conductivity sensor (optional), and one spare port. An optional ON light can be installed into the sixth probe holder. This LED flashes once per record (second) and gives a visual indication that the data acquisition process is underway. We recommend that an opaque cover be placed over the LED shortly before the instrument is deployed because it may attract marine life.

6.1 MicroRider-1000LP Overview — Mechanical

There are two MCBH wet mateable underwater connectors installed on the rear bulkhead as shown in Figure 2. The 8-pin female connector provides the link to the supporting vehicle. It handles the 12VDC power, the On/Off control signal and RS-232 Serial Communications. The 4-pin male connector handles the USB connection for file transfers to and from your host computer. A third MCBH connector can be installed for auxiliary sensor connections.

6.2 MicroRider-1000LP Overview — Electrical

A Persistor onboard computer running the PicoDOS operating system handles the data acquisition. The data are logged on to a Compact Flash card. The computer setup is done through the RS-232 serial connection and the data download is done over USB; see the ODAS5-IR Software User Guide for details. The user can communicate with the instrument with its deck cable.

The instrument typically runs on 12VDC power supplied by either the platform or from the optional RSI battery pack. The operating voltage range of the MicroRider-1000LP is 9.5V to 17V. Typical current consumption is 100 mA at 12V. The power supply must always be on when the instrument is in use. A sudden power failure may destroy the data file being written at the time of power failure. The instrument is turned on and off using the ON-OFF function. Shortly after the instrument is turned on it will start recording in to a new data file, and shortly after the instrument is turned off it will terminate data acquisition, close all files and signal the power supply board that it is safe to turn the instrument off. While the instrument is off it draws no power from the external power supply.

6.2.1 ON-OFF Function

There are two ways to turn the MicroRider on and off. The first method uses a logic level signal. A value of zero volts will turn the instrument on. This can be produced by a simple mechanical switch that shorts two conductors on the Power Supply Board P050, J2-1 and J2-3. A logic level of "high" (between 2.4 and 5V), or an open circuit, will turn the instrument off. This can also be instigated with a switch that opens the connection between the two conductors. The second method is to drive a current of 2 to 10 mA in to an optical-coupler (into J2-4 and out of J2-5 on the Power Supply P050 circuit board) . This current will turn the instrument on, while a current of less than 1 mA will turn it off.

MicroRider-1000LP instruments intended for use with a Slocum Glider, are turned on and off with the 2mA current method. The current is passed into Pin 3 of the IE55-1206 connector and its return path is via Pin 4 of this connector. The current is generated by applying a voltage through an appropriate current limiting resistor. A 1 kΩ resistor in series with the optical coupler limits the current to the correct value for voltages of 3.3 to 5V. For larger voltages sources, such as 12V, an additional series resistance of 3 kΩ sets the current to a suitable value. The photo-diode in the optical coupler has a voltage of 1.1V when it is turned on.

There is an ON-OFF switch built into the deck cable. Refer to the system block diagram (Figure 17, drawing number 010-024-05 Rev2) for connection details and an overview of the external cabling options. This current is provided by the ON switch on the supplied Deck Box (Figure 18), which is used to download data and to configure the data acquisition system

Certain instruments have custom arrangements for turning the instrument ON and OFF and these will described in a separate document shipped with the instrument.

6.2.2 Back-up Battery in the MicroRider-1000LP

The power supply board in your MicroRider-1000LP monitors the state of the ON-OFF switch to start the power-up sequence and to signal the data acquisition software when to stop collecting data. A lithium CR123 battery maintains the logic function of the power supply board, and the time-of-day clock in the data logger, and it has enough capacity to last about 6 months. When this battery is depleted, the MicroRider cannot be turned on. Therefore, the user should always insert a fresh new battery before every major deployment and certainly after it has been in storage for more than a few months. When the instrument is turned on, no current is drawn from the CR123 battery.

6.2.3 Communicating with the MicroRider-1000LP

When the MicroRider is mounted on the vehicle and ready for deployment, the MCBH-4-MP is capped with its dummy plug, and the MCBH-8-FS is connected to the vehicle through an appropriate underwater cable.

You can communicate with the instrument on deck for programming and data download with the following method. Remove the cable that connects the vehicle to the MCBH-8-FS connector on the back of the MicroRider-1000LP. Connect the RSI deck cable to the MCBH-8-FS and the MCBH-4-MP connectors on the back of the MicroRider-1000LP. Power the instrument through the deck cable by connecting the cable power adapter to a suitable AC outlet. Connect the deck cable to the serial and USB ports on your Notebook computer and start the Motocross Terminal Program. Note that you can use a Serial to USB adaptor cable if your PC does not have a 9-pin Serial Connector. Use the ON/OFF switch on the deck box (connected to the deck cable) to turn the instrument on. Follow the instructions in the ODAS5IR Software User Manual to communicate with the MicroRider-1000LP.

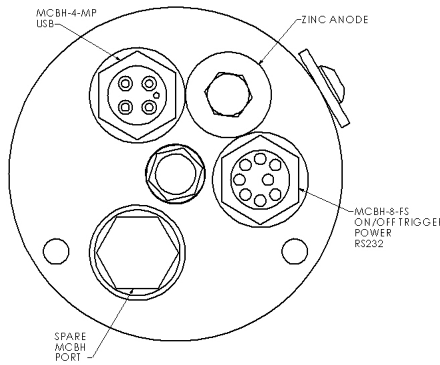


Figure 2: MicroRider-1000LP rear bulkhead.

6.3 MicroRider-1000LP Sensors and Electronics

The MicroRider-1000LP contains at least three electronics boards. The ASTP-LP board (P049) provides analog signal conditioning for 2 shear probes, 2 FP-07 thermistors, a pressure transducer and a 2-axis vibration sensor. The ASTP-LP also provides anti-aliasing filtering for all analog channels and has an ultra-linear low-noise analog-to-digital converter that samples the data into 16-bit words. The CF2-Interface board (P040) holds the Persistor CF2 processor and handles all communication of data samples from the other boards and provides the user with RS-232 and USB lines. The Low-Power Power Supply board (P050) provides the internal power rails (+5V for analog signals, +3.3V for digital signals, and a "raw battery" supply of nominally +12V for optional instrumentation. It also manages the ON-OFF function of the instrument. Onboard the Power Supply board is a high precision two-axis tilt sensor.

The MicroRider-1000LP is extensively calibrated and tested for noise. Each instrument is supplied with a calibration certificate documenting the performance of the instrument. This report is also required to convert the data from certain channels into physical units.

Some instruments have the optional micro-conductivity sensor and its electronics board (P059).

Another optional sensor pair are the Sea-Bird SBE3F and SBE4C high-accuracy thermometer and conductivity sensor. The signals from these sensors are processed by the CF2-Interface board.

The coordinate system of the MicroRider-1000LP depends on how it is to be used. For quasi-horizontal profiling, such as with a Slocum Glider, the *x*-axis is along the axis of the pressure case and positive forward. The *y*-axis is defined as horizontal and positive in the "port" direction. The *z*-axis is nominally vertical, positive upward and direct through the pressure port on the side of the MicroRider-1000LP. For vertical profiling the *x*-, *y*-, and *z*-axes are through the pressure port, horizontal and orthogonal to the pressure port in the right-hand sense, and upward along the axis of the pressure case, respectively.

The numeric assignment of the signal channels follows standard values used by most RSI instruments and this is summarized in table 1. Further details are in the ODAS5IR Software User Guide.

Ch #	Name	Signal
0	gnd	pseudo-ground
1	Ax	piezo-accelerometer 1
2	Ay	piezo-accelerometer 2
4	T1	Thermistor 1
5	T1_dT1	Thermistor 1 with pre-emphasis
6	T2	Thermistor 2
7	T2_dT2	Thermistor 2 with pre-emphasis

8	sh1	Shear probe 1
9	sh2	Shear probe 2
10	P	Pressure
11	P_dP	Pressure with pre-emphasis
12	PV	Voltage on pressure transducer
32	V_bat	Power Supply Voltage divided by 10
40	Incl_Y	y-inclinometer (pitch)
41	Incl_X	x-inclinometer (roll)
42	Incl_T	Inclinometer temperature
64	C	Micro Conductivity
65	C_dC	Micro Conductivity with pre-emphasis
255	Sp_char	Special Character, 7FF0H

Table 1. Numeric assignment of signal channels in a MicroRider-1000LP.

7 Operations

1. Before mounting the MicroRider on the rosette or a vehicle, ensure that all o-rings are intact and all seals are properly secured. The pressure tube and nose use piston seal o-rings. CRITICAL – make sure there is no visible gap between the pressure tube and the bulkheads and between the nose and the front bulkhead. Replace the zinc anodes if necessary.

2. **NOTE:** If necessary wrap plastic adhesive UHMW or Teflon tape around the pressure case at the mounting points so that the black anodized aluminum surfaces are not damaged.

3. Connect the deck cable to the MCBH-8-FS and the MCBH-4-MP connectors.

4. Follow the instructions in the ODAS5-IR manual for logging into the computer and verifying the parameters in the setup.txt file.

5. Connect the instrument to the vehicle through the MCBH-8-FS connector. Put the cap on the MCBH-4-MP connector.

6. Install the microstructure sensors as follows:

   i. Loosen the holder cap of the test probe. Usually a half to three-quarter turn is enough. CAUTION: When tightening or loosening an SMC connector, rotate either the probe or the end of the connector while preventing the cable from rotating. Allowing the cable to twist will damage the cable and connector over time.

Figure 3: Wrench on Holder - Tight

Figure 4: Wrench on Holder - Loosened.

   ii. Gently pull out the test probe. Disconnect the SMC cable and leave it hanging out of the probe holder. Please note that the test probes are labeled (T1, T2, S1, S2, C1, for temperature, shear and conductivity, respectively) and these identifications must match the tags on the SMC cables attached to these test probes.

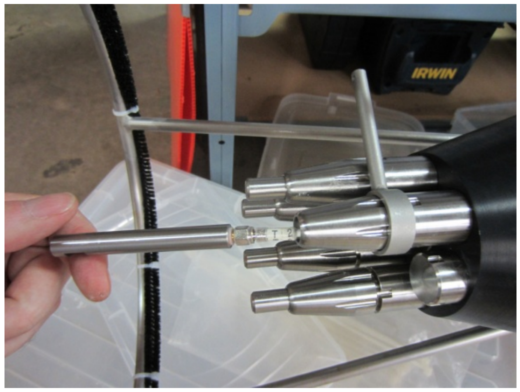
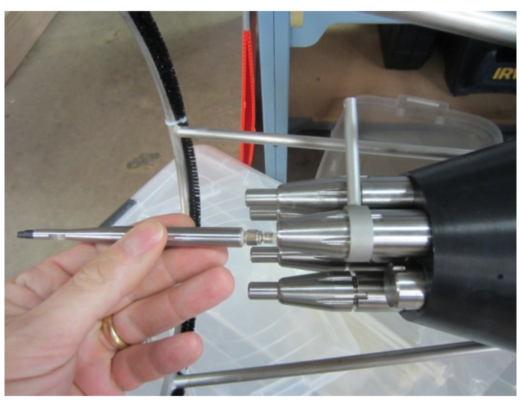


Figure 5: *Test probe Removed*

Figure 6: *SMC Cable*

iii. Inspect the SMC cable on each probe port. A layer of clear heat shrink tubing should cover all exposed metallic components on the connector, electrically isolating the connector from the front bulkhead. Care should be exhibited when inserting or removing probes to ensure the heat shrink tubing remains intact. In the event that the heat shrink tubing is cut/damaged, contact RSI. Note: Check for any tarnishing or corrosion around the connector and the exposed cable section. If there is discoloration in the label of the cable, this is likely due to water ingress in the sensor port. If this occurs, you may have irreparably damaged your sensor cable. Contact RSI.

iv. Connect and tighten the temperature, shear, and the optional micro-conductivity probes into their appropriate cables. Insert the sensors into the probe holders. Make sure the probes are fully seated. You should be able to hear a "click" sound of the metal base of the probe contacting the base of the probe port. If the probe does not easily seat, try rotating the probe and reseating. Note: make sure the probe holder caps are loosened so that the o-ring is not being squeezed around the probe. If you are still having difficulty seating the probe, contact RSI.



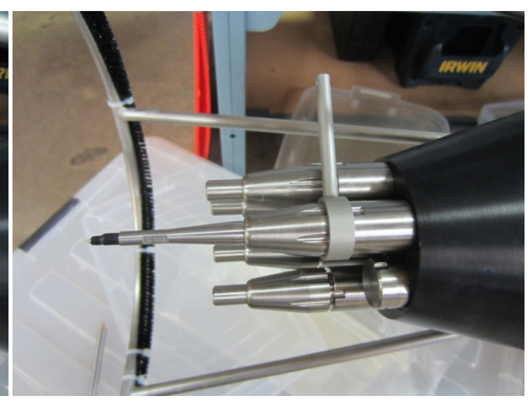


Figure 7: *Probe on SMC Cable*

Figure 8: *Probe Seated in Holder*

v. Orient the shear probes to their proper axes and tighten the probe holders. Typically, one shear probe is aligned with the instrument's x-axis (that is, the pressure port), and the other with its y-axis. The sensitivity on a shear probe is in the direction normal to the flat section of the sensor's serial number.

vi. Note: In some cases, while tightening the probe holder cap, the shear probes will want to rotate with the cap. This is because of the friction from the o-ring inside the probe holder hole. If this occurs, make sure that the o-ring is properly lubricated. In some cases this does not fix the problem and the probes will need to be rotated before tightening so that after they are secured, they have the proper alignment.

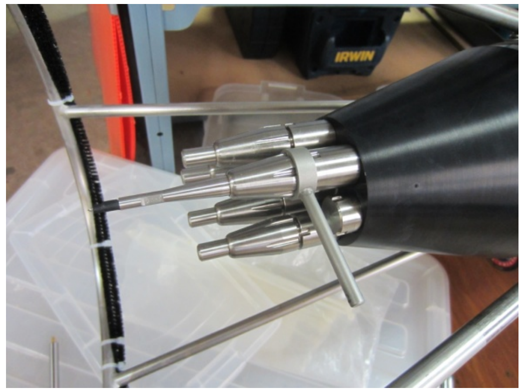


Figure 9: *Probe Seated and Holder Tightened*.

CRITICAL: The probe holders should not be over-tightened – tighten to the point where the probe holder caps can no longer be rotated by hand, then use the probe wrench to tighten the caps an additional 1/4 or 1/2 turn. At the proper tightness, it should be difficult to rotate the probes by hand. Over-tightening the probes will deform the plastic ferrule and affect the integrity of the o-ring seal

CAUTION: Insert the Temperature Probes last and be very careful because they are the most fragile.

CAUTION: When the Probes are installed on the ship deck, ensure the probes are protected.

Figure 10: Shear and FP07 probes installed on the MicroRider.

7. Connect the Sea-Birds SBE3/4/5 units, if your instrument has support for these sensors.
8. Deploy the instrument.
9. Recover the instrument.
10. Disconnect the platform cable from the MicroRider MCBH-8-FS.
11. Connect the deck cable to the MCBH-8-FS and the MCBH-4-MP connectors.

12. Turn the instrument on with the switch on the deck unit.

13. Follow the instructions in the ODAS5-IR manual for logging into the computer and downloading the data.

14. At the end of the cruise, or at any time for safety reasons, remove the microstructure sensors and replace them with test probes.

15. Remove the instrument from the vehicle and rinse with fresh water.

16. Upon your return to your base of operations, follow the maintenance instructions for cleaning and preparation for storage.

8 Maintenance

After every cruise, fully disassemble the instrument using the instructions in this section. Inspect all o-rings and sealing surfaces for damage. Inspect all components for wear and damage. Refer to the Maintenance Drawing included in the manual.

8.1 Disassembly and Maintenance

1. Remove the rear bulkhead Sealing Nut using an ½-inch Socket & Ratchet on a 6-inch extension.
2. Install two ¼-20 x 3 or 4 inch bolts into the two mounting points on the rear bulkhead. Hold on to the pressure tube and gently wiggle the rear bulkhead out of the tube by holding onto the bolts as shown in Figure 11.

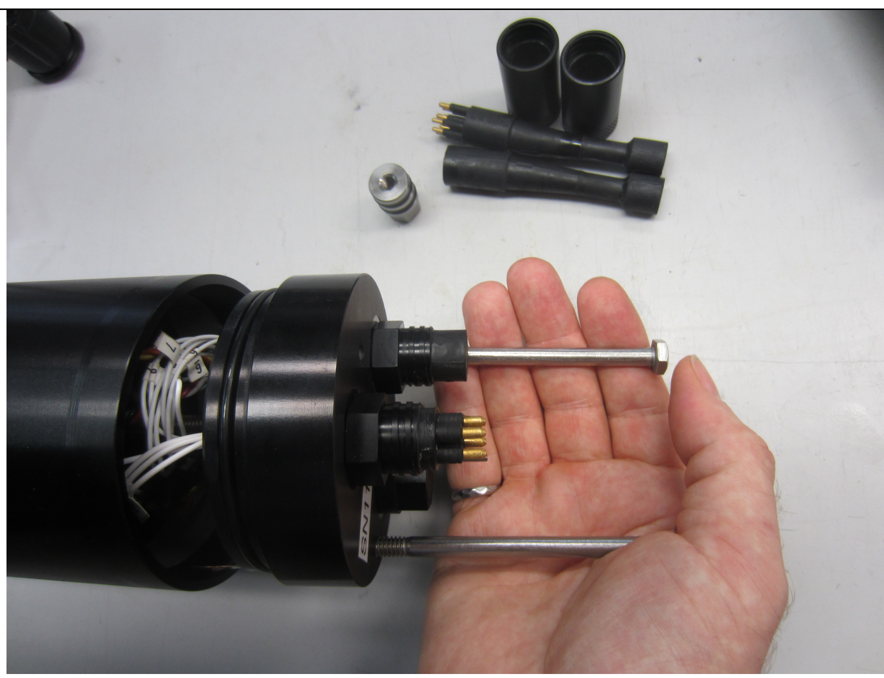


Figure 11: Removing rear bulkhead.

3. Slowly slide the rear bulkhead out over the threaded rod.

CAUTION: Remove the bulkhead slowly as the Molex Connectors are plugged into the inner electronics (Figure 12).

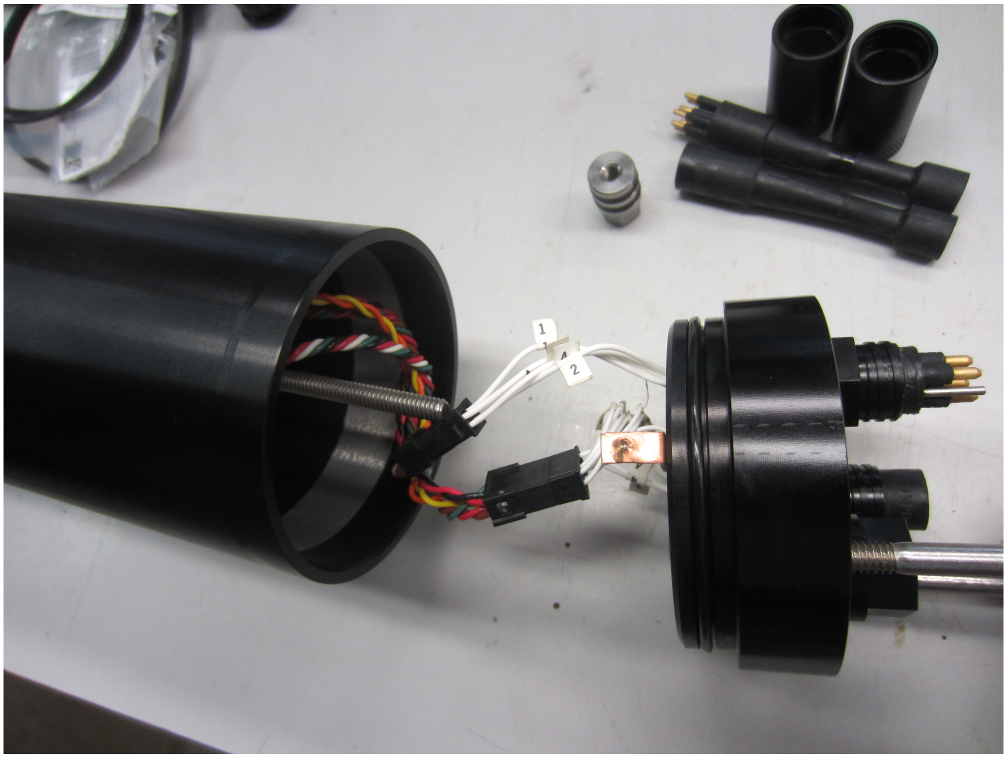


Figure 12: Rear bulkhead removed showing Molex Connectors.

4. Disconnect the Molex Connectors between the rear bulkhead and the internal electronics.
5. Set the rear bulkhead aside, being careful not to damage cables, connectors and the o-rings.
   NOTE: The following is best completed with two people.
6. Holding on to the pressure tube, gently wiggle the nose cone until the front bulkhead is free of the tube. Slide the internal electronics assembly out of the pressure tube (Figure 13).
   CAUTION: Be VERY careful not to damage the internal faces on the Pressure Tube. These are sealing surfaces and must remain smooth and clean.

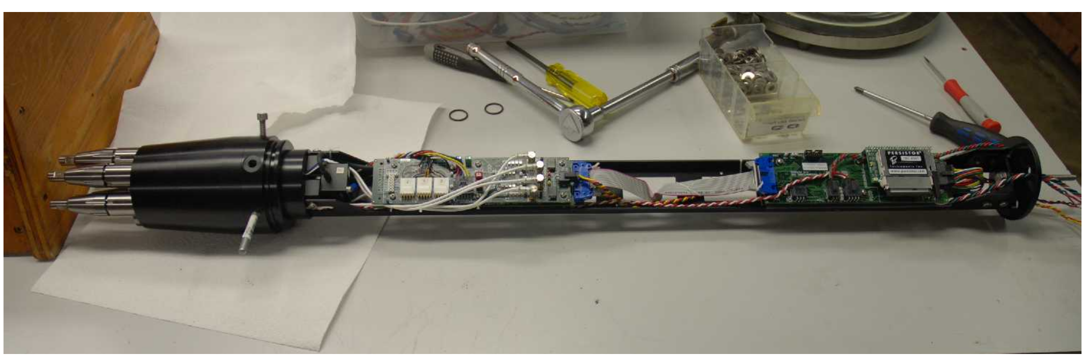


Figure 13: Nose cone/Front bulkhead/electronics Assembly.

7. Remove the test probes from the probe holders.
8. Disassemble the probe holders and remove them from the nose cone.
9. Use the ½-inch socket to remove the nose cone sealing nut and remove the nose cone by wiggling it free of the front bulkhead.

10. Inspect all o-rings. Replace any that are worn or damaged or older than one year.
11. Clean all sealing faces with isopropyl alcohol. Inspect the sealing surfaces for debris and damage. If any sealing surfaces are scratched or damaged contact Rockland Scientific.

8.2 Assembly

1. These steps assume that all o-rings have been cleaned (or replaced) and greased.
2. Feed the microstructure sensor coaxial cables through the holes in the nose cone. Figure 14 shows our standard convention with the ON LED sting installed in the "Plug" position.

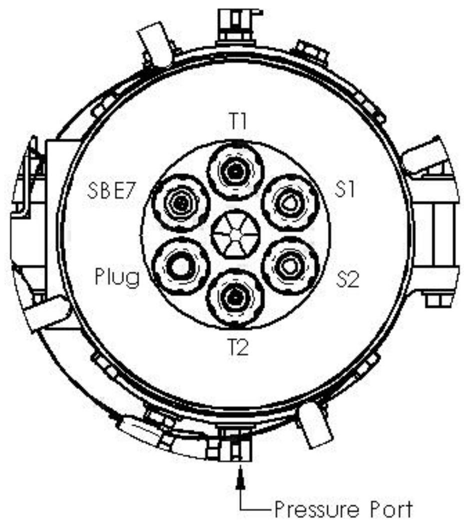


Figure 14: Typical microstructure sensor layout.

3. Gently install the nose cone onto the front bulkhead piston seal until it is fully seated. Install the sealing nut and tighten.
4. Install the probe holders and dummy stings. Make sure the o-rings and ferrules are properly oriented and seated (refer to Figure 15).

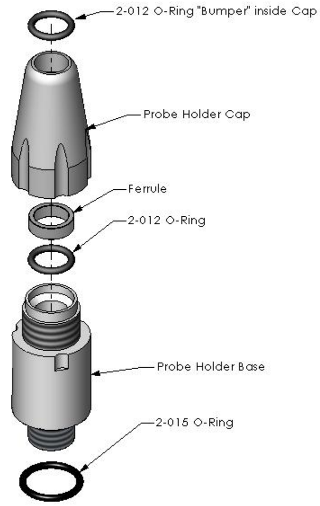


Figure 15: Probe Holder Assembly.

5. Slide the nose and electronics assembly into the pressure tube up to the o-ring on the front bulkhead.
6. Take the supplied plastic plate and place it over the rear threaded rod until it contacts the pressure tube. Use the supplied ¼-20 nut or the rear sealing nut to pull the nose and electronics assembly into the pressure tube as shown in Figure 16

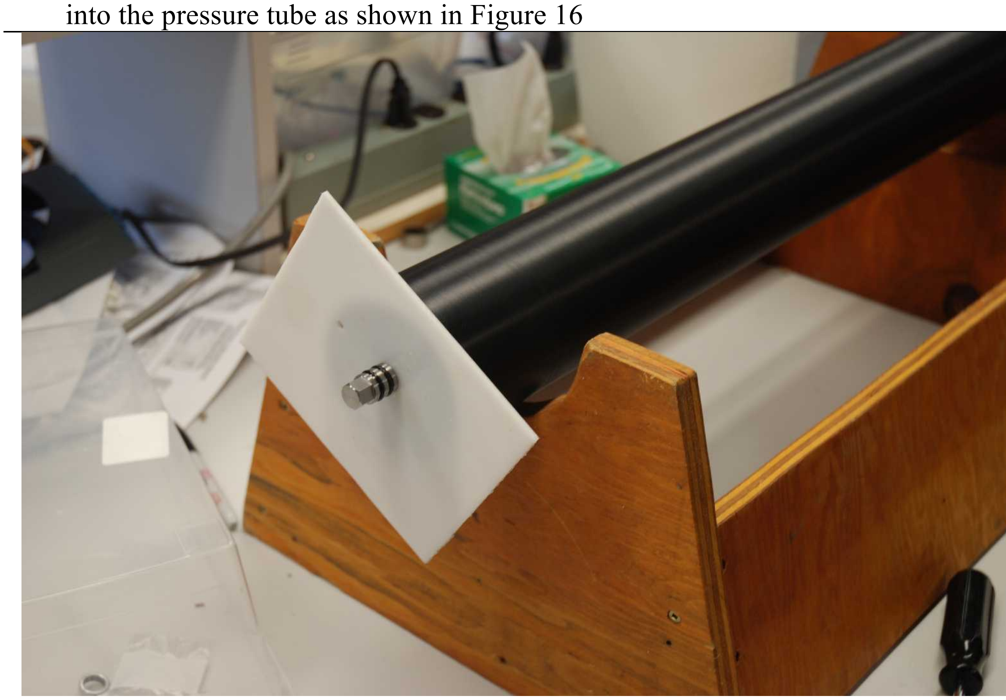


Figure 16: Using the plastic plate to pull the nose and electronics into the pressure tube.

7. Plug the rear bulkhead internal Molex connectors into the instrument connectors.
8. Insert the rear sealing nut into the bore on the rear bulkhead (this will ensure that it engages the threaded rod) and push the rear bulkhead into the pressure tube until the nut hits the threaded rod (about where the o-ring touches the pressure tube). Make sure the internal wires are not pinched.

9. Tighten the rear sealing nut to seat the rear bulkhead into the tube. For installation on the Teledyne Webb Slocum Glider make sure the pressure port on the front bulkhead is oriented in the vertical plane and at the top of the instrument. Then make sure that the two ¼-20 mounting holes on the rear bulkhead are horizontal and near the bottom of the instrument.

9 Preparation for Storage

1. Do the post-cruise maintenance.
2. Re-assemble the instrument in the reverse order of the assembly instructions.
3. Install the test probes and store the instrument in its shipping case in a clean dry environment.
4. Replace the Lithium CR123 battery on the Power Supply circuit board every 6 – 12 months.