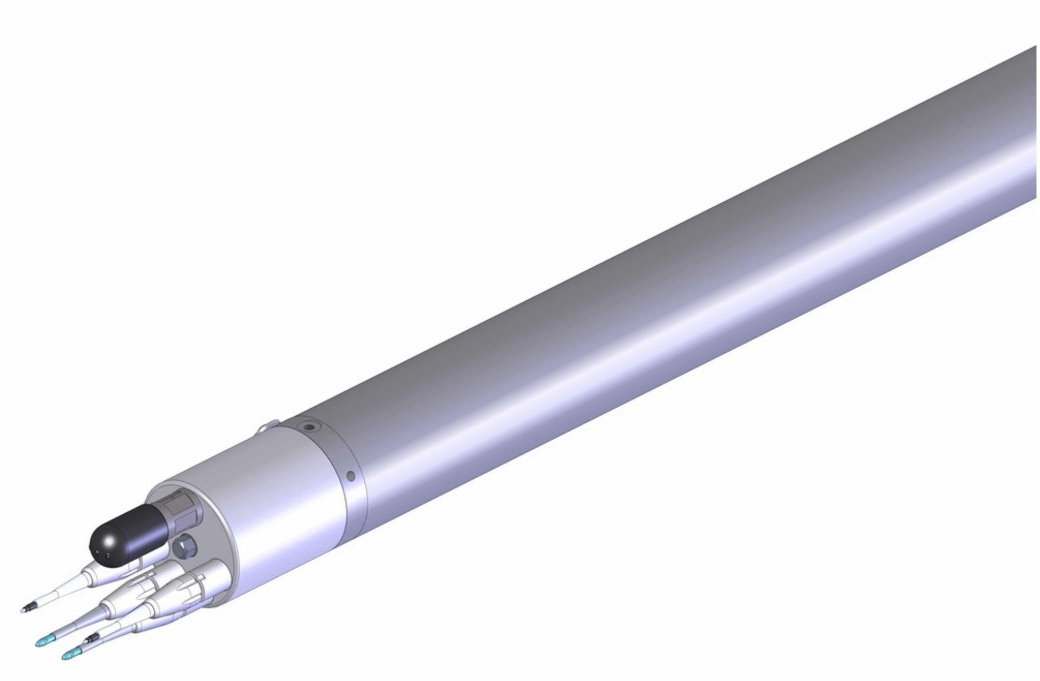


User Manual

MicroRider-1000-EM

PN 010-157-20

Revision 1.1

2021-01-07

Rockland Scientific International Inc.

520 Dupplin Road, Victoria BC V8Z 1C1 Canada

tel +1-250-370-1688
fax +1-250-370-1688
toll free 1-877-370-1688

e info@RocklandScientific.com
w www.RocklandScientific.com

info@rocklandscientific.com
tel: +1 250 370 1688

Contents

Revision History . . . 1
Warnings . . . 2
Limitations . . . 3
Contact Information . . . 3
1 Getting Started . . . 4
1.1 Receipt of Goods . . . 4
1.2 Several Months Before your Deployment (in the lab) . . . 4
1.3 Several Hours Before Deployment (on the ship) . . . 6
1.4 Several Minutes Before Deployment (on the ship) . . . 6
2 Overview of the MicroRider-1000 . . . 7
2.1 What is the MicroRider-1000? . . . 7
2.2 General Specifications . . . 8
2.3 Requirements . . . 10
2.4 Mechanical Systems Overview . . . 13
2.5 Electrical Systems Overview . . . 17
2.6 Software Systems Overview . . . 21
3 Assembly and Disassembly . . . 23
3.1 Installing Microstructure Probes . . . 23
3.2 Disassembling the Pressure Case . . . 27
3.3 Reassembling the Pressure Case . . . 33
4 Operations . . . 38
4.1 Turning the Instrument ON/OFF . . . 38
4.2 Connecting the Instrument to a Computer . . . 39
4.3 Performing an Electronics Bench Test . . . 44
4.4 Pre-Platform Checks . . . 45
4.5 Pre-Deployment . . . 46
4.6 Deployment . . . 47
4.7 Post-Deployment . . . 47
5 Maintenance . . . 48
5.1 Timelines . . . 48
5.2 O-Rings . . . 51
5.3 Sealing Surfaces . . . 53
5.4 Corrosion Prevention . . . 53
5.5 Probes and Sensors . . . 56
6 Troubleshooting . . . 60
6.1 Unable to turn the instrument on . . . 60
6.2 Cannot establish a connection to the instrument . . . 61

6.3 Data corruption . . . 61
6.4 Noisy data on microstructure channels . . . 62
6.5 Broken probes and sensors . . . 63
6.6 There are large vibrations in the spectra data . . . 63
Appendices . . . 65
A.1 Bench Test Checklist . . . 65
A.2 Pre-Deployment Checklist . . . 69
A.3 Configuration Files . . . 71
A.4 Log files . . . 76
A.5 TN 052 – Rockland Data Logger . . . 77
A.6 Spares Kit . . . 91
A.7 Outline Drawing . . . 93
A.8 Maintenance Drawing . . . 96
A.9 Impulse Connector Technical Bulletin . . . 99
Index . . . 107

List of Figures

1 MicroRider-1000 . . . 7
2 Coordinate System . . . 13
3 Sensors on the Front Bulkhead . . . 14
4 Vibration Sensors . . . 15
5 Test Probe . . . 15
6 Rear Bulkhead Connectors . . . 16
7 Electronics Block Diagram . . . 17
8 CR2032 Battery on Rockland Data Logger board . . . 19
9 Probe Holder Schematic . . . 23
10 Loosening a Probe Holder . . . 24
11 Removing a Probe . . . 24
12 Installing a Probe . . . 25
13 Tightening a Probe Holder . . . 25
14 Shear Probe Sensitivity . . . 26
15 Sensor Layout on the Nose Cone . . . 26
16 Removing the Sealing Nut . . . 27
17 Leverage to Remove the Rear Bulkhead . . . 27
18 Removing the Rear Bulkhead . . . 28
19 Separating the Pressure Tube . . . 28
20 Removing the Pressure Tube . . . 29

21 Nose Cone after Removal of Test Probes . . . 29
22 Loosening the Front Sealing Nut . . . 30
23 AEM1-G Wiring Inside Nose Cone . . . 31
24 Disassembly: Removing Probe Holders from the Nose Cone . . . 31
25 Removal of AEM1-G EM Current Meter . . . 32
26 Installing the AEM1-G on the Nose Cone . . . 33
27 Feeding SMC cables through the Nose Cone . . . 34
28 Nose Cone Sensor Layout . . . 34
29 Sliding the Nose Cone onto the Front Bulkhead . . . 35
30 Sliding Electronics into Pressure Tube using the Plastic Plate . . . 36
31 Tightening the Sealing Nut . . . 37
32 On/Off via the Deck Cable . . . 38
33 Connecting the Instrument to a Computer . . . 39
34 Connecting to the Instrument as a USB Mass Storage Device . . . 40
35 Viewing the Rockland Data Logger status with Zissou Essentials . . . 41
36 Zissou Essentials Home Page . . . 42
37 Connecting to the Instrument with Zissou Essentials (Step 1) . . . 42
38 Connecting to the Instrument with Zissou Essentials (Step 2) . . . 43
39 Maintenance: Removing Bulkhead Connector O-Rings . . . 52
40 Maintenance: Sealing Surfaces . . . 53
41 Maintenance: Corrosion of Pressure Tube . . . 55
42 Maintenance: Corrosion of an SMC Connector . . . 55
43 Maintenance: Applying Grease to an Underwater Connector . . . 56
44 Maintenance: Shear Probe . . . 57
45 Maintenance: FP07 Thermistor . . . 58
46 Troubleshooting: Checking the Input Fuse . . . 60
47 Troubleshooting: Checking the R1 Fuse on the Power Supply Board . . . 61
48 Modifying Connections on the ASTP Board to Diagnose Noise . . . 63

List of Tables

1 General Specifications . . . 8
2 Sensor Specifications . . . 9
3 Required Tools . . . 10
4 Recommended Tools . . . 11
5 Recommended Technical Notes . . . 12
6 Maintenance Supplies . . . 48

7 O-ring Specifications 51
8 Description of Log File Entries 76

Revision History

Revision	Date	Description
1.0	2020-12-17	First version for Rockland Data Logger (RDL) systems
1.1	2021-01-07	Updated required software. Other minor corrections.

Warnings

Symbol Description

Throughout the manual, symbols and colours are used to highlight important information. This information is categorized as follows:

Information that is *critical* to the safety of the user.

Information that *improves* the performance of the instrument and the quality of the data.

Information that is *helpful*.

Pressure buildup due to flooding of nose cone

For instruments that have a nose cone – such as the MicroRider-1000 – flooding of the nose cone may cause it to become pressurized. If you suspect the nose cone has been flooded during deployment, exercise caution as it may be under pressure when recovered. It is important to release the pressure safely by **slowly** backing off the sealing nut in the center of the nose cone. This will release the pressure near the front bulkhead. Please take precaution when opening the pressure case.

Do not remove probes before releasing pressure and do not stand in front of probes as the pressure is released.

Limitations

This oceanographic instrument is a complex piece of equipment and is equipped with sensitive (and delicate) sensors. It is the user's responsibility to be familiar with the instrument's capabilities and limitations. This instrument manual assumes that the user has already received appropriate training on the usage of the instrument, reducing the risk of damage incurred to your instrument during its operation.

In addition, the quality of the measurements obtained with the instrument is directly affected by your operation of the instrument and by your level of care and maintenance.

Before processing the data acquired by your instrument, it is also assumed that you have sufficient knowledge of the fundamentals of the sensors equipped on the instrument as well as the theory of turbulence measurements.

Contact Information

Rockland Scientific is committed to enabling science by helping our customers obtain high quality data and have successful deployments of our instrumentation.

If you are uncertain about any aspect of operations, handling, sensor installation, data processing and configuration, please contact Rockland Scientific. We provide an array of technical training courses and workshops. We are always happy to assist you.

For support, including emergencies, contact us via:
- Email: support@rocklandscientific.com
- Phone: 250-370-1688 (9am - 5pm, Pacific Time)

1 Getting Started

The MicroRider-1000 is an instrument for measuring turbulence microstructure, designed to integrate with a variety of marine instrumentation platforms, such as gliders, AUVs, moorings, CTD rosettes, and profiling floats.

The following guide provides the basic information to prepare your instrument for deployment, but it – in no way – serves as a replacement for the detailed content contained within this manual. The recommendations and proposed timelines below are only suggestions, due to the variability of cruise preparations and the nature of your research.

> *i* It is expected that any user of the MicroRider-1000 is familiar with the operation of the instrument. If you have any questions about this instrument or the content contained within this document, please contact Rockland Scientific.

1.1 Receipt of Goods

Immediately after you receive your instrument, you should:

1. Inspect all equipment for possible damage incurred during shipping. 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. Check the contents of the shipping case(s) against the packing list. Confirm that all items on the list are in the case(s) to ensure you have received all items ordered.
3. Confirm that you have received the tools/equipment for operating the instrument (Section 2.3.2).
4. Confirm that you have received a kit that includes spare components (i.e. O-rings, fasteners) for your instrument (Section A.6).
5. Conduct an electronics bench test (Section 4.3).

If there are any concerns with the items listed above, please contact Rockland Scientific.

> *i* Inspect your instrument **as soon as possible** to maximize the time between the receipt of goods and your scheduled field work. It may take some time to resolve any issues.

1.2 Several Months Before your Deployment (in the lab)

We recommend that you inspect and communicate with your instrument at a **minimum of three months** in advance of your cruise because instrument repairs, if necessary, can often take several weeks. The following recommendations are *critical for instruments that have* *been stored for prolonged periods*, but should also be carried out for new instruments:

1. **Check the mechanical integrity of your instrument:**
   - Disassemble your instrument (Section 3.2) and inspect all components for evidence of bio-fouling, corrosion, and physical damage.
   - Inspect the O-rings (Section 5.2) and sealing surfaces (Section 5.3). Replace your O-rings annually or before every cruise.
   - Inspect all anodes and replace worn anodes (Section 5).
2. **Check and/or replace batteries:**
   - Check the recommended replacement date labelled on the CR2032 battery (Section 2.5.7 and Figure 8), and replace if necessary.
3. **Gather and inspect probes:**
   - Ensure that you have enough probes for your upcoming deployment. Probes are fragile and we recommend having a few spares on board.
   - Check the calibration dates of your probes (refer to the Calibration Certificates). We recommend that FP07s be calibrated *in-situ*[1] and that shear probes are calibrated annually at Rockland's facility.
   - Shear probes: Inspect for signs of damage (Section 5.5.1) and, if possible, review the most recent data acquired with sensor to confirm it was functioning properly.
   - FP07 themistors: Verify that the tiny sensing tip is intact (Section 5.5.2), and, if possible, review the most recent data acquired with this sensor to confirm that it was functioning properly.
4. **Establish communication with your instrument:**
   - Connect your instrument to a computer (Section 4.2). If possible, use the laptop(s) you plan to use during the deployment.
   - Check and update your `setup.cfg` configuration file (Refer to Section A.3).
   - Perform a bench test (Section 4.3).
5. **Gather the required equipment and documentation:**
   - Assemble the suggested tools (Section 2.3.2).
   - Check your spares kit and ensure that it has all necessary supplies (Section A.6).
   - Download the relevant documentation, drivers and software (Section 2.3.1) to your field computer. You may not have high bandwidth internet access in the field.
   - If shipping your instrument to the deployment or field site, ensure that you have proper documents for transit.

[1] See Technical Note 039 for details of *in-situ calibration*

1.3 Several Hours Before Deployment (on the ship)

Assuming your instrument is in good working order, proceed with the following deployment preparations:

1. Connect the instrument to your computer (Section 4.2).
2. Verify the contents in the configuration file, `setup.cfg`, match the configuration of the instrument. (Refer to Section A.3).
3. Complete an electronics bench test (Section 4.3).
4. Inspect the O-rings and sealing surfaces (Section 5.2 and Section 5.3).
5. Discuss the ship operations with the captain and crew (Section 4.5.2).

1.4 Several Minutes Before Deployment (on the ship)

1. Confirm mechanical integrity of all components:
   (a) Sealing nut is tightened to 25 in · lb (Section 3.3).
   (b) Connectors on rear bulkhead are tightened.
   (c) There are no loose components that could cause unwanted vibrations.
2. Install the microstructure probes into the correct probe ports (Section 3.1).
3. Record the serial numbers of the probes in your deployment notes (Figure 14).
4. Turn the instrument on (Section 4.1).

⚠ A detailed pre-deployment checklist is provided in Section 4.5.1.

2 Overview of the MicroRider-1000

2.1 What is the MicroRider-1000?

The MicroRider-1000 is an instrument for measuring turbulence microstructure, designed to integrate with a variety of marine instrumentation platforms , such as gliders, AUVs, moorings[2], CTD rosettes, and profiling floats. The MicroRider-1000 carries an array of turbulence sensors and supports simultaneous logging of external sensors. Electromagnetic (EM) current sensors and high-accuracy CTD sensors are available as optional upgrades.

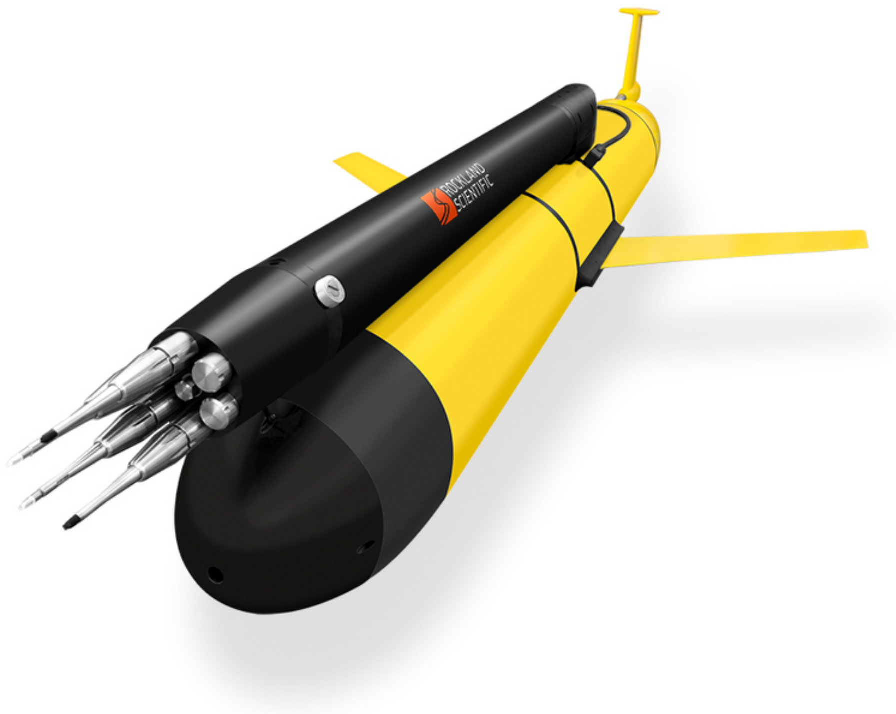


Figure 1: MicroRider-1000 mounted on a glider. Optional EM current meter not installed.

[2]Please inquire with Rockland Scientific for support when planning integrated stationary moored deployments

2.2 General Specifications

2.2.1 Instrument Specifications

The basic specifications of the instrument are summarized in Table 1. Refer to Section A.7 for the Outline Drawing. All specifications are subject to change without notice.

Table 1: General Specifications

Model	MicroRider-1000-EM
Depth Range	0–1000 m (6000 m optional)
Weight in Air/Water	5.5 kg / 0.0 kg
Housing Length/Overall Length	0.88 m / 1.11 m
Sampling Rate	512 Hz / 64 Hz (fast channel / slow channel) *up to 2048 Hz available*
Data Acquisition	Internally Recording
Data Storage	Up to 2100 hours of data with a 64 GB card *based on continuous sampling, 8 columns in the address matrix* (Section 2.5.8)
Power Consumption (Nominal)	2.2 W

2.2.2 Configuration and Sensor Specifications

The MicroRider-1000 includes several sensors that measure (i) the turbulent properties of the flow, (ii) the physical characteristics of the water, and (iii) the performance of the instrument. The specifications of the sensors and the quantity included with your instrument are summarized in Table 2. Optional sensors are also listed, but changes to the electronic boards may be required to use these sensors. **Please contact Rockland Scientific before modifying the configuration of your instrument.**

Notes:
- Other bandwidths are available upon request.
- Higher accuracy CT temperature calibrations are available upon request.
- To calibrate the FP07 thermistor, we recommend performing an *in situ* calibration which is outlined in Technical Note 039. Upon request, Rockland can perform a 3-point calibration using a WOCE quality, pumped CT sensor accurate to 0.005°C.

Table 2: Sensor specifications and instrument configuration.

Quantity	Sensor	Parameter Measured	Range	Accuracy	Resolution	Bandwidth
1	**PA-10L**	pressure	0–100 bar	0.1 % of FS	5×10^{-4} bar	0–2.5 Hz
1	**inclinometer**	instrument tilt	Dual Axis, ±90 °	0.1 °	0.015 °	
2	**piezo-accelerometer (1-axis)**	instrument vibrations	±1 g	2 %	3×10^{-3} g	0.1–100 Hz
2	**Shear Probe**	velocity shear	0–10 s^{-1}	5 %	10^{-3} s^{-1}	0.1–100 Hz
1	**FP07**	temperature	−5–35 °C	0.005 °C	10^{-5} °C	0–25 Hz
1	**AEM1-G**	1-D axial velocity	0–500 cm s^{-1}	0.5 cm s^{-1} or 2 % of full scale	0.01 cm s^{-1}	0–5 Hz
Optional	**SBE4C**	conductivity	0–70 mS cm^{-1}	0.003 mS cm^{-1}	0.004 mS cm^{-1}	
Optional	**SBE3F**	temperature	−5–35 °C	0.001 °C	0.0001 °C	n/a

2.3 Requirements

Proper use of the MicroRider-1000 requires additional software, tools, equipment and documentation that are summarized below.

2.3.1 Minimum Required Software and Documentation

Instrument communication requires:

- Computer with USB Support
- At least one USB Type-A connection

Data analysis with Zissou Essentials requires:

- PC running Windows 10 (or newer) or macOS High Sierra 10.13.6 (or newer)
- 64-bit Operating System

Data analysis with Matlab requires:

- MATLAB 8.4 (R2014b) or newer

The following additional software and documentation is supplied by Rockland Scientific:

- Zissou Essentials (stand-alone software for data visualization)
- ODAS MATLAB Library (Matlab based software for data visualization and processing)
- ODAS MATLAB Library User Manual

2.3.2 Minimum Required Tools

The MicroRider-1000 is shipped with a tool kit that contains all the necessary tools for assembly, disassembly and maintenance of your instrument. This tool kit is summarized in Table 3.

Table 3: Minimum Required Tools (supplied by Rockland)

Tools	Description/Size	Application/Use	Qty
Wrench	Custom Rockland wrench	Probe Holder	1
Torque Wrench	25 in · lb 1/4” drive	Sealing Nut	1
Deep Socket	1/2 inch 1/4” drive	Sealing Nut	1
Wrench, Adjustable	0-1 inch (0-25 mm)	Bulkhead Connectors	1
Crowfoot Wrench	1/2-inch size, 3/8-inch drive	EM Sensor	1
Socket Extender	6-inch length, 3/8-inch drive	EM sensor	1
Extender to wrench adapter	3/8-inch square bar, 2-inch length	EM sensor	1

2.3.3 Recommended Tools

A list of tools that are recommended by Rockland are summarized in Table 4.

Table 4: Recommended Tools (not supplied by Rockland)

Tools	Description/Size	Application/Use	Qty
Vulcanizing (Self-Fusing) Tape	EPR Rubber	Repairing underwater cables	1
Multi-meter	Fluke(R) Digital Multi-meter	Electrical diagnostics	1
Wire Cutting Pliers	Side Cutting	Cutting Cable Ties, Waxed Lacing	1
Waxed Lacing Tape		Tying down Wiring Harnesses	1
Screwdriver, Phillips	Size #1	Circuit Board Screws	1
Screwdriver, Slot-ted	1/2-inch	Anode Assembly Screw (if applicable)	1
Wrench	1/4-inch	Circuit Board Standoffs, SMC Connectors	1
Aluminum Foil	Roll	Electromagnetic Shielding	1
Electrical Tape	Roll	General use	1
Duct Tape	Roll	General use	1
Compressed Air	Canister	Cleaning components	1
Isopropyl Alcohol	Small Bottle	Cleaning components	1
Kimwipes	Soft, lint-free tissue	Cleaning o-rings/sensitive equipment	1
Heat Gun	Weller 6966C	Heat shrink tubing	1

2.3.4 Additional Reading

Table 5 contains a list of technical notes useful for understanding how the MicroRider-1000 measures turbulence data, as well as information for data processing using Rockland's software products. These technical notes are available for download from the "Technical Notes" section of Rockland's website www.rocklandscientific.com.

Table 5: Recommended Technical Notes

Note	Description
TN 002	**Digital Signal Processing to Enhance Oceanographic Observations** A paper explaining the theory behind using signal pre-emphasis on critical channels to maximize the signal-to-noise ratio.
TN 005	**Converting Shear Probe, Thermistor and Micro-Conductivity Signals into Physical Units** Gives a detailed explanation of how raw counts are converted to physical units.
TN 010	**Design and Optimization of Anti-aliasing Filters** Gives a detailed explanation of the filtering required for ocean turbulence measurements to produce sampled data that is free from aliased components.
TN 011	**Serial Instrument Bus Protocol** Explains how digital data is transferred within the instrument. Useful only to those wanting deeper knowledge of the workings inside of the instrument.
TN 015	**Modeling the Spatial Response of the Air Foil Shear Probe Using Different Sized Probes** A paper describing the wave number response of the shear probe.
TN 022	**Turbulence Measurements from a Glider** A paper describing the intitial measurements made using a Slocum glider. Relevant content for all glider users.
TN 028	**Calculating the rate of dissipation of Turbulent Kinetic Energy (TKE)** Describes the algorithm used to compute the rate of dissipation of TKE from the shear measured with an air-foil type shear probe.
TN 039	**A Guide to Data Processing** A guide to using the ODAS Matlab library to process Rockland Scientific data files, including how to perform an *in situ* calibration of the FP07 thermistor using data from a Sea-Bird CT or JFE Advantech CT sensor.
TN 040	**Noise in Temperature Gradient Measurements** Provides a method for estimating the noise in measurements of the gradient of temperature fluctuations obtained with a Rockland instrument.
TN 042	**Noise in Shear Probe Measurements** Provides a method for estimating the noise in measurements of the velocity shear obtained with a Rockland instrument.
TN 044	**MicroRider Proglet for a Slocum glider** Provides a guide for setting up the MicroRider Proglet on G1 and G2 Slocum Gliders using TWR Glider Software version 8.0 and higher.
TN 046	**RSI Inclinometers** Describes the functionality of the inclinometer in Rockland instruments.
TN 047	**Why Calibrate the FP07 Thermistor?** Describes the reasons for and against calibrating the FP07 thermistor.
TN 048	**Interpreting the Results of Calibrate All** Provides a guide to interpreting the results of the `cal -all` function for common instrument channels found on standard Rockland Instruments
TN 051	**Rockland Data File Anatomy** Describes the anatomy and format of Rockland `.P` data files
TN 052	**Rockland Data Logger (RDL)** Gives an overview of the Rockland Data Logger and describes differences between RDL and CF2 Persistor systems

2.4 Mechanical Systems Overview

This section gives an overview of the mechanical components of the MicroRider-1000. Details of the operations – including assembly and disassembly of the instrument – can be found in Section 3.

2.4.1 Coordinate System

For **horizontal, or quasi-horizontal, profiling** (e.g. on a glider), the coordinate system (Figure 2) of the MicroRider-1000 is as follows:

- x-axis: Along the axis of the pressure case, positive forward.
- y-axis: Defined as horizontal, positive in the "port" direction
- z-axis: Through the pressure port and hence, nominally vertical, positive upward.

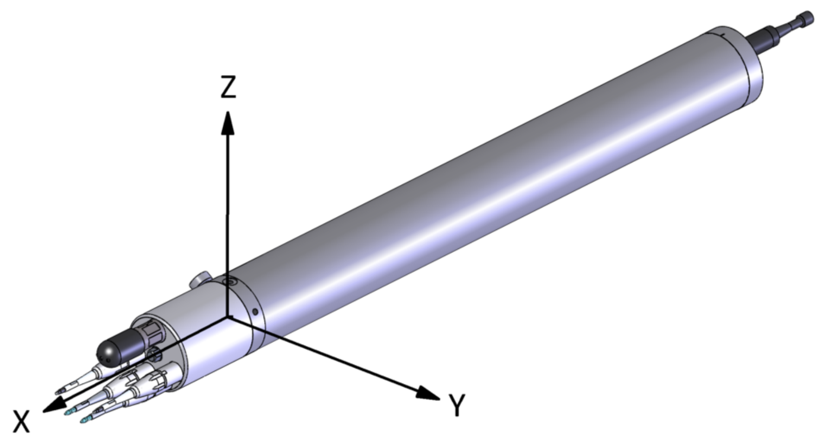


Figure 2: Coordinate System

For **vertical profiling** (e.g. on a WireWalker), the coordinate system is rotated such that the axes definitions are as follows:

- x-axis: Through the pressure port, positive away from the instrument body (i.e. +Z in Figure 2)
- y-axis: Defined as horizontal, positive in the "port" direction (same as for horizontal profiling, i.e. +Y in Figure 2)
- z-axis: Along the axis of the pressure case, positive upward from the front bulkhead to the rear bulkhead (i.e. -X in Figure 2)

2.4.2 Sensors

The nose cone of the MicroRider-1000 contains the microstructure probes and the EM current meter (Figure 3). The specifications for each sensor are detailed in Table 2.

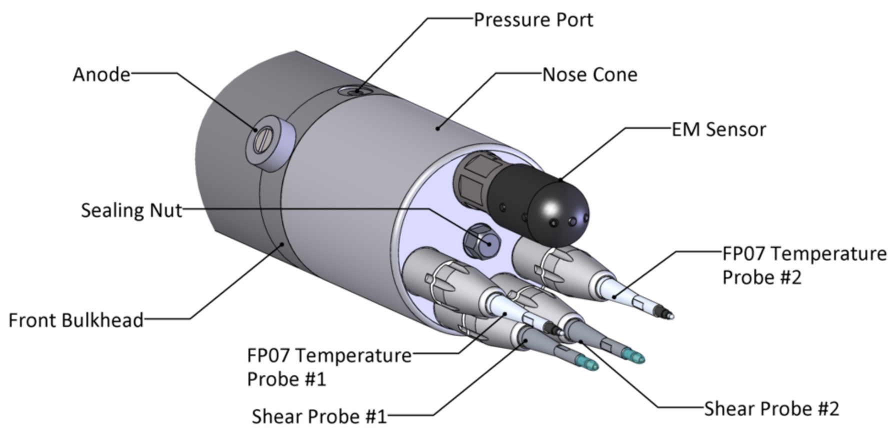


Figure 3: MicroRider-1000 Sensors

Up to four microstructure probes (shear, FP07) can be installed on the nose cone in probe holders. The probes are electrically connected to the instrument electronics via SMC coaxial cables. Typically the instrument is configured with electronics that support two shear probes and two FP07 fast response thermistors. Test probes (Section 2.4.3) can be installed in place of real probes if the measured signals are not desired.

The JAC AEM1-G electromagnetic (EM) current meter is manufactured by JFE Advantech. The EM sensor is installed on the nose cone of the MicroRider-1000 and measures the mean water velocity in one dimension as it flows over the sensor. The electromagnetic field generated by the AEM1-G induces noise into the shear and temperature probes, thus its orientation and the relative orientation of the microstructure probes is very important (See Section 3.1).

Two vibration sensors are installed on a mounting block that is located inside the instrument (Figure 4). Each vibration sensor is a piezo-accelerometer that is fixed in position and cannot be adjusted or removed. The vibration sensors are alternating current (AC) sensors and are treated like shear probe channels. Their primary purpose is to sense the vibrations of the instrument in the y- and z-directions (Figure 2). Common-mode vibrations measured by both the vibration sensors and the shear probes (such as vibrations induced from the instrument) can be removed from the shear signals during post-processing of the data.

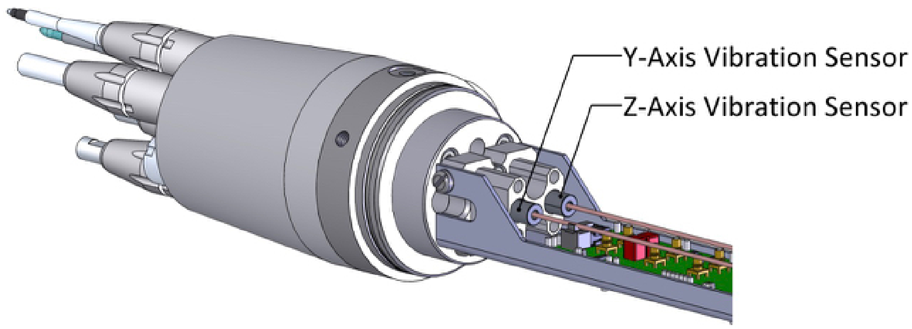


Figure 4: Vibration Sensors

There is also a 2-axis tilt sensor installed on the power supply board that is located inside the instrument. The sensor measures the DC and low-frequency response to tilting and has an accuracy of $\pm 0.1°$ over the oceanic temperature range. For the MicroRider-1000, the inclinometer measures the rotation about the x-axis (roll) and y-axis (pitch), where the axes are defined in Figure 2.

2.4.3 Test Probes

Test probes (Figure 5) are used as place holders for real microstructure probes. They can be used during deployments if measurements are not desired on a particular channel, and should **always** be used when storing or shipping your instrument, and when performing an electronics bench test (Section 4.3). The test probes have internal electronics that bring measured values to approximately mid-scale. More specifically, the temperature and conductivity test probes have internal termination resistors whereas, shear test probes are un-terminated.

> It is good practice to **install test probes into the correct ports**. It is *necessary* during an electronics bench test, and optional otherwise.

Figure 5: Test probe with an SMC connector.

2.4.4 Rear Bulkhead

Located on the rear bulkhead of the instrument are the following components (Figure 6):

- A sealing nut for installation or removal of the rear bulkhead to access the internal components.
- A MCBH-4-MP connector which provides the USB connection to the deck cable.
- A MCBH-8-FS connector which provides the connection to the mounting vehicle.
- An active aluminium anode to help prevent corrosion to the external metallic components on the MicroRider-1000.[3]
- A spare port for auxiliary sensor connections.

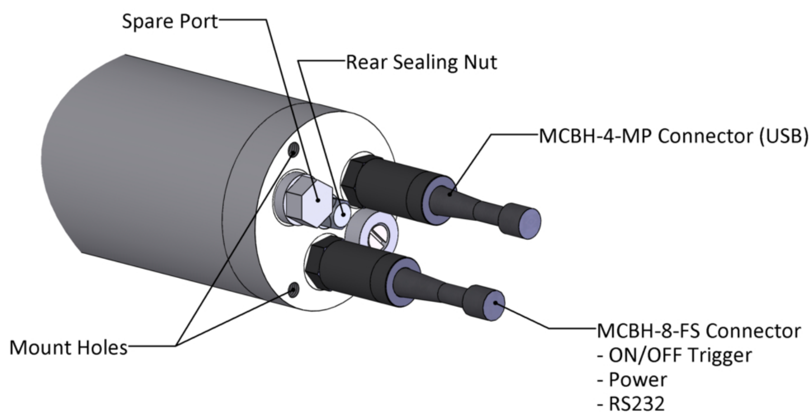


Figure 6: Rear Bulkhead

[3] A blog post pertaining to the aluminium anode and general corrosion prevention can be found here: https://rocklandscientific.com/support/corrosion-prevention-anodes-nail-polish-continuity-checks/

2.5 Electrical Systems Overview

The electrical system that is present within the MicroRider-1000 is designed to take the signals measured by the sensors and transmit them to the Rockland Data Logger where the data acquisition is controlled.

The system block diagram is shown in Figure 7 and each of the components are described in the following subsections.

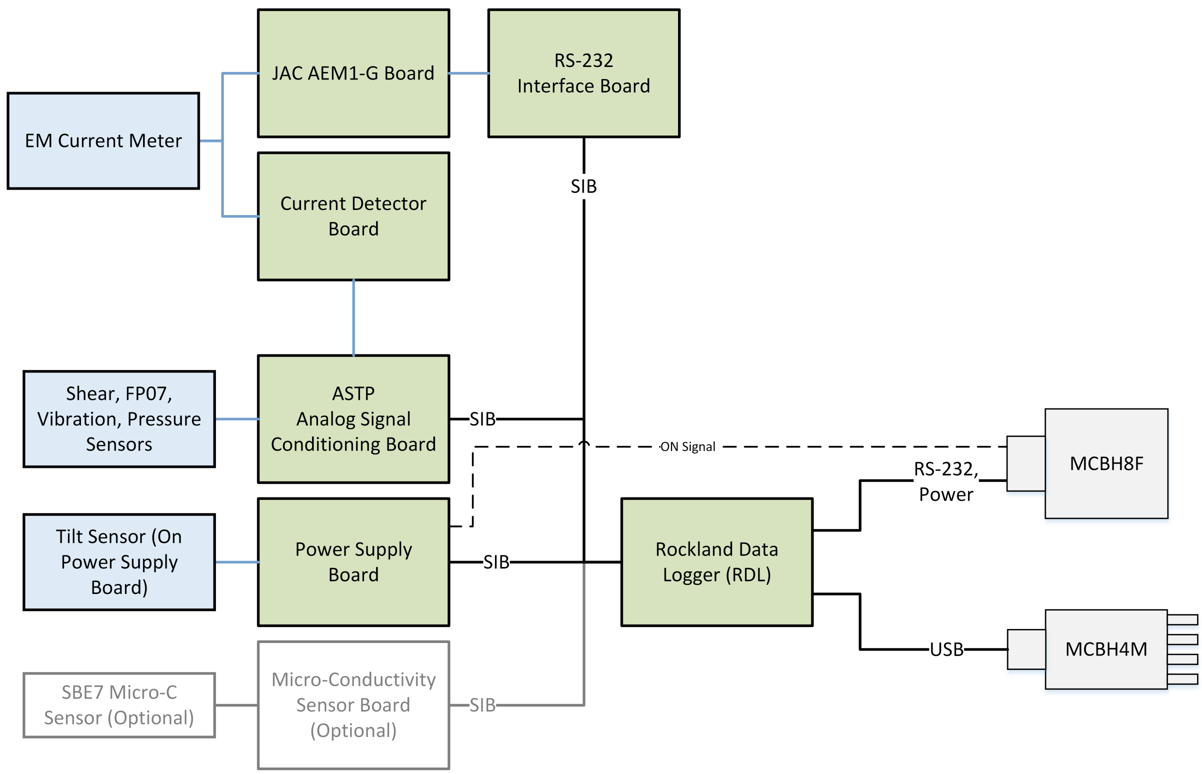


Figure 7: Instrument sensor and electronics system block diagram

2.5.1 Serial Instrument Bus (SIB)

Data is conveyed over a serial "bus". In Rockland instruments, it is called the serial instrument bus (SIB). The SIB is a 14-conductor ribbon cable connecting circuit boards (Figure 7). Its conductors are used for the distribution of power, clocking signals, addresses (request for data) and for the data itself. Details are given in Technical Note TN-011.

2.5.2 ASTP Analog Signal Conditioning Board (P049)

The analog signal conditioning (ASTP-LP) board supports two 1-axis piezo-accelerometers (vibration sensors), two shear probes, two FP07 thermistors, and a pressure transducer. This board is the heart of the data acquisition system and it is extensively calibrated and tested for noise.

Each instrument is supplied with a calibration certificate documenting the performance of this board.

The ASTP-LP board also provides anti-aliasing filtering. The microstructure and vibration sensor signals are low-pass filtered at 101 Hz, and the pressure signal is low-pass filtered at 5 Hz.

The data are sampled at 512 Hz for the “fast” micro-structure signals and at 64 Hz for the other “slow” channels. The numeric assignment of the signal channels is detailed in Technical Note 039.

Analog to digital conversion of the data is done using an ultra-linear, extremely low-noise 16-bit analog-to-digital converter.

2.5.3 JAC AEM1-G Board (KP-1435)

The JAC AEM1-G board is provided by JFE Advantech Co. electronics and is designed to work with the AEM1-G EM Current Meter. The board supplies a square wave excitation to the magnetic coil inside the sensor head to generate the magnetic field. The AEM1-G EM board also receives the voltage induced due to the water flow and generates a DC voltage by demodulating and filtering the received signal. The analog signal is then digitized and further processed into an RS232 data stream in ASCII format for data acquisition with the RS232 interface board.

2.5.4 Current Detector Board (P091)

The Current Detector board measures the current through the coil inside the AEM1-G EM sensor, which is linearly related to the magnetic field that the EM sensor generates. This signal is output as an analog signal to the ASTP board and is used during data processing to remove noise generated by the electromagnetic interference of the EM sensor that affects the microstructure measurements.

2.5.5 RS232 Serial Interface Board (P090)

The RS-232 Serial Interface board converts either RS232 or UART serial output from external sensors (i.e. Rinko-FT Dissolved Oxygen, AEM1-G Current Meter), to the Serial Instrument Bus (SIB). This board also takes the raw voltage output from the power supply board and converts it to the voltage required by the external sensor.

2.5.6 Rockland Data Logger (RDL) board (P113)

The Rockland Data Logger (RDL) board runs a Linux operating system and handles the data acquisition.

The internal processor on the board controls the data acquisition using information contained in a configuration file (`setup.cfg`), which is a plain text file that can be edited to change certain aspects of the data acquisition, such as which channels to record and at what rate. See

Section A.3 for more information.

The Rockland Data Logger board handles all communication of data samples using the Serial Instrument Bus (SIB). The board works closely with the power supply board to provide graceful shutdown of the instrument after it is signalled to turn off. Additionally, the RDL board has a supercapacitor to provide enough energy to ensure that the data logging can shutdown properly in the event of power loss. Interactions with the RDL are done using the USB connection provided by the deck cable. This provides USB Mass Storage capability for file transfer (Section 4.2.1) and basic interaction with the instrument using Zissou Essentials (Section 4.2.2).

The Rockland Data Logger board also carries a 3V CR2032 lithium battery (Figure 8). The CR2032 battery maintains the onboard Time of Day clock.

> The CR2032 battery has a life of several years. Rockland recommends replacing every 4 years.

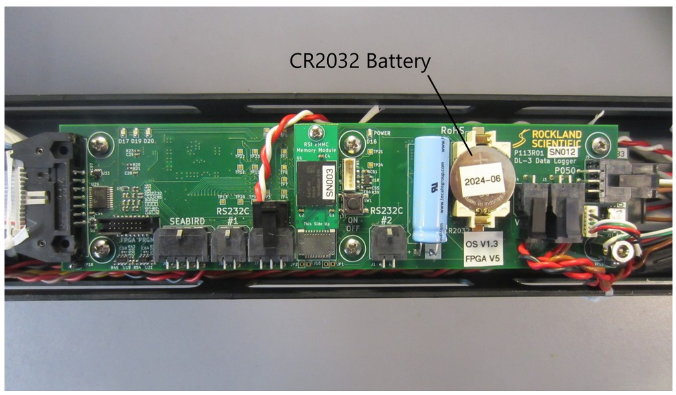


Figure 8: CR2032 Battery on Rockland Data Logger board

2.5.7 Power Supply Board (P050)

The power supply board provides an isolated +5 VDC power rail to all analog components, a 3.3 VDC rail for all digital components, and provides "raw power" equal to its input voltage (i.e. from an internal battery, or external source), less 1 V for optional equipment (i.e. JFE Advantech circuit boards, micro-conductivity board). The power supply board measures the raw input voltage and it is recorded by the data acquisition system (typically named `V_Bat`).

The power supply board monitors the ON/OFF switch. Shortly after the instrument is turned on, it will start recording a new data file. Shortly after the instrument is instructed to turn off, it will terminate data acquisition, close the data file and signal to the power supply board that it is safe to turn the instrument off. While the instrument is off, it draws no power from the main battery.

The power supply board also carries the 2-axis inclinometer.

2.5.8 Data Storage

Data acquired by the instrument are recorded internally on a proprietary RDL Memory Module that can be mounted on a computer as the RDL USB Drive (Section 4.2.1). The rate of data recorded is approximately:

$$\textit{Data Rate}\ [\textit{bytes}/s] = \textit{columns in address matrix} \times 2\ [\textit{bytes}/\textit{column}] \times \textit{Sampling Rate}\ [\textit{Hz}]$$

For the MicroRider-1000, with a typical address matrix of 8 columns and a sampling rate of 512 Hz, this works out to just greater than 8 kB/s. In this configuration, a 64 GB RDL Memory Module would allow for approximately 2100 hours of recorded data.

> Use your address matrix and sampling rate to get a more exact estimate of the expected data storage. Ensure there is sufficient free space on your CF card before any deployment.

2.6 Software Systems Overview

2.6.1 Data Acquisition and Data Download

The MicroRider-1000 acquires data with the custom Rockland Data Logger board (P113) using the data acquisition software. The data acquisition is controlled using the configuration file `setup.cfg`. For more information, refer to Section A.3.

The MicroRider-1000 is configured to launch data acquisition after power is connected, the instrument is turned ON (Section 4.1), and the Rockland Data Logger completes its boot up sequence (∼40 seconds). Data acquisition is stopped when the instrument is turned OFF.

> Note: The instrument will not log data if the instrument is connected to a computer and the Rockland Data Logger is connected as a USB Mass Storage device (Section 4.2.1).

To transfer the data files to your computer, connect to the MicroRider-1000 (Section 4.2) and transfer the data files as you would to/from a USB Drive.

The Zissou Essentials software package[4] can be used to interact with the Rockland Data Logger and perform basic tasks (Section 4.2.2). More specifically, the software can be used to:

- Retrieve the version numbers of the software, firmware, and operating system (OS)
- Check the battery voltage
- Set the instrument clock
- Review the instrument log file
- Determine the free space on the RDL USB Drive
- Check for warnings or errors
- Display channel statistics from a specific record in a previously recorded datafile.

2.6.2 Data Viewing and Processing

The Zissou Essentials software package can be used to convert the data to physical units and to inspect the data with simple visualization tools. It is a stand-alone package that does not require any additional software and it is common to all instruments made by Rockland Scientific. The software allows you to:

- analyze bench test data collected with test probes
- convert P files to MATLAB format
- convert acquired data to physical units
- visualize data for a customized range of interest

[4] Version 1.6 released November 2020

- calibrate FP07 thermistors using in-situ CTD data
- compute spectra for a segment of data and estimate the rate of dissipation for the chosen range

To obtain the latest version of Zissou Essentials, email support@rocklandscientific.com.

Alternatively, the ODAS MATLAB Library[5] of functions can be used for more comprehensive data viewing and processing. The library provides all the basic functionality included in Zissou Essentials (i.e. listed above), and also has the following advanced features:

- automated profile selection
- advanced despiking visualization tools
- calculation of the rate of dissipation of turbulent kinetic energy over an entire profile
- simple visualization of a series of spectral estimates
- calculation of quality control metrics for the spectra and dissipation rates

Further information on the use of the ODAS MATLAB Library can be found in Technical Note 039: “A Guide to Data Processing” . The technical note, the latest version of the library and its User Guide can be obtained my emailing support@rocklandscientific.com.

[5]Version 4.4 released July 2019

3 Assembly and Disassembly

The following subsections outline assembly and disassembly of your MicroRider-1000. This information is critical for deployment preparations, instrument maintenance (Section 5) and troubleshooting (Section 6).

> The MicroRider-1000 is shipped fully assembled with test probes. To prepare the instrument for deployment, connect the instrument to power, mount it on the vehicle and install the microstructure probes. Refer to Section 1 for more details on getting started with your instrument.

3.1 Installing Microstructure Probes

Each of the microstructure probes on the MicroRider-1000 are retained using a probe holder, and sealed using a ferrule and several O-rings (Figure 9). Before removing or installing probes, place the instrument on a stable platform such that it is fully supported and cannot roll.

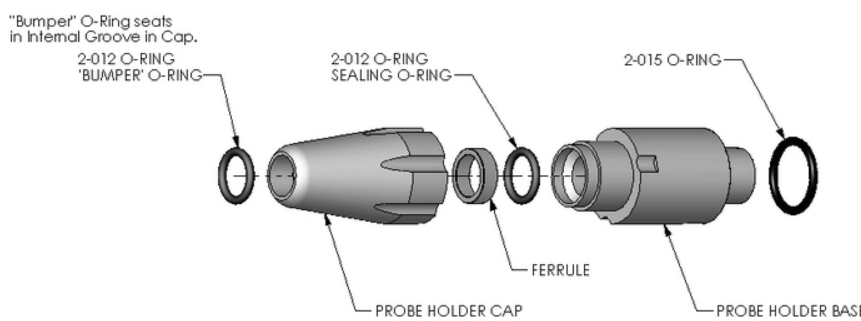


Figure 9: Probe holder assembly (exploded view of probe holder).

> The position of the ferrule and the O-rings is critical to maintain the seal and prevent water from entering your instrument.

To remove a probe (either a real sensor or a test probe):

1. Loosen the probe holder cap using the probe wrench (Figure 10). Usually a half to three-quarter turn (counter-clockwise) is enough. You do not need to fully remove the cap.

Figure 10: Loosening the probe holder using the custom probe wrench.

2. Remove the test probe by pulling on it until the label on its SMC cable is visible (Figure 11). **A gentle pull is all that is required.** Pulling with higher force or a distance beyond the label could cause damage to the cable.

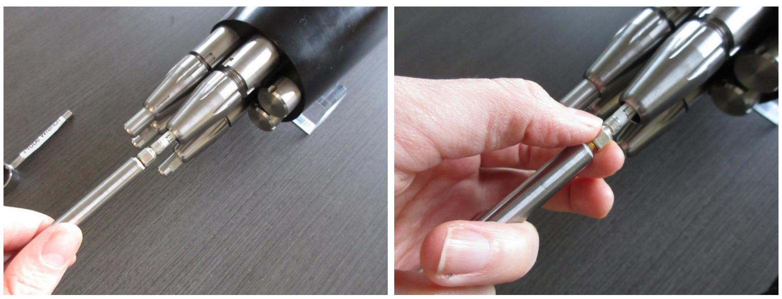


Figure 11: Removing the test probe. Note the clear heat shrink tubing around the SMC connector.

3. Disconnect the SMC cable and leave it hanging out of the probe holder. Please note that the test probes are labelled (S1, S2, T1, T2) and these identifications must match the tags on the SMC cables attached to the probes.

> ⚠ When tightening or loosening an SMC connector, rotate either the probe or the end of the connector while preventing the cable from rotating. Twisting the cable will damage the cable and connector over time.

4. 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. **Damaged heat shrink must be replaced.** Detailed instructions are provided in Technical Note 023 and in a blog post[6]. Also check for any tarnishing, corrosion or biofouling on the cable, around the connector, or beneath the label (Section 5.4.2). If found, contact Rockland Scientific.

To install a probe:

1. Connect and tighten the microstructure probes to their appropriate SMC cables. Insert the sensors into the probe holders (Figure 12). **Make sure the probes are fully seated.**

[6] https://rocklandscientific.com/support/replacing-clear-heat-shrink-tubing-smc-cables/

You should be able to hear 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. Make sure the probe holder caps are loosened so that the O-ring is not being squeezed around the probe.

⚠ Probes are fragile. Be careful. It is advised that you insert the temperature probes LAST because they are the most fragile.

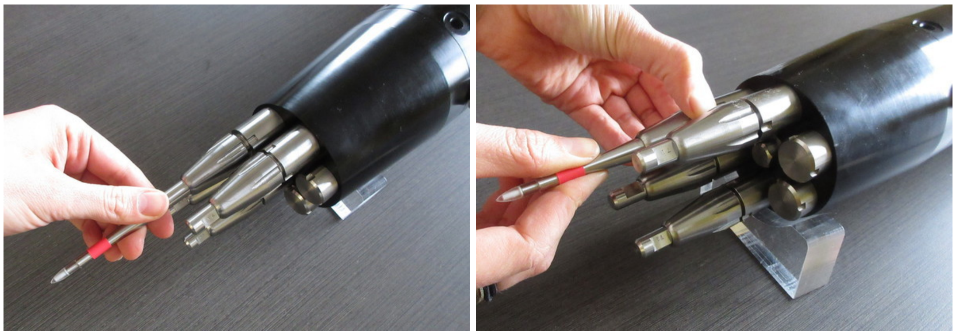


Figure 12: Inserting a probe into a probe holder.

2. Tighten the probe holder caps using your fingers until they can no longer be easily tightened by hand. Then, use the probe wrench to tighten the caps an additional **1/8 or 1/4 turn** (Figure 13). At the proper tightness, it should be difficult to rotate the probes by hand.

⚠ The probe holders should not be over-tightened because it will deform the plastic ferrule and affect the integrity of the O-ring seal.

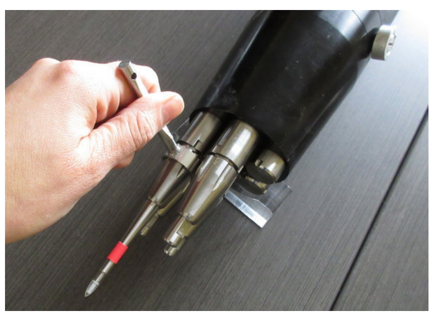


Figure 13: Tightening the probe holder.

3. As you tighten the probe holders, ensure that the shear probes are oriented correctly. The shear probes should be oriented such that one probe is aligned with the pressure port (Figure 2, z-axis) and the other probe aligned perpendicular (Figure 2, y-axis). The sensitivity on a shear probe is in the direction normal to the flat section of the sensor's

serial number (Figure 14). **The orientation of the FP07 temperature probes is also important when the AEM1-G electromagnetic current meter is installed.** To minimize electromagnetic interference with the EM sensor, the temperature probes must be oriented as shown in Figure 15.

> As you tighten the probe holder cap, the shear probes will want to rotate with the cap. This is due to friction from the O-ring inside the probe holder hole. If this occurs, ensure that the O-ring is properly lubricated. In some cases, this does not fix the issue and the probes will need to be rotated before tightening so that after tightening they have the proper alignment.

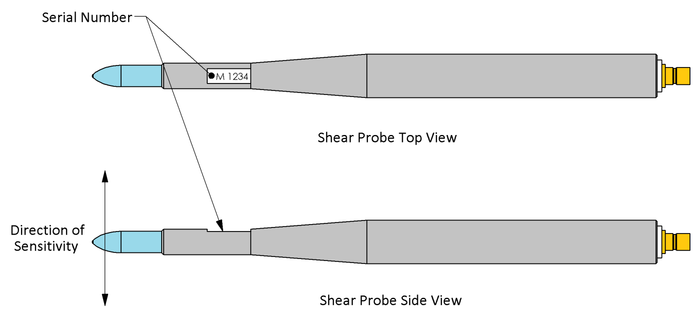


Figure 14: Shear probe direction of sensitivity.

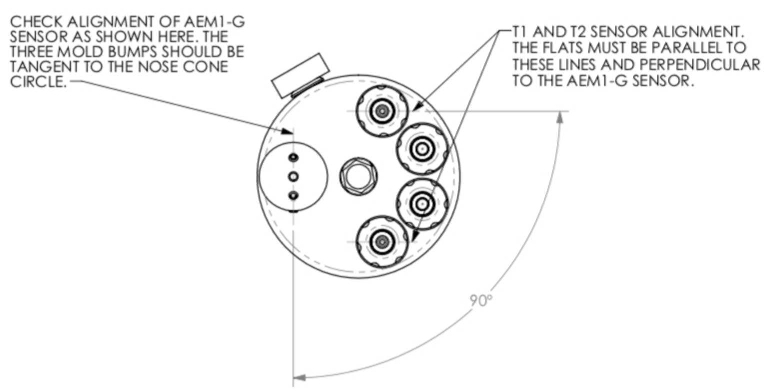


Figure 15: Nose cone sensor layout

4. In your deployment notes, record the serial numbers of the microstructure sensors you have installed in each port. If possible[7], update your configuration file with their respective serial numbers and their sensitivities (if they are provided for that given sensor).

[7] The setup file can be modified post-deployment, if necessary.

3.2 Disassembling the Pressure Case

The following subsections outline the steps to disassemble the instrument pressure case.

3.2.1 Removing the Rear Bulkhead

To remove the rear bulkhead for access inside the pressure case of the instrument:

1. Remove the sealing nut from the rear bulkhead using the provided 1/2-inch (13 mm) deep socket and torque wrench (Figure 16). Alternatively, a socket wrench with extension or a nut driver can be used.

Figure 16: Removing the sealing nut.

2. Gently rock the rear bulkhead as you slowly separate it from the pressure tube. If extra leverage is required, install two 1/4-20 × 3 or 4 inch bolts into the two mounting points on the rear bulkhead (Figure 17). Hold onto the pressure tube and gently wiggle the rear bulkhead out of the tube by holding onto the bolts.

> ⚠ Remove the bulkhead slowly, being careful not to pull on the wiring harnesses connected to the inner electronics.

Figure 17: Leverage to Remove the Rear Bulkhead

3. Slowly slide the rear bulkhead out over the threaded rod.
4. Gently disconnect the Molex connectors on the wiring harnesses between the rear bulkhead and the internal electronics (Figure 18).

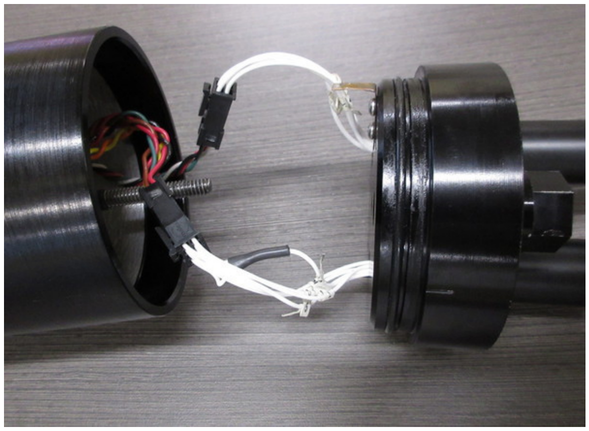


Figure 18: Disconnecting the rear bulkhead connections

3.2.2 Removing Components from the Rear Bulkhead

During instrument maintenance (Section 5.1.2), it is recommended that you remove the components of the rear bulkhead. The following tools can be used to unthread the components:

- MCBH connector(s) and spare port(s): supplied 6-inch (adjustable) crescent wrench
- Anode: 3/8-inch or 10 mm slotted screwdriver

3.2.3 Removing the Pressure Tube

After the rear bulkhead has been removed, the pressure tube can be removed as follows:

1. With one hand on the pressure tube, and the other on the nose cone, gently wiggle the nose cone until the front bulkhead is free of the tube.

Figure 19: Separating the front bulkhead from the pressure tube.

2. Slowly slide the pressure tube past the internal frame (Figure 20), exposing the internal electronics. This step is best completed with two people to prevent damaging the electronics when removing the tube from the front bulkhead.

> ⚠ Take extra caution to avoid scratching the inside of the tube on the threaded rod located at the rear end of the internal frame. Be very careful not to damage the internal faces at either end of the pressure tube. These are sealing surfaces and must remain smooth and clean.

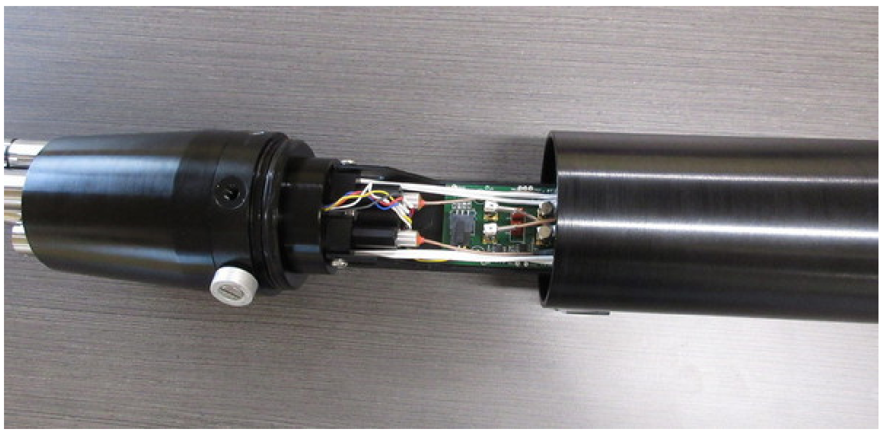


Figure 20: Sliding electronics out of pressure tube

3.2.4 Removing the Nose Cone

The procedure to remove the nose cone is as follows:

1. Remove the test probes (Figure 21). See Section 3.1 for probe removal instructions.

Figure 21: Nose cone after removal of test probes.

2. Remove the sealing nut with the provided 1/2” deep socket and provided torque wrench. Alternatively, a socket wrench with extension (Figure 22), or nut driver can be used.

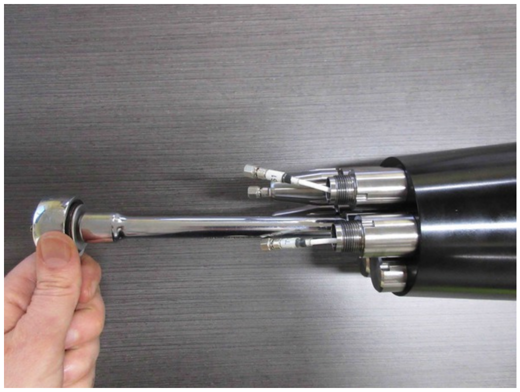


Figure 22: Loosening the front sealing nut with a socket wrench (with extension).

3. Gently wiggle the nose cone free from the front bulkhead.

> ⚠ Once the nose cone is free from the seal, **stop pulling**. The AEM1-G wiring is still connected inside.

4. Very carefully slide the nose cone up the threaded rod to expose the wiring inside.
5. Disconnect the AEM1-G sensor (Figure 23):
   (i) Cut the cable tie that connects the AEM1-G wiring to the mounting rod.
   (ii) Cut the wax string ties on the AEM1-G wiring.
   (iii) Disconnect the four connectors for the AEM1-G wiring.
6. Slide the nose cone over the threaded rod, allowing the SMC cables to pass through the probe holders.

> ⚠ Take extra caution to avoid scratching the inside of the nose cone on the threaded rod.

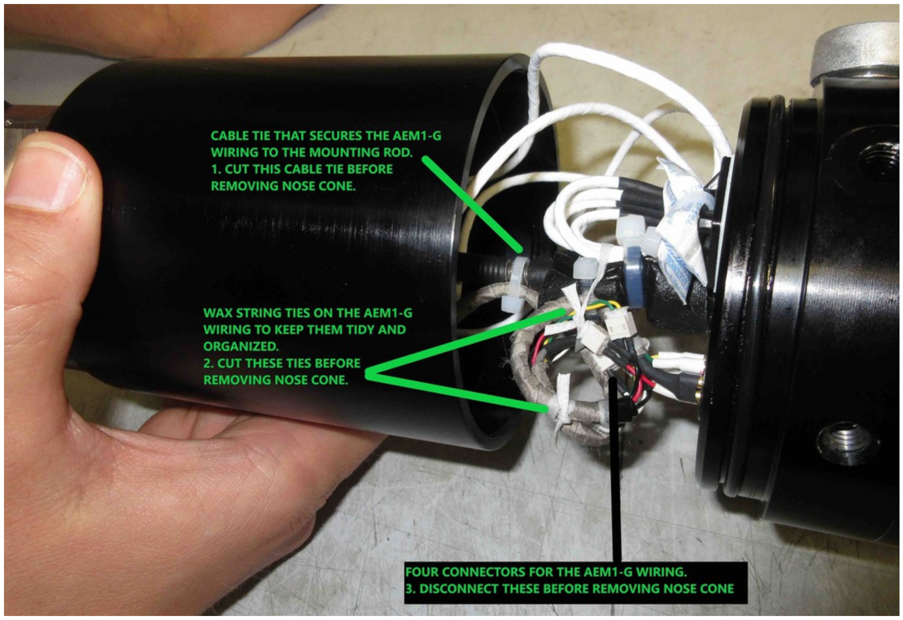


Figure 23: AEM1-G sensor wiring inside nose cone. The wires from the EM sensor are wrapped in conductive tape that is connected to the instrument body for grounding. This is to reduce the electronmagnetic interference caused by the EM sensor signals and picked up by the microstructure sensors.

3.2.5 Removing Probe Holders from the Nose Cone

To disassemble and remove the probe holders from the nose cone:

1. Remove each probe holder cap, ferrule and O-ring (Figure 24, left).
2. Remove the probe holder base from the nose cone using the custom wrench (Figure 24, right).


Figure 24: Removal of the probe holders from the nose cone. Note: AEMG-1 G sensor not shown.

3. Repeat steps 1 and 2 for the remaining probe holder caps and bases.
4. At this time clean and inspect all the O-ring sealing surfaces (Section 5.3). Clean, inspect and grease the O-rings (Section 5.2).

3.2.6 Removing AEM1-G EM Current Meter from the Nose Cone

To remove the AEM1-G sensor head from the nose cone:

1. Hold the body of the AEM1-G using a crescent wrench.
2. Loosen the retaining nut on the inside of the nose cone using a wrench and the supplied crow-foot wrench head on an extension with the square bar adaptor (Figure 25). Alternatively, use a 3/8” inch ratchet.

Figure 25: Using the crowfoot wrench on AEM1-G retaining nut to remove the sensor from the nose cone.

3. Once the nut is loose and removed, gently pull on the AEM1-G sensor head to remove it from the nose cone.
4. At this time clean and inspect all the O-ring sealing surfaces (Section 5.3). Clean, inspect and grease the O-rings (Section 5.2).

3.3 Reassembling the Pressure Case

Before reassembling the nose cone, pressure tube and rear bulkhead back together, **check for scratches or debris that could compromise the seals**. Clean surfaces with isopropyl alcohol and apply grease to the O-rings, if necessary. Replace any O-rings that show signs of damage. If there are any scratches on any sealing surfaces, contact Rockland Scientific.

> ⚠ In particular, check (1) the inside of the nose cone, (2) the O-ring seals on the inside of the pressure tube, (3) the sealing surfaces on the front and rear bulkheads, and (4) the sealing nut. See Section 5 for more information on instrument maintenance.

3.3.1 Reassembling the Nose Cone

To reassemble the nose cone do a reversal of the disassembly procedure. The reassembly is usually completed in the following order, however steps 2 and 3 may be interchanged depending on the user's preference:

1. Install the AEM1-G on the nose cone.
   (i) Position the AEM1-G on the nose cone.
   (ii) Tighten the retaining nut using the supplied crow-foot wrench head on a racket.
   (iii) Ensure that the mold line on the head is tangent to the diameter of the nose cone (Figure 26). There is an alignment mark punched into the body of the AEM1-G and the sensor is to be rotated such that this mark is as close to the outside diameter of the nose cone as possible (Figure 28).

Figure 26: Alignment of the AEM1-G sensor on the nose cone. They grey circles have been enhanced for clarity.

2. Attach nose cone to front bulkhead.
   (i) Inspect the O-ring and the groove on the outer side of the front bulkhead.

(ii) Inspect the sealing face on the nose cone.

(iii) Feed the sensor cables through the holes in the nose cone (Figure 27). We recommend the layout shown in Figure 28. Passing the SMC cables through each probe holder port is most easily accomplished by positioning the nose cone next to the front bulkhead at a ninety degree angle to the instrument. The cables are just long enough to reach all the way through the holders.

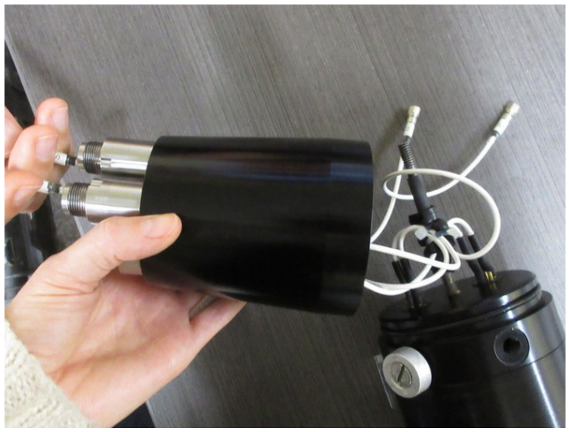


Figure 27: Feeding the SMC cables through the nose cone. The picture shows the probe holders already installed on the nose cone. It is recommended that you first install the nose cone, and then install the probe holders. Note: The instrument pictured does not have an AEM1-G EM sensor.

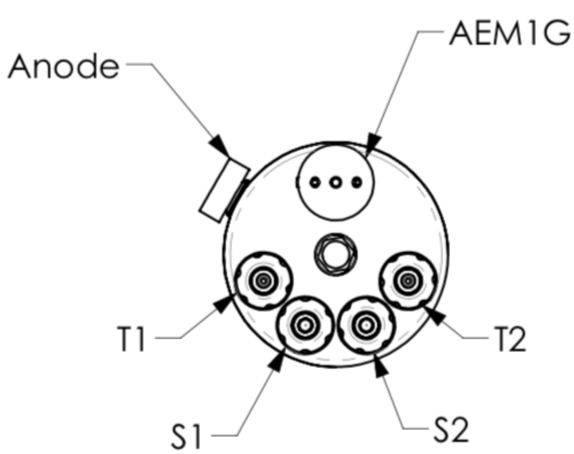


Figure 28: Nose cone sensor layout.

(iv) Connect the AEM1-G wiring inside the nose cone (refer to Figure 23):

- Loop AEM1-G wiring as factory shipped. Tie loop with string.
- Connect the AEM1-G connectors.
- Use 4-inch cable tie to secure AEM1-G wiring to mount rod. Make sure the conductive tape firmly touches the bare metal on the rod.

(v) Gently slide the nose cone onto the front bulkhead piston seal until it is fully seated.

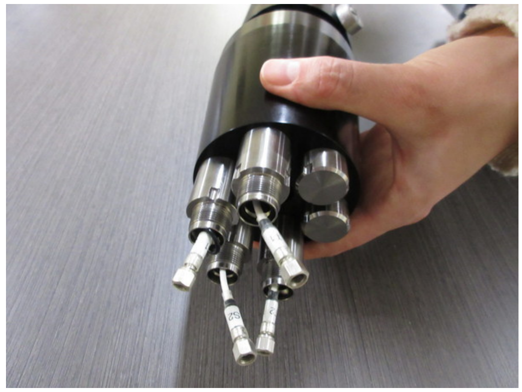


Figure 29: Sliding the nose cone onto the front bulkhead. Note: The picture shows the probe holders already installed on the nose cone. It is recommended that you first install the nose cone, and then install the probe holders.

3. Install probe holders onto the nose cone.
   (i) Ensure that the 2-015 O-ring is installed in the probe holder base. Also, inspect the groove on the bottom of the probe holder base and the matching seal face on the nose cone.
   (ii) Feed the SMC cable through the probe holder base and attach the base to the nose cone. Use the custom wrench to securely tighten the probe holder caps.

   > ⚠ The probe holder base needs to be tight to the nose cone. This is in contrast to the caps, which are only tightened a 1/4 turn beyond hand tight.

   (iii) Place the O-ring and ferrule onto the probe holder base in the correct order.

   > ⚠ Place the O-ring first, followed by the ferrule (Figure 9).

   (iv) Attach the probe holder cap.
4. Install the test probes (Section 3.1).

3.3.2 Reassembling the Rear Bulkhead

If components on the rear bulkhead were removed, re-install them. Ensure O-rings are in good condition and use adjustable wrench to tighten components.

3.3.3 Reassembling the Pressure Tube

If the nose cone and rear bulkhead are assembled, the pressure tube can then be reassembled as follows:

1. Inspect the sealing faces on the pressure tube, and the O-rings and grooves on the front and rear bulkhead.
2. Slide the pressure tube over the internal frame.
3. Take the supplied plastic plate and place it over the rear threaded rod until it contacts the pressure tube. Tighten the rear sealing nut on the threaded rod to pull the pressure tube onto the front bulkhead.

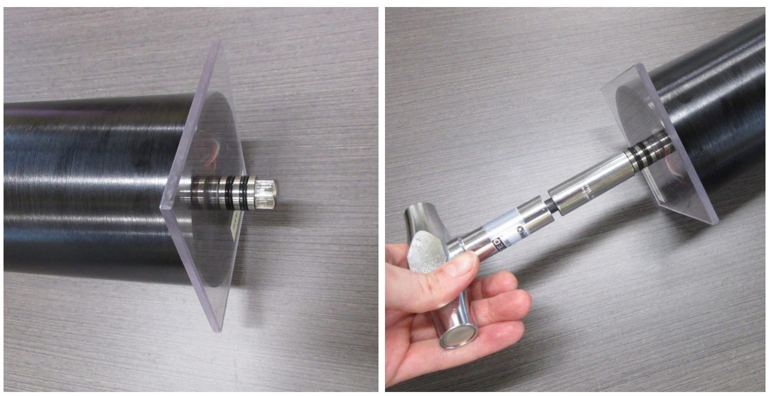


Figure 30: Sliding electronics into the pressure tube using the plastic plate.

4. Attach rear bulkhead to the pressure tube.
   (i) Inspect the O-ring and groove on the rear bulkhead.
   (ii) Connect the Molex connectors between the rear bulkhead and the internal electronics.
   (iii) Clean and inspect the sealing nut, sealing nut O-rings (and backup rings) and grease if necessary.
   (iv) Insert the rear sealing nut into the bore on the rear bulkhead. This will ensure that it engages the threaded rod.
   (v) Push the rear bulkhead into the pressure tube until it is possible to turn the sealing nut onto the threaded rod.

   > ⚠ Make sure the internal wires are not pinched when installing the rear bulkhead.

   (vi) Tighten the sealing nut with the provided torque wrench (Figure 31) to a torque of 25 in · lb (3 N m).

⚠ Do not exceed this torque or you can cause damage to the instrument's internal frame. A distortion of the frame will also affect the orientation and alignment of the tilt sensor.

Figure 31: Tightening the sealing nut on the rear bulkhead.

⚠ When assembly is complete check the seals between: (1) the nose cone and front bulkhead, (2) the front bulkhead and pressure tube, and (3) the pressure tube and the rear bulkhead. There should not be any gaps between the parts at the three joints.

4 Operations

This section outlines the best practices for operating and deploying your instrument.

4.1 Turning the Instrument ON/OFF

4.1.1 Turning the Instrument On

The MicroRider-1000 is turned on by **FIRST** supplying power to the instrument, and **THEN** sending an ON signal. Constant 12 to 18 VDC power is provided through the deck cable when it is plugged into the wall. Be careful of electric shock. The ON signal is sent by either:

1. **deck cable:** Connect one end of the deck cable to the 8-pin MCBH connector on the instrument, and the other end to wall power. Flip the ON/OFF switch on the deck box to the ON position (Figure 32).

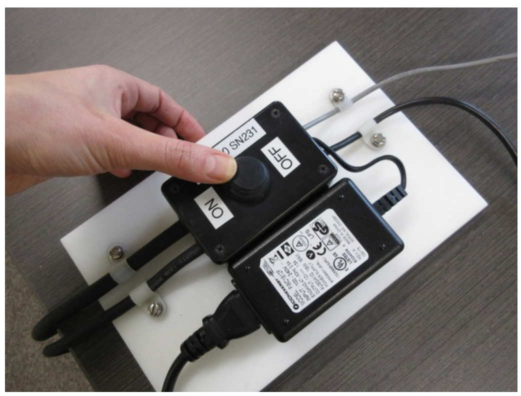


Figure 32: Sending the ON signal using the deck unit switch.

2. **instrument platform or external battery (e.g. glider, Wirewalker):** Using the appropriate wiring harness, supply power from the platform to the 8-pin MCBH connector on the rear bulkhead of the MicroRider-1000. Then, send the ON signal via either the platform (e.g. glider) or shorting plug.

> The MicroRider-1000 is configured to launch data acquisition automatically after the boot process is finished.

> Warning: risk of electric shock. The end of the deck cable has 12 - 18 VDC across two exposed pins providing constant power to the instrument.

4.1.2 Turning the Instrument Off

The MicroRider-1000 is turned off by **FIRST** sending the OFF signal (via the deck cable, the shorting plug or the platform), and **THEN** disconnecting the MCBH connector from its power source. If the instrument is recording data, data acquisition will be stopped prior to turning the instrument off completely.

4.2 Connecting the Instrument to a Computer

There are two methods to connect to the instrument: (1) as a mass storage device (i.e. as the RDL USB Drive) to transfer files (Section 4.2.1), or (2) using Zissou Essentials to perform basic tasks (Section 4.2.2). Both methods require the following:

- Instrument
- Deck Cable with Deck Unit (power supply and ON switch)
- Computer (with a USB-A connection)

The connection can then be established as follows:

1. Ensure that the instrument is OFF (Section 4.1.2).

> The instrument must be OFF when connecting the instrument to a computer. Unexpected behaviour can occur otherwise.

2. Remove the Dummy Cap from the MCBH connector on the rear bulkhead.
3. Connect the deck cable to the MCBH connector.
4. Connect the deck cable to a USB port on your computer. This will turn ON the Rockland Data Logger board, but not the instrument as a whole. Data acquisition will NOT be started.

> If the pins on the deck cable connector are not lubricated, use O-ring grease to lubricate the pin connections. See Section 5.4.3

Figure 33: Connecting the deck cable to the computer.

4.2.1 Connecting to the Instrument as a USB Mass Storage Device

Connecting to the instrument as a USB Mass Storage device is similar to connecting to other mass storage devices, such as a USB Drive or an external hard drive. When connecting a computer to the instrument with the deck cable, the RDL Memory Module contained in the instrument will appear as an external USB Drive on your computer (i.e. the “RDL USB Drive”).

Detailed instructions for connecting to the instrument as a RDL USB Drive are as follows:

1. Wait for the RDL USB Drive to be detected. A notification from the computer should indicate when the connection has been established.

> It can take up to two minutes for a connection to be established because the instrument’s operating system must boot up first.

2. Open the folder by following the prompts on your computer, or go to the built-in file manager (e.g. File Explorer, Finder) to find the RDL USB Drive.
3. Double click on the RDL USB Drive to open it and view the contents of the RDL Memory Module on the instrument (Figure 34).

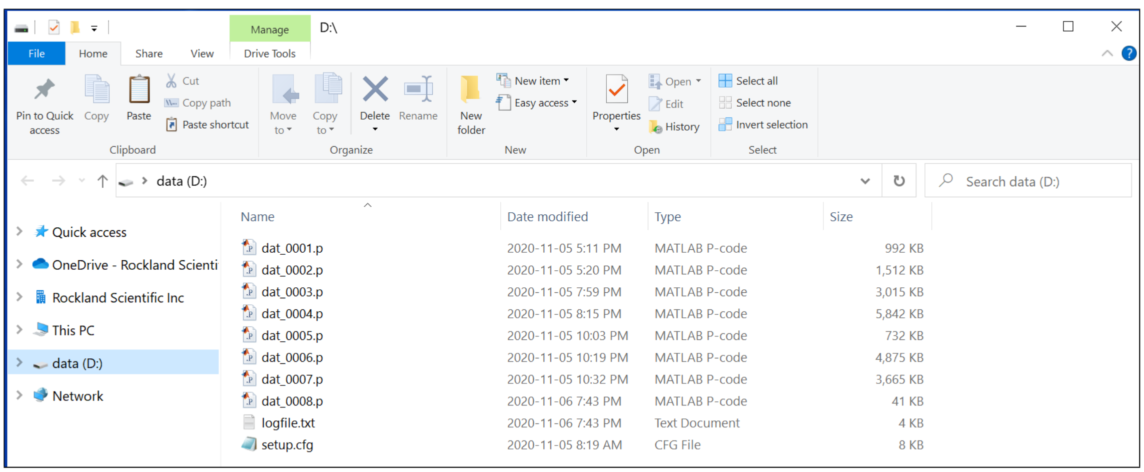


Figure 34: Connecting to the instrument as a mass storage device.

4. Transfer files on and off the instrument as necessary. The transfer can be done using all standard methods (e.g. drag and drop, copy and paste).
5. When ready, instruct your computer to properly eject the RDL USB Drive before physically disconnecting the instrument from the computer.

> ⚠ Ensure that you instruct your computer to properly eject the RDL USB Drive before disconnecting the instrument from the computer. Taking this step will reduce the chances of corrupting the memory module’s File Allocation Table (FAT).

4.2.2 Connecting to the Instrument using Zissou Essentials

Connecting to the instrument using the Zissou Essentials software provides additional functionality via the "Instrument Dashboard" (Figure 35). For more information, refer to the Help menu of the Zissou Essentials software program. When the connection is made with the Instrument Dashboard, the computer will simultaneously connect to the RDL USB Drive (as described in Section 4.2.1) to allow file transfer. The additional functionalities of the Instrument Dashboard include:

- Setting the instrument clock
- Checking the battery voltage
- Displaying the software version on the instrument
- Reviewing the instrument log file
- Determining the free space on the memory module
- Checking for warnings or errors
- Displaying channel statistics from a specific record in a previously recorded data file

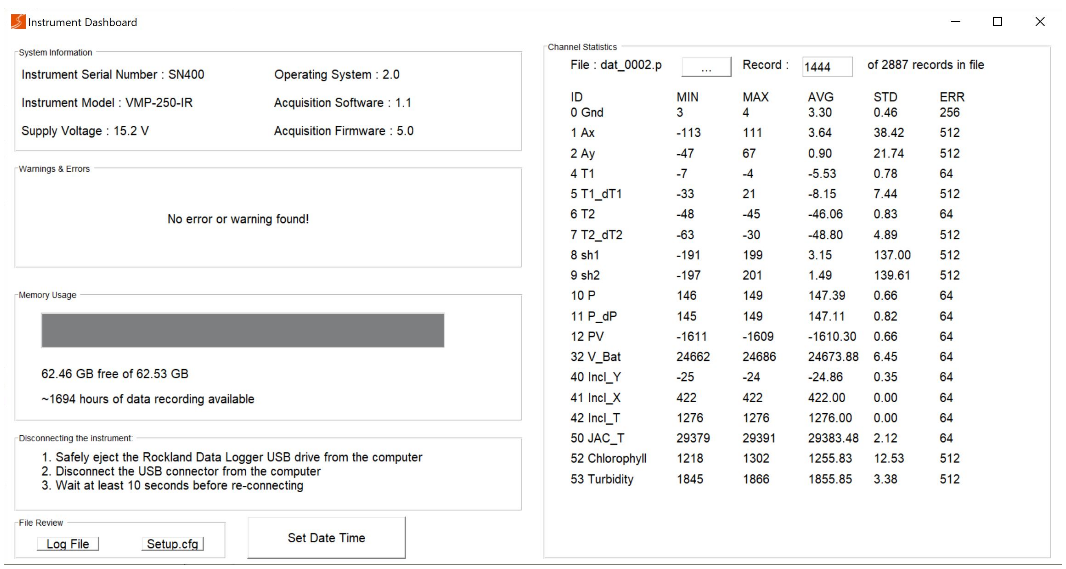


Figure 35: Viewing the Rockland Data Logger status with Zissou Essentials.

To connect to the Rockland Data Logger via Zissou Essentials:

1. Open Zissou Essentials on your computer.
2. On the software home page, hit the "Instrument Dashboard" button (Figure 36). The option is also available under the "Tools" drop-down menu.

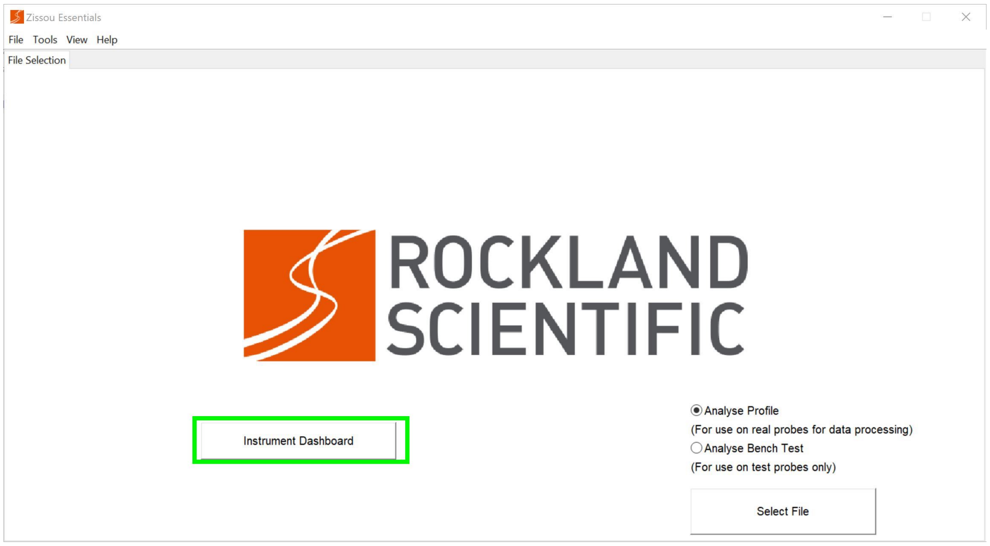


Figure 36: The "Instrument Dashboard" button (green) on the Zissou Essentials home page.

3. Ensure that the instrument is OFF.
4. Connect the deck cable to the instrument, but do NOT plug the USB into the computer.
5. Hit the "Connect Instrument" button (Figure 37).

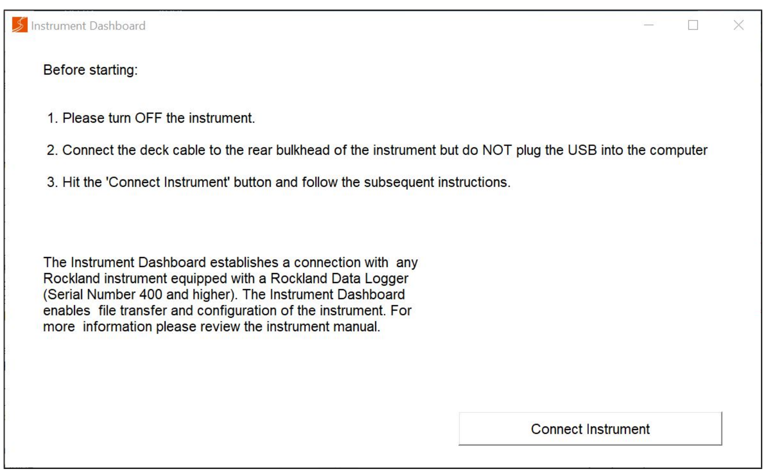


Figure 37: Connecting to the instrument with Zissou Essentials.

6. When prompted (Figure 38), plug the USB end of the deck cable to the computer and wait for the RDL Memory Module to be detected (up to 2 minutes). A notification should indicate when the connection has been established.

> It can take up to two minutes for the connection to be established because the instrument's operating system must boot up first and the software needs to be initialized.

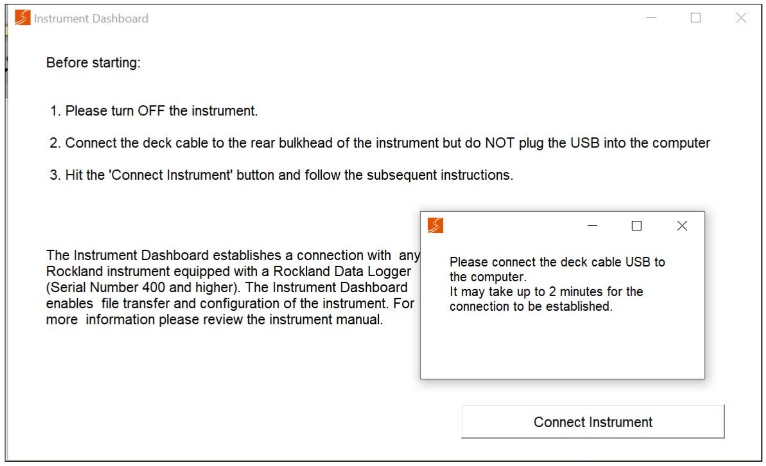


Figure 38: Zissou Essentials Prompt to Connect USB to Computer.

7. The Instrument Dashboard will appear and provide you information about your instrument and your Rockland Data Logger (Figure 35). Refer to the "Help" menu of the Zissou Essentials software program for more information about the dashboard.
8. When completed, eject the RDL Memory Module from your computer.

> ⚠ Ensure that you instruct your computer to properly eject the memory module before disconnecting the instrument from the computer. Taking this step will reduce the chances of corrupting the memory module's File Allocation Table (FAT).

4.3 Performing an Electronics Bench Test

The purpose of an electronics bench test is to confirm that the internal electronics of the instrument are functioning properly. Data is collected on all channels and several plots are generated to visualize the signals and assess the electronic noise level. The test is completed as follows:

1. Ensure that **test probes** (Section 2.4.3) are installed.

> ⚠ **Test probes need to be installed into the correct ports** because the probes have internal electronic components that bring the readings to approximately mid-scale. The test probes are identified by a label (e.g. T1, S1, S2) on the flat surface of the probe (Figure 5).

2. Rest the MicroRider-1000 horizontally on a table or bench, preferably on something soft like open cell foam.
3. Ensure that the USB deck cable connection is NOT plugged into the computer.
4. Turn the instrument ON by connecting the deck cable and flipping the switch to ON (Section 4.1). Ensure that the deck cable is connected to AC power.
5. Wait for 2 minutes. This allows the instrument to boot up and to acquire at least one minute of data.
6. Turn the instrument OFF with the switch on the deck cable.
7. Connect the USB deck cable to your computer (Section 4.2).
8. Once the mass storage device appears on your computer, transfer the latest data file to your computer.
9. Use either Zissou Essentials or the `quick_bench.m` function found within the ODAS Matlab Library to process the data. This generates at least two figures[8] – time series of the signals measured by the ASTP and inclinometer channels, and spectra computed from the ASTP signals.
10. Verify that the sensor signals are as expected[9]. Values and expected ranges are provided in the Bench Test Checklist (Section A.1).

[8] Additional figures may be generated depending on the installed sensors.
[9] If you have concerns, please contact support@rocklandscientific.com

4.4 Pre-Platform Checks

The following checklist describes the steps necessary to prepare the instrument **before assembly onto the platform**.

1. If necessary, install a new CR2032 battery. The recommended replacement date is indicated on a sticker on the battery.
2. Ensure all O-rings and sealing surfaces are clean and undamaged (no scratches). O-rings should be lightly greased.
3. Ensure the instrument is fully assembled and that all fasteners are tight.
4. Ensure that there is no visible gap between the pressure tube and the bulkheads and between the nose and the front bulkhead.
5. Ensure that the RDL Memory Module contains a valid configuration file. Check the time of day clock to make sure that it is set to the proper time (Section 4.2.2).
6. Perform an electronics bench test (Section 4.3) to verify that all channels are working properly. Complete the bench test checklist (Section A.1).
7. Modify the `setup.cfg` file with the probe serial numbers and sensitivities or calibration coefficients (if known). Note: The `setup.cfg` file can be modified post deployment, but be sure to record the serial numbers in your deployment notes.

   > If the probe serial numbers are not known prior to installation of the MicroRider-1000 on the platform, use nominal values in the `setup.cfg` file. Configuration file information is contained in your data file and can be updated during post processing. Be sure to record the serial numbers at the time of deployment.

8. Disconnect the deck cable from the instrument and replace it with the dummy plug.

4.5 Pre-Deployment

The following section provides guidance on the critical steps and checks that should be carried out in the *hour or so* before the deployment of your instrument. It is assumed that regular maintenance on the instrument and general cruise preparation has already been performed.

> ⚠ Pre-deployment preparations and checks must be performed before the instrument is deployed. Do not assume the the instrument is ready for deployment immediately after it is shipped from Rockland.

> ⓘ A one-page summary of the pre-deployment checks is provided in Section A.2. It is encouraged to retain a completed version of the provided checklist and sensor configuration with your deployment notes.

4.5.1 Preparing the instrument

The following checklist describes the steps that should be taken (or re-taken) to prepare your instrument for deployment:

1. Perform the Pre-Platform Checks (Section 4.4).
2. The instrument is now ready for assembling onto the platform. Refer to the platform documentation for instructions on assembly and pre-deployment using the platform.
3. Ensure that the instrument is correctly and securely mounted on the platform. Connect the instrument to the platform through the MCBH-8-FS connector. Put the dummy on the MCBH-4-MP connector.
4. Select and install your microstructure sensors (Section 3.1). Visually inspect each sensor to ensure that there is no obvious damage (Section 2.4.2).
5. Record the serial numbers of the sensors (Figure 14) on the pre-deployment checklist (Section A.2) to include in your records. For the shear probes, you should also note the orientation with respect to the instrument coordinate system (Figure 2).

   > ⓘ It is also recommended that you take a picture of the configuration for added record-keeping.

6. Ensure that you have discussed deployment and recovery with the crew and captain before proceeding (Section 4.5.2).
7. The instrument should now be ready for deployment.

4.5.2 Discussing Ship Operations

Prior to deployment, discuss your operations with the captain and crew of your ship so that they clearly understand how the deployment of your instrument will take place.

⚠ Take extra caution to ensure that the microstructure probes are protected.

4.6 Deployment

After completing your Pre-Deployment Checklists to ensure you are ready for deployment, refer to the platform documentation for properly deploying your instrument.

4.7 Post-Deployment

Refer to the platform documentation for recovering your instrument once your deployment has been completed.

Once your instrument is back on deck (or back in the lab), remove the instrument from the platform and then connect to it using the deck cable to download and review your data.

If your instrument is being re-deployed in a short time, it is still a good idea to **download and review your data when possible** in case of unexpected issues such as:

- to identify poor quality data (e.g. due to a broken sensor)
- corruption of the memory module
- potential loss of your instrument

5 Maintenance

This section discusses best practices and critical steps for maintaining your instrument and its sensors. General procedures are outlined in the following sections and should be followed after every deployment. Suggested timelines are described in Section 5.1 and specific details about O-rings, sealing surfaces and corrosion prevention are outlined in Sections 5.2, 5.3 and 5.4, respectively. The maintenance of particular sensors is described in Section 5.5. The tools and supplies required to perform essential maintenance on the instrument are listed in Table 6. The maintenance drawing is provided in Section A.8.

> ⚠ Post-cruise maintenance MUST be performed upon returning to shore after every cruise. Good maintenance is critical to prevent corrosion during storage.

Table 6: Tools and supplies required to perform maintenance on the MicroRider-1000

Item	Purpose
Tools supplied with instrument	Disassembly of the instrument (See Section 3)
Spare O-rings (Spares Kit)	Replacing O-rings (annually or as needed)
Spare anodes and ferrules (Spares Kit)	Replacing anodes and ferrules (as needed)
Source of fresh water	Rinsing the instrument after deployment
Container of fresh water	Rinsing small components
Wood or plastic tooth pick (or similar)	Removing O-rings from grooves
Lint-free wipes (e.g. Kimwipes)	Cleaning O-rings and sealing surfaces
Isopropyl Alcohol	Cleaning O-rings and sealing surfaces
Wax string	Removing O-rings from bulkhead connectors
O-ring grease (e.g. Dow Corning 4)	Lubricating O-rings

5.1 Timelines

The integrity of your instrument can be ensured through proper maintenance practices that are carried out during and after every cruise. It is also important to ensure that your instrument is properly stored.

5.1.1 During Cruises

During a cruise, it is recommended that you **rinse the MicroRider-1000 with fresh water whenever the instrument is on deck** for an extended period of time. Remove as much saltwater as possible.

> ⚠ Be careful to not direct any high-pressure water directly into the pressure port on the front bulkhead.

5.1.2 Immediately after Last Deployment

On deck, after the last deployment:

1. Thoroughly rinse the MicroRider-1000 with fresh water.
2. Before removing the probes from the instrument, gently rinse the microstructure probes with fresh water.
3. Dry the probe holders and stings of the microstructure probes using dry, compressed air.
4. Carefully remove the microstructure probes ensuring water does not enter probe ports.

> ⚠ Avoid getting water on the SMC connector of a sensor as it may cause damage to the connector.

5. Install test probes (Section 3.1).
6. When the instrument is dry, place it in the case.

5.1.3 Post-Cruise Disassembly and Maintenance

As soon as possible after the last deployment (and possibly back on shore):

1. Gather maintenance supplies (Table 6). Have a pail of clean fresh water available.
2. Disassemble the instrument. As you disassemble the instrument, place small components into the fresh water to remove any residual salt or debris. The disassembly sequence is as follows:
   i) Remove the test probes (Section 3.1).
   ii) Remove the probe holders (Section 3.2.5). Clean O-rings.
   iii) Remove the JAC AEM1-G electromagnetic current meter (Section 3.2.6) and clean O-rings.
   iv) Remove the nose cone (Section 3.2.4). Clean pressure tube O-ring.
   v) Remove the rear bulkhead (Section 3.2.1). Clean pressure tube O-ring.
   vi) Remove components from the rear bulkhead (Section 3.2.2) and clean O-rings. Refer to Section 5.2.2 for particular guidance on removal of the bulkhead connector O-rings.
   vii) Remove pressure tube (Section 3.2.3). Clean O-ring on front bulkhead. (Note: You will have to slide it over the internal electronics frame.)
3. Wipe sealing surfaces with a damp, lint-free cloth or towel using fresh water to remove residual salt. Clean sealing surfaces with isopropyl alcohol.
4. Inspect O-rings and replace any that are no longer in good working condition (see Section 5.2).

5. Once components are rinsed and dry, reassemble the instrument in the reverse order. As necessary:
    - Inspect sealing surfaces for debris, corrosion and/or scratches (Section 5.3).
    - Re-grease and re-install O-rings.

5.1.4 Annually

To ensure the longevity of your instrument, it is recommended that you perform annual maintenance on your MicroRider-1000. In particular, you should:

- Complete the post cruise maintenance disassembly procedure (Section 5.1.3).
- **Replace O-rings with new O-rings** (See Section 5.2 for more details).
- Perform a 60 second electronics bench test on the MicroRider-1000. See Section 4.3 for detailed instructions.

> Rockland provides an annual instrument maintenance package for the MicroRider-1000. For more information, contact support@rocklandscientific.com.

5.1.5 Preparation for Storage and Shipping

To prepare your instrument for **storage**:

1. Perform post-cruise maintenance (Section 5.1.2).

> Ensure the MicroRider-1000 and all of its exposed (i.e. wetted) components have been rinsed with clean fresh water and dried.

2. Place in a clean and dry storage area.

To prepare your instrument for **shipping**:

1. To avoid corrosion, please ensure instrument is completely dry before putting in shipping case.

5.2 O-Rings

O-rings are a critical component of your instrument. They provide the barrier that prevents water ingress into your instrument. Proper maintenance, care and installation of O-rings is very important. O-rings are inexpensive and disposable components that need to be replaced regularly. The locations of the O-rings in the MicroRider-1000 are summarized in Table 7 and identified in Section A.8.

⚠ O-rings stored under compression must be replaced **annually** to avoid water ingress due to compression set (flattening). When in doubt, replace used O-rings with a fresh set.

Table 7: O-rings and replacement recommendations for the MicroRider-1000

O-ring location	Qty.	Specification	Replacement Interval
Pressure tube to bulk-heads	3	2-151 Buna-N, 70A	Annually or pre-deployment
Probe holder bumper O-ring	1/holder	2-012 Buna-N, 70A	Annually or pre-deployment
Probe holder sensor seal	1/holder	2-012 Buna-N, 70A	Annually or pre-deployment
Probe holder face seal	1/holder	2-015 Buna-N, 70A	Annually or pre-deployment
Front sealing nut	2	2-014 Buna-N, 70A	Annually or pre-deployment
Rear sealing nut	2	2-014 Buna-N, 70A	Annually or pre-deployment
Rear sealing nut (backup ring)	2	8-014 Backup Ring	Annually or pre-deployment
Front sealing nut (backup ring)	2	8-014 Backup Ring	Annually or pre-deployment
MCBH connectors on rear bulkhead	2	2-014, Buna-N, 70A	Annually or pre-deployment
Plug on rear bulkhead	1	2-014, Buna-N, 70A	Annually or pre-deployment
AEM1-G EM Sensor	1	P16	Annually or pre-deployment
AEM1-G EM Sensor	1	S10	Annually or pre-deployment

ⓘ Refer to the maintenance drawing (Section A.8) for more information on the location of each O-ring.

5.2.1 Inspecting and installing an O-ring:

In general, O-rings can be inspected and maintained as follows:

1. Remove the O-ring from the instrument.
2. Rinse with clean fresh water.
3. Clean with isopropyl alcohol.

4. Dry with lint-free wipes (e.g. Kimwipes).
5. Inspect the O-ring for debris and/or imperfections such as scratches, wear and tear or compression set. If in poor condition, or an O-ring has been installed for one year or more, then replace it. **If in doubt, then replace.**

To install an O-ring:

1. Re-inspect the O-ring for debris and/or imperfections such as scratches or disfiguration.
2. Grease the O-ring.

> A variety of O-ring grease brands may be used. Rockland Scientific recommends Dow Corning 4 Electrical Insulating Compound.

3. Install the O-ring into the correct location ensuring it isn't pinched.

5.2.2 Helpful Tips for the MicroRider-1000 O-rings

- **Probe Holders:** Each probe holder has three O-rings (Figure 9). The sealing O-rings adjacent to the probe holder base should only have a very light coating of grease; there should be no excess. Grease can be applied to the "bumper" O-ring using the non-connector end of the test probe. Note: the purpose of the bumper O-ring is to minimize vibrations and it does NOT provide a seal.

> Excess grease on microstructure probe O-rings can make it easier for a probe to be rotated after the probe holder has been properly tightened.

- **Bulkhead Connector(s)**: To remove the connector O-rings, thread string around the O-ring and pass both ends of the string through the threaded hole (Figure 39). Gently pull on the string to pass the O-ring through the hole and around the wiring harness. Reverse these steps to replace this O-ring.

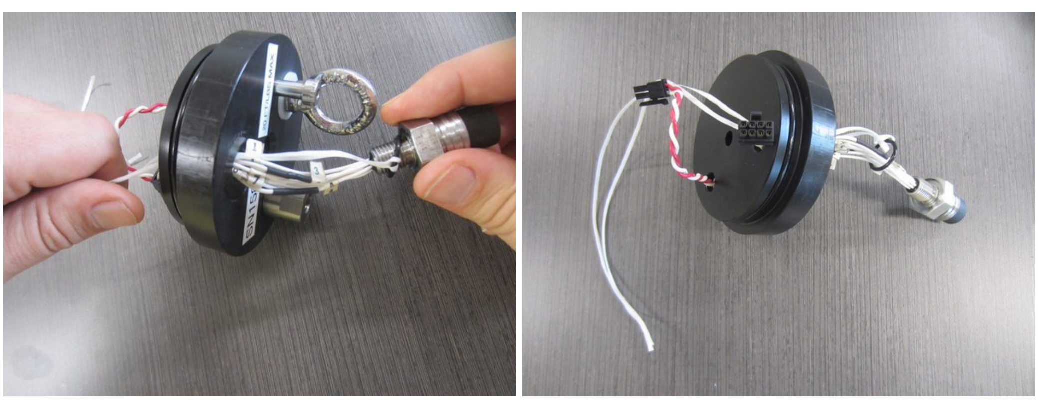


Figure 39: Removal of an O-ring from an MCBH connector (a MicroCTD is pictured).

5.3 Sealing Surfaces

Sealing surfaces are the surfaces that O-rings contact to create a water tight seal (Figure 40). Sealing surfaces are carefully engineered to ensure your instrument remains watertight. Any debris, corrosion, scratches or damage to sealing surfaces may allow water to leak past the O-ring and enter your instrument. Proper maintenance and inspection of sealing surfaces is critical to ensure your instrument does not flood with water when deployed.

> ⚠ Clean sealing surfaces with isopropyl alcohol. Then inspect each sealing surface visually for damage or debris. It may be helpful to use a flashlight and/or pass your finger over the surface to feel for the presence of scratches or debris.

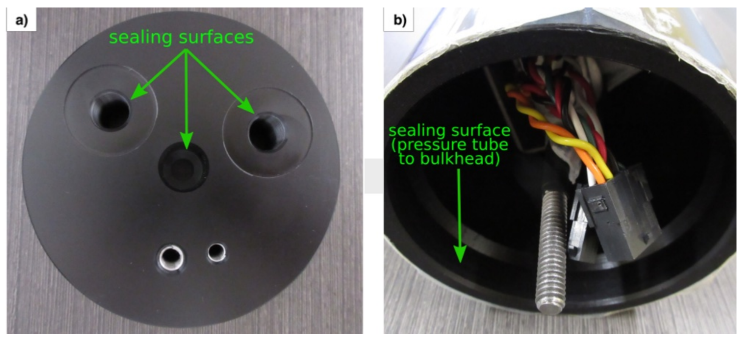


Figure 40: Typical sealing surfaces for a (a) rear bulkhead, and (b) pressure tube. (Note: A MicroCTD bulkhead and tube are pictured.)

5.4 Corrosion Prevention

Corrosion prevention is an easy to overlook, yet critical practice for operating in the corrosive environment of the ocean. Early detection and good maintenance practices are the best defense to protect your instrument against extensive corrosion.

> ⚠ To best avoid corrosion, ensure the instrument has been rinsed with clean freshwater and dry thoroughly before storing or returning to the shipping case. Post cruise maintenance must be performed soon after deployment.

5.4.1 Pressure Tube and Bulkheads

The pressure tube, bulkheads and nose cone of the MicroRider-1000 are made of aluminum and are, therefore, susceptible to corrosion. Three components of the MicroRider-1000 that are designed to protect it against corrosion are:

1. **Black anodization layer:** The pressure tube, bulkheads and nose cone have an oxidization layer added to their surfaces that protects the aluminum from corrosion when in

contact with seawater. Note that this layer is non-conductive.

> ⚠ Avoid scratching the black anodized layer. It is recommended that any scratches in the anodization layer be washed, dried and treated with nail polish. See blog post link provided in the footnote.

2. **Copper tab:** The tab on the inside of the rear bulkhead contacts the inside of the pressure tube where the anodized layer has been intentionally removed. This tab electrically connects the tube to the rear bulkhead and its anode.

> ⚠ Ensure that the copper tab is not bent and is contacting the inside of the pressure tube. Polish the top of the tab to make it shiny.

3. **Aluminum anodes:** The aluminum anodes are located on the front and rear bulkheads and are electrically connected to the entire instrument, providing protection to the instrument when submerged in seawater. To check the functionality of the anodes, use a multimeter to confirm that they are electrically connected to the bulkheads, nose cone and pressure tube. More specifically, check the connections between:

   (i) the anode on the front bulkhead and the front sealing nut

   (ii) the anode on the front bulkhead and the rear sealing nut

   (iii) the anode on the rear sealing nut and the copper tab

Additional information on corrosion protection is provided in a detailed blog post on Rockland Scientific's website[10].

> ⚠ The anodic protection only works while the instrument is submerged in seawater. When in air, any residual sea water will cause corrosion to occur at vulnerable sites.

Despite these precautions, **corrosion can still occur**, particularly during long deployments. Pitting is a common manifestation of corrosion that can vary in severity. If it occurs on or around any of the sealing surfaces (Figure 41, left) the affected component should be replaced, whereas pitting on the exterior surface of your instrument (Figure 41, right) may not require immediate replacement, however should be monitored. In many cases, the depth of a pit is much greater than the width and even if the corrosion is away from a sealing surface, it can severely compromise the structural integrity of the pressure case component.

> ⚠ For ALL cases of corrosion, please contact support@rocklandscientific.com and, if possible, include photos of the corrosion to help Rockland staff identify the severity of the problem.

[10] https://rocklandscientific.com/support/corrosion-prevention-anodes-nail-polish-continuity-checks/

Figure 41: Extreme corrosion on a MicroRider1000 after a long-term deployment

5.4.2 Probe SMC Connectors

Each probe connects to a SMC connector (Figure 42). The connector is susceptible to corrosion because it is frequently in proximity of water. To minimize the likelihood of corrosion, it is recommended that you:

- Avoid handling the probe connectors with wet hands.
- Avoid installing or removing probes when there is risk of water entering the probe port.

Conducting a bench test with test probes installed (Section 4.3), can help to reveal if corrosion is causing noise in the microstructure channels. Contact support@rocklandscientific.com if your bench test fails the Bench Test Checklist (Section A.1)[11].

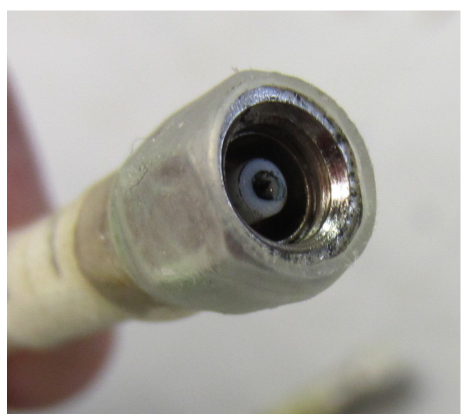


Figure 42: Green corrosion on the inside pin of an SMC connector. Without corrosion, the pin would appear shiny and gold.

It is also recommended that you regularly inspect the bulkhead feedthroughs to which the SMC cables connect. The feedthroughs are located inside the nose cone, installed in the front bulkhead. If corrosion is visible, the feedthroughs may need to be replaced. If the nose cone does not contain a desiccant pack, consider adding one by carefully tying one to the threaded rod inside the nose cone.

[11] The ASTP Calibration Report that shipped with your instrument can also be used as a reference for the expected noise spectra.

5.4.3 Underwater Connectors

Corrosion can appear on the metallic pins of an underwater connector. This is an indication that the connector was either not connected properly or the seals in the parts of the connection have failed. Check and change the O-rings and check all the sealing surfaces for contamination or damage.

The bulkhead connectors on the MicroRider-1000 can be treated with O-ring grease as per the manufacturer's specifications (Figure 43).

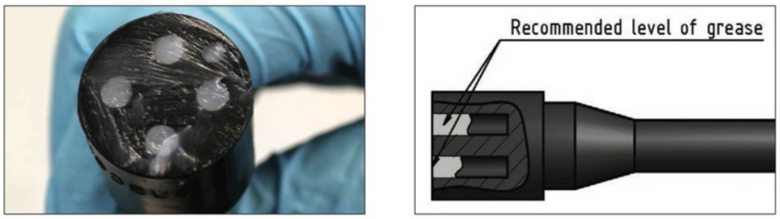


Figure 43: Applying grease to a MCBH connector. (Image source: SubConn and McCartney Underwater Connector Group (2018). *Underwater and Harsh Environment Connectors.* p. 122.[12])

5.5 Probes and Sensors

The probes and sensors on the MicroRider-1000 are very fragile and need to be properly maintained. Recommended procedures are outlined below.

5.5.1 Shear Probe

Shear probes are extremely fragile and should be handled carefully. Before removing the shear probe from the instrument, rinse it with gently flowing water and allow it to dry. Blow away residual water with compressed clean dry air (e.g. compressed air can). Between deployments, store the probes in their protective sheaths.

> ⚠ The shear probe is extremely fragile. Never touch the silicone tip with any solid object, including hair, clothing or a Kimwipe.

To determine if a probe is broken, first conduct a visual inspection to check if the white mantle housing the peizo ceramic beam inside the probe tip is straight in line with the main axis of the probe. A bent mantle and beam almost certainly means the probe is broken (Figure 44).

[12] https://www.macartney.com/what-we-offer/systems-and-products/connectors/subconn/subconn-book/

Figure 44: A shear probe with a crack in the silicone tip.

The integrity of the piezo-ceramic can be checked by measuring the capacitance and the resistance (see note) of the probe using a high quality digital multimeter and a high quality Giga-ohm meter. Nominal values are:

- capacitance: greater than 0.7 nF
- resistance: greater than 50 GΩ

If the capacitance is 0.7 nF or less, then the probe is broken. Check the probe capacitance value listed on the most recent shear probe calibration report. A significant drop in capacitance (near half the original value) is a clear sign the probe is broken.

> To check the resistance, use a Giga-ohm meter with an input voltage of no more than 50 V. Otherwise you will damage the probe.

> To avoid electric shock, do not hold the shear probe when testing the resistance with the Giga-ohm meter.

Even for an unbroken shear probe, **the sensitivity can change over time** due to aging and repeated use. While there is no observed historical trend for sensitivity changes of our shear probes, we recommend that the probes are recalibrated annually, or before and after a deployment.

> If you wish to recalibrate your probes before your cruise, we recommend you allow 4 - 6 weeks before you need your probes back before your cruise.

5.5.2 FP07 Temperature Probe

The FP07 temperature probes are extremely fragile and should be handled carefully. When installing microstructure probes (Section 3.1), it is recommended that you install the FP07s last (i.e. after the shear and SBE7 probes). Similarly, you should also remove the FP07 probes first. Before removing the FP07 probe from the instrument, rinse it with gently flowing water and allow it to dry. Blow away residual water with compressed clean dry air (e.g. compressed air can). Between deployments, store the probes in their protective sheaths.

> ⚠ The FP07 temperature probe is extremely fragile. Never touch glass tip with any solid object including hair, clothing, or a Kimwipe.

To determine if a probe is broken, confirm by visual inspection (using a microscope or magnifying lens) that the glass tip is free of cracks or fissures. Also, confirm that the small sensing tip on top of the glass body is visible and intact (Figure 45).

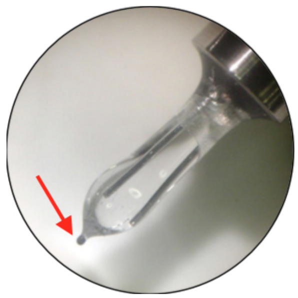


Figure 45: FP07 thermistor. The small sensing tip is indicated by the red arrow.

The health of the probe can also be checked using a high quality digital multimeter (Fluke brand) to measure the resistance of the probe (in air). At room temperature, the resistance should be approximately $\sim$2 kΩ ($\pm$25%). An open circuit or short circuit means the probe is broken.

> ⚠ Be careful not to damage the small pin in the probe connector when measuring resistance.

Temperature sensors are typically un-calibrated. We recommend using the reference CT data to perform an *in situ* calibration. For more information refer to the Zissou Essentials User Guide or Technical Note 039 (Section 2.3.4). If you ordered a calibrated temperature sensor, note that **its sensitivity can change over time** due to aging and use of the sensor. While there is no observed historical trend for sensitivity changes of our temperature probes, we recommend that they are recalibrated annually, or before or after a cruise.

> ⓘ Temperature sensors are typically un-calibrated, however, if you wish to recalibrate your probe before your cruise, we recommend you allow 4 - 6 weeks before you need your probe back before your cruise.

5.5.3 Pressure Sensor

The pressure transducer is located within the pressure port on the front bulkhead of the instrument (Figure 3).

> ⚠ Do not stick or screw anything into the pressure port. If you suspect that your pressure sensor is damaged, contact support@rocklandscientific.com.

To clean the pressure sensor, rinse it with fresh water. **After a long deployment, you should also rinse it with a weak bleach solution.** If rinsing with bleach, follow by a thorough rinsing with fresh water (i.e. several rinses) and a final rinse with IPA.

5.5.4 Electromagnetic Current Meter (AEM1-G)

Maintenance of the AEM-1G EM current meter should be conducted after every deployment. This includes:

- Rinsing the sensor with fresh water
- Removing of the sensor from the nose cone of the instrument (Section 3.2.6)
- Cleaning sealing surfaces and replacing O-rings, if necessary. (Refer to Section A.8 for the maintenance drawing.)

6 Troubleshooting

This section discusses how to troubleshoot some commonly reported issues you may experience during usage. If the information below does not address the issue you are experiencing or you are still having difficulties, contact Rockland Scientific.

6.1 Unable to turn the instrument on

If the RDL USB Drive doesn't appear when the USB is plugged in to the computer, then it is possible that the laptop or computer USB port can't supply power or has a poor USB link. Use the supplied USB Hub cable between the deck cable and the computer to ensure a good connection.

If the instrument refuses to turn on (i.e. won't energize and log data), then it is likely that a fuse has blown or the power supplied is inadequate.

To troubleshoot the issue, it is recommended that you:

1. Check the fuse wired between the rear bulkhead and the Rockland Data Logger board (Figure 46). This can be done by opening the fuse holder and removing the cartridge fuse. The fuse is blown if the fine wire inside the glass body is broken, or if a measurement across the fuse indicates "open" on the multi-meter.

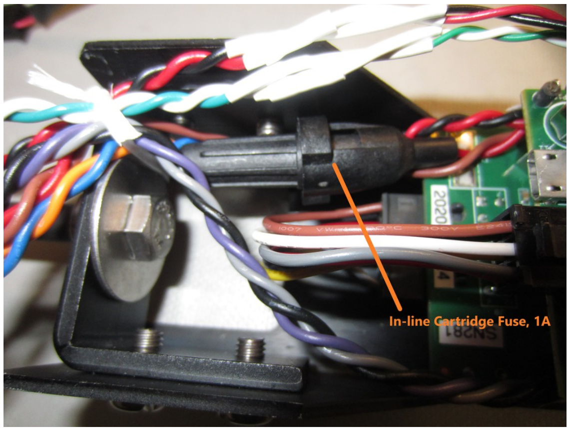


Figure 46: Input fuse between the rear bulkhead and the Rockland Data Logger board.

2. If that fuse is functional, then check the 1 A fuse, labelled "R1", that is located on the underside of the power supply board (Figure 47).

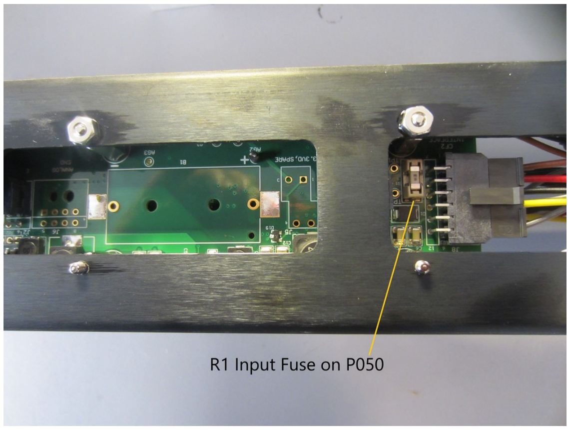


Figure 47: R1 fuse on the Power Supply board (P050).

3. Check that the external power supply is supplying the correct power. There should be 12 or 18 VDC across Pin 1 to Pin 2 on the 8-pin deck cable connector.

6.2 Cannot establish a connection to the instrument

If the instrument turns on, but the mass storage does not appear, then use a USB powered hub to boost the power and communication connection. If you are still unable to communicate with the instrument, contact Rockland Scientific.

6.3 Data corruption

The Rockland Data Logger board is equipped with a supercapacitor to provide the system with the required resources to gracefully shutdown even in instances of power loss. This design significantly reduces the odds of corrupting the File Allocation Table (FAT) of the RDL Memory Module; however, it is still possible to corrupt the drive.

In the event of FAT corruption, the Rockland Data Logger board will not mount the drive, and your instrument will not launch data acquisition. FAT corruption can be fixed by the following procedure:

- Connect your instrument to a computer (Section 4.2).
- Use the disk formatting tool provided by your operating system to reformat the memory module. This will result in all files on the drive being deleted.
- Copy back your `setup.cfg` file onto the RDL USB Drive; otherwise, if data logging is started when no `setup.cfg` file is on the drive, the Rockland Data Logger will use the factory default `setup.cfg` that is stored in the onboard memory. If the factory default is used, a file named `MISSING_SETUP_FACTORY_SETUP_USED.txt` will be placed in the directory.

> Ejecting the Rockland Data Logger drive before disconnecting the instrument reduces your chances of corrupting the memory module's FAT.

6.4 Noisy data on microstructure channels

Noisy data, which is broad-banded in frequency, can be an indication of damaged electronics or a broken probe (refer to Section 6.5). Damaged electronics are most likely caused by the presence of moisture and/or salt and caution MUST be taken to **ensure that water does not contact the probe connections (SMC)**. To check for the presence of moisture and/or salt:

1. Visually inspect the probe port.
2. Inspect the SMC connector and cables and the feedthrus for signs of discolouration (i.e. biological growth, corrosion).
3. Conduct an electronics bench test with the test probes installed (Section 4.3). Ensure that your test probes do not show signs of damage and/or corrosion.
4. Review your bench test and compare it with the bench test in your ASTP Calibration Report. Water damage to your connectors will result in increased noise across the frequency spectrum.
   - If you observe increased noise on a **shear** channel, then we suggest the following tests:
     (i) Remove the test probe and do a bench test. If the problem is resolved by the removal of the probe, then the *test probe may need to be replaced*. On the other hand, if the noise still persists, proceed with test (ii).
     (ii) Open up the instrument and disconnect the shear probe's SMC connection to the ASTP board (Figure 48). Do a bench test. If the problem is resolved, then the SMC connector is likely damaged and the *SMC cable assembly may need to be replaced*.
   - If you observe increased noise on one of the **thermistor** channels, then we suggest the following tests:
     (i) Swap the T1 and T2 test probes and do a bench test. If the noise is now on the opposite channel, then the *test probe may need to be replaced*. On the other hand, if the noise still persists on the same channel, proceed with test (ii).
     (ii) Open up the instrument and swap the two thermistor SMC connections to the ASTP board (Figure 48). Do a bench test. If the noise is now on the opposite channel, then the SMC connector is likely damaged and the *SMC cable assembly may need to be replaced*.

> ⚠ If you suspect that saltwater has contacted the probe connections and/or you want assistance interpreting your bench test data, contact Rockland Scientific.

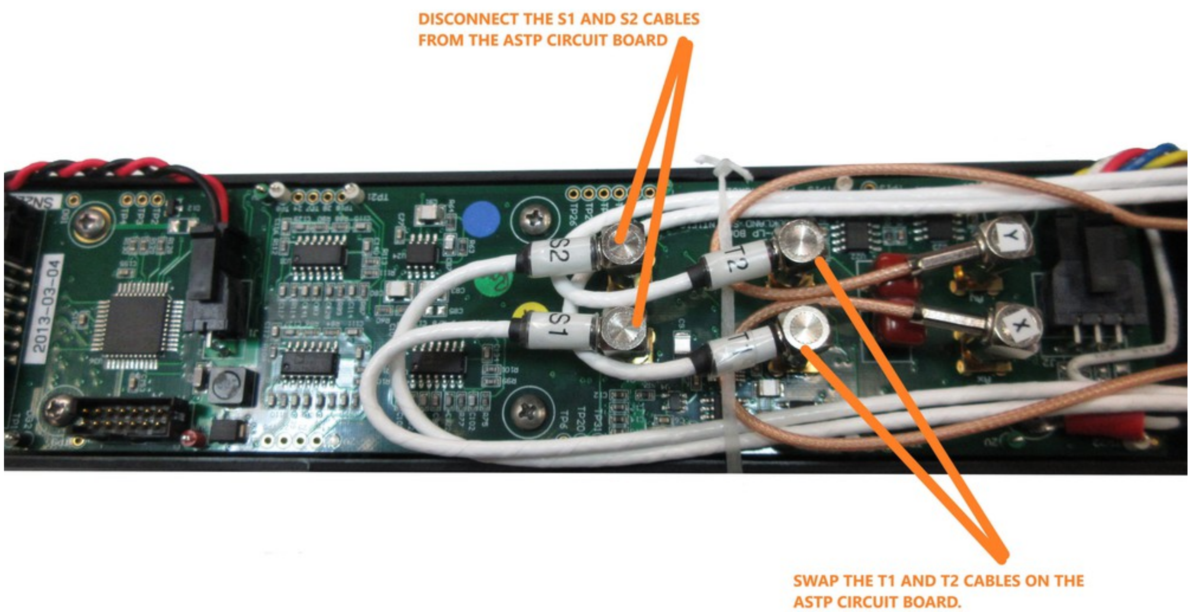


Figure 48: Modifying SMC connections on the ASTP board to identify the cause of noisy data.

6.5 Broken probes and sensors

Refer to Section 5.5 for instruction on determining if your probes or sensors are broken.

6.6 There are large vibrations in the spectra data

If the vibrations in the spectra are substantially large, inspect all the fasteners, cables, and components. Make sure they are secured. If the issue still exists or you require assistance, contact Rockland Scientific.

Appendices

A.1 Bench Test Checklist

The bench test checklist included on the following pages provides guidance on the expected signals from an electronics bench test (Section 4.3). If the signals deviate from the expected values, please forward the checklist and the data file to support@rocklandscientific.com.

> The values provided are for a standard instrument.
> Results may vary for custom configurations.

ROCKLAND SCIENTIFIC INTERNATIONAL INC.
520 Dupplin Road, Victoria, B.C. V8Z 1C1
Canada

web: www.RocklandScientific.com
tel: +1-250-370-1688 | fax: +1-250-370-0234
Business No.: 82695-5544

Bench Test Review Checklist

Please note that the document format has been optimized for Adobe Acrobat Reader

Conducted by: ______________________________ Date: ____________________

Reviewed by: ______________________________ Date: ____________________

Instrument Type: ___________________________ SN: _______________ Data File: ________________

Notes: ____

Bench Test Instructions:

1. Ensure that test probes are installed on the instrument.
2. Rest the instrument horizontally on a table or bench, preferably on something soft (e.g. open cell foam), with the pressure port/magnet centered and facing up.
3. Collect a minimum 60s data file and transfer to your computer, minimizing vibrations and shocks.
4. Generate figures using Zissou Essentials or the ODAS Matlab Library.

Please refer to your instrument user manual for further details on performing a bench test.

Are there any known factors that could affect the quality of the bench test? E.g. located at the top of a tall urban building, on a ship at sea, excessive electronic noise in the lab, people moving near the instrument?

Time Series Figure

- ☐ Ax and Ay counts are typically within ±500 counts. *Range:* ________________________________
  - ☐ Are there any large spikes in Ax or Ay? ____
- ☐ Ax and Ay are similar to each other, with Ax typically larger than Ay.
- ☐ Incl_T is at a reasonable, constant value (i.e. near room temperature). *Value:* _______________
- ☐ Incl_Y and Incl_X are at reasonable, constant values (based on instrument orientation). *Values:* ______________________
- ☐ T1_dT1 and T2_dT2 counts are typically within ±40 counts. *Range:* ________________________
- ☐ T1_dT1 and T2_dT2 offset values are less than 100 counts (specified in figure legend). *Values:* ______________________
- ☐ sh1 and sh2 counts have a mean of less than 10 counts. *Mean:* ____________________________
- ☐ sh1 and sh2 counts are typically within ±30 counts. *Range:* ________________________________
- ☐ P counts are typically within ±2 counts. *Range:* ____________________
- ☐ P_dP counts are typically within ±10 counts and seemingly random (i.e. no spikes or patterns at regular intervals). *Range:* ___________________
- ☐ (If applicable) The C1_dC1 counts are typically within ±50 counts. *Range:* ________________
- ☐ (If applicable) The C1_dC1 offset value is less than 6000 counts (specified in figure legend). *Value:* _______________________

Notes:

ROCKLAND SCIENTIFIC INTERNATIONAL INC.
520 Dupplin Road, Victoria, B.C. V8Z 1C1
Canada

web: www.RocklandScientific.com
tel: +1-250-370-1688 | fax: +1-250-370-0234
Business No.: 82695-5544

Spectra Figure

- ☐ P_dP shows a spectral density everywhere less than 10^1 counts^2/Hz.
- ☐ The peak of P_dP is less than 3 counts^2/Hz, and rolls off at approximately 2 Hz.
- ☐ The spectral peaks of Ax and Ay are below 10^2 counts^2/Hz, provided the instrument is well cushioned.
- ☐ Ax and Ay are similar to each other.
- ☐ T1 and T2 are similar to each other.
- ☐ T1 and T2 follow rising curves with spectral density of approximately 10^{-1} counts^2/Hz near 10^2 Hz.
- ☐ sh1 and sh2 are similar to each other.
- ☐ sh1 and sh2 follow rising curves with spectral density of approximately 10^{-2} counts^2/Hz near 10^2 Hz.
- ☐ (If applicable) C1 follows a rising curve with spectral density of approximately 10^0 counts^2/Hz near 10^2 Hz.

Please note that the spectra are expected to follow smooth curves, however, narrow band spikes may be visible due to explainable sources, such as: AC electrical field (50 or 60 Hz), EM sensor (15 Hz), and corresponding resonant frequencies. Broad band noise, particularly occurring in only one channel, should be investigated. Please note the presence of any spikes in the Notes below.*

Notes:

* Refer to the ASTP Calibration Report for reference.

ROCKLAND SCIENTIFIC INTERNATIONAL INC.
520 Dupplin Road, Victoria, B.C. V8Z 1C1
Canada

web: www.RocklandScientific.com
tel: +1-250-370-1688 | fax: +1-250-370-0234
Business No.: 82695-5544

(If applicable) CT/CLTU Time Series Figure

- ☐ JAC_T counts are typically within ±50 counts. *Range:* ______________________________
- ☐ JAC_C_I counts are typically within ±5 counts. *Range:* ______________________________
- ☐ JAC_C_V counts are on the order of 10^4 and have a typical range within ±100 counts.
  Range: ______________________
- ☐ Turbidity counts are typically within ±50 counts. *Range:* ___________________________
- ☐ Chlorophyll counts are typically within ±50 counts. *Range:* _________________________

Optional Test: To test for a signal response in the CT and/or CLTU sensors, blow on the temperature sensor and pass a fluorescent object in front of the CLTU sensors. Please note observed responses (i.e. changes in the signal) below.

- ☐ A response is observed after blowing on the temperature sensor.
  Response: ____
- ☐ A response is observed after passing a fluorescent object in front of the turbidity sensor.
  Response: ____
- ☐ A response is observed after passing a fluorescent object in front of the chlorophyll sensor.
  Response: ____

Notes:

(If applicable) EM Current Meter Figure

- ☐ The EMC_Cur (upper plot) signal appears to be of uniform amplitude over the entire dataset. Note: the middle plot shows the first second of this signal.
- ☐ The EMC_Cur (middle plot) signal shows a consistent 15 Hz pattern (i.e. 15 peaks visible over the 1 second interval).
- ☐ Narrow band spikes are visible at 15 Hz intervals (bottom plot). The first spike should occur at 15 Hz, and every second spike will be smaller than the previous one.

Notes:

(If applicable) U_EM Sensor Figure

- ☐ U_EM counts are typically within ±2000 counts. *Range:* ___________________________
- ☐ In the spectrum, peaks are visible at 10 Hz intervals. The first peaks should occur at approximately 10 Hz.

Notes:

A.2 Pre-Deployment Checklist

The pre-deployment checklist should be completed before EVERY deployment. It is encouraged to retain a completed version of the checklist with your deployment notes.

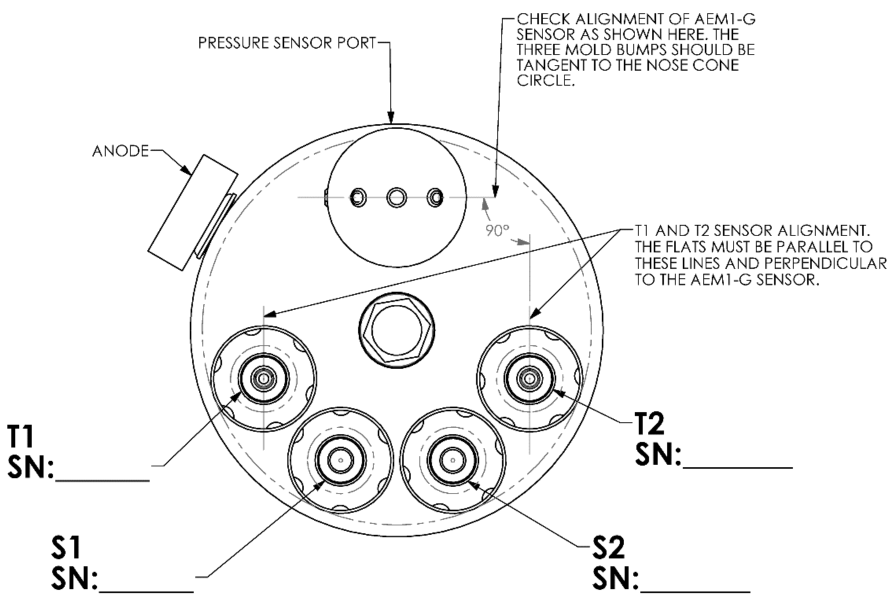
PRE-DEPLOYMENT CHECKLIST

This device is a very sensitive scientific instrument. To ensure proper operation and optimal results please follow the instructions in the instrument user manual.

This checklist summarizes essential pre-deployment steps.

MicroRider-1000-EM

- [ ] Read and understand the instrument manual
- [ ] Inspect all sealing surfaces & o-rings on instrument & confirm their integrity
- [ ] Complete electronics bench test checklist with test probes & confirm data acquisition
- [ ] Verify there is enough free space to record all the data files
- [ ] Set Date and Time on the instrument
- [ ] Ensure all probe ports have a greased o-ring and a white ferrule
- [ ] Ensure o-ring and ferrule are in correct order - consult manual for diagram
- [ ] Ensure that all bolts & connectors are secure (consult manual for safe torque rating)
- [ ] Ensure probes are fully inserted
- [ ] Confirm all probes are oriented correctly
- [ ] Ensure probe holders are tightened correctly - consult manual
- [ ] Confirm power supply and ancillary sensors (if applicable) are connected & functional
- [ ] Consult platform manufacturer for correct/safe integration instructions (if applicable)
- [ ] Turn on instrument and confirm communication via deck cable or platform interface



A.3 Configuration Files

The Rockland configuration file is a standard ASCII[13] text file. The instrument ships with a configuration file on the RDL Memory Module, created specifically for your instrument. The Rockland configuration file serves three purposes:

1. The file contains all settings required to configure the data acquisition. Upon start-up, the data acquisition software parses the configuration file to acquire data accordingly and provide the behaviour specified in the configuration file.
2. The configuration file is also used to store parameters required to convert the recorded raw data to physical units.
3. Finally, the file enables users to store additional information that will be useful for data processing, such as deployment location, cruise information and comments.

A.3.1 Anatomy of a Configuration File

The configuration file is an ASCII file that contains "parameters" and "comments", which are grouped into "sections". Definitions of these components are outlined below.

Parameters

Parameters are information that are stored within a configuration file. Parameters consist of two parts delimited by an equal sign: (i) a name, and (ii) a value. The syntax to specify a parameter is as follows:

```
name=value
```

Each line can have a maximum of one parameter, and an equal sign must separate the name of a parameter from its value. Extra white-space surrounding the name or value is ignored. Thus, `name=value` is equivalent to `name = value`.

Comments

Comments are all characters that follow a semicolon (;). Comments are ignored in data acquisition and data processing, but are still valuable because they can assist in understanding the meaning and value of a parameter. Examples of the use of comments include:

```
; A generic example showing comments.
[section] ; Description of section
parameter = value; Value from probe calibration on 2020-04-22
```

Sections

Sections are used to define groups of parameters. A section declaration must be on its own line and consist of the `name` string enclosed in square brackets ([ ]), i.e.

```
[section]
```

The declaration of a section automatically ends the previous section. Sections are referenced by their section identifier, which is a value constructed in one of two ways. First, sections are

[13] Configuration files can only contain 7-bit characters - values from 0x00 to 0x7F.

scanned for a parameter with the name `name`. If present, this parameter value is used as the section identifier. If not found, the `name` in brackets is used as the section identifier.

Root

Parameters declared before the first section declaration are automatically assigned to the root section `[root]`. The parameters in the `root` are used for data acquisition. The `[root]` section may contain parameters that determine the data acquisition and instrument functionality. If parameters are not listed, the default values will be used.

> Using the default parameters for the root section is recommended by Rockland.

An example of a typical root section is:

```
; -----------------
; The [root] section may contain parameters that determine the data
; acquisition and instrument functionality.  If parameters are not listed,
; the default values are recommended, and will be used if applicable to the
; instrument.  For more information about available [root] section parameters,
; refer to your instrument manual or contact support@rocklandscientific.com.
[root]
minSystemVoltage = 13.5 ; [V] Battery voltage at which data acquisition stops.
                        ; Do NOT modify this parameter.
```

The `minSystemVoltage` is a required parameter that controls the cut off battery voltage for data acquisition and provides protection for the electronics and data of the instrument. The value of this parameter is determined by the type of battery in your instrument and will be set in the configuration file shipped with your instrument. Do not change this parameter without consulting Rockland Scientific.

For instruments with a Rockland Data Logger, all other parameters in the `[root]` section do NOT need to be specified in the configuration file because they have default values. It is recommended that you use these default values, but in some situations you may wish to change the following data acquisition parameters:

- `prefix`: Controls the naming of the files written to the memory module. The files will be named incrementally with the prefix followed with an incremental number of the file.
  Default = DAT_
- `maxFileDuration`: Controls the length of each data file, in seconds. There is no time delay and therefore no data lost between closing and creating a new file. A new data file will automatically be started once the max file duration has been reached.
  Default = 14400 seconds (4 hours or 117 MB[14])

[14] for an address matrix with eight columns and a sample rate of 512 Hz, see Section 2.5.8

- `maxFileSize`: Controls the maximum size of each data file, in megabytes. There is no time delay and therefore no data lost between closing and creating a new file. A new data file will automatically be started once the max size duration has been reached. Default = 200 MB (approximately 6.8 hours[15])

> Both `maxFileDuration` and `maxFileSize` can be declared. The software will create a new file when the smaller of the two conditions is met.

Other parameters in the `[root]` section control the sampling rate and the battery type. Please contact Rockland Support at support@rocklandscientific.com if you wish to change these parameters.

Matrix

The matrix section is used to configure the order of channels acquired and their rate of sampling. Each number in the address matrix corresponds to a channel id. Channel 0 (ground reference) is sometimes used as a filler to maintain the shape of the address matrix. Each row is acquired at the sampling rate (512 Hz if not specified).

```
; -----------------
; The [matrix] section is used to configure the order of channels acquired and
; their rate of sampling.  Each number in the address matrix corresponds to a
; channel id.  Channel 0 (ground reference) is often used as a filler to maintain
; the shape of the address matrix.  Each row is acquired at the sampling rate
; (512 Hz if not specified), therefore, the channels of the first 2 columns will
; be acquired at 64 Hz (512 Hz/8 rows) and the other channels will be acquired
; at 512 Hz.

[matrix]
row01 =  0    0    1   2   5   8   9   52   53   64   65
row02 =  32   40   1   2   5   8   9   52   53   64   65
row03 =  41   42   1   2   5   8   9   52   53   64   65
row04 =  4    0    1   2   5   8   9   52   53   64   65
row05 =  10   11   1   2   5   8   9   52   53   64   65
row06 =  12   48   1   2   5   8   9   52   53   64   65
row07 =  0    49   1   2   5   8   9   52   53   64   65
row08 =  0    50   1   2   5   8   9   52   53   64   65
```

Channels

Channel sections are used to identify each of the channels sampled by the data acquisition system. Each channel listed in the address matrix has a unique channel section which identifies the `name` and `id` of the channel. Additional parameters used to convert the raw data to physical units may also be included in the channel section.

Optional sections

Additional sections can be added to the configuration file to provide additional information that may be relevant for record keeping and/or data-processing. Any relevant information

[15]for an address matrix with eight columns and a sample rate of 512 Hz, see Section 2.5.8

can be stored in these optional sections. For example, your instrument typically ships with an [instrument_info] section which includes details about the instrument type and serial number:

```
; -----------------
; This section identifies your instrument.  The vehicle parameter is used for data
; processing.  The other values are for reference only.
[instrument_info]
 vehicle    =  vmp          ; downward-profiling, comment parameter for upward-profiles.
 ; vehicle  =  rvmp         ; upward profiling, uncomment for upward-profiling.
 model      =  VMP250IR-DL3 ; the actual model.
 sn         =  401          ; the serial number of the instrument.
```

It is also recommended that you include a [cruise_info] section to identify details about the deployment.

A.3.2 Modifying the Configuration File

Adding Values

Information can be added to a configuration file but the resulting file must adhere to the format described in Section A.3.1. In addition, Rockland instruments expect certain sections and parameters to exist, so please exercise care when modifying your configuration file and confirm that it performs data acquisition as expected before your deployment by collecting data with the updated `setup.cfg` file and processing the data.

When adding a new section to the configuration file, make sure that it has a unique name. Never use a parameter with the name `id` because that is used in conjunction with the [matrix] section to identify a channel and to demultiplex the data (unless, of course, that channel exists on the instrument and it is identified in the [matrix] section).

> ⚠ After making any changes to the configuration file, confirm that it performs data acquisition as expected. Errors in the format of the configuration file may prevent the instrument from collecting data.

Updating Coefficients

Coefficients used for the conversion to physical units may need to be updated, particularly after installing a new probe or sensor or after performing an *in situ* calibration. More specifically, your `setup.cfg` file will need to be updated in the following scenarios:

- After installing a new shear or temperature probe.
- After performing an *in situ* calibration of an FP07 temperature probe.
- After the annual (recommended) shear probe re-calibration.
- After the bi-annual (recommended) JAC-CT sensor re-calibration.
- To zero the pressure sensor (see below).
- After replacing a circuit board.

Zeroing the Pressure Sensor

To zero the pressure sensor, the coefficient `coef0` for the `P` channel needs to be modified. The following method is recommended:

1. Take a one minute data file at the time and place where the pressure should be set to zero (e.g. in air at the deployment location). The procedure to collect the data file is the same as performing an electronics bench test (Section 4.3).
2. Load the data file into Zissou Essentials and plot the pressure channel[16].
3. Estimate the average value of the pressure from the plot.
4. Use this value to adjust the `coef0` in the `P` channel section by subtracting from the existing value. The `setup.cfg` file can be modified using either Zissou Essentials or any text editor.
5. Save the updated `setup.cfg` file to the RDL USB Drive.
6. Take another data file to verify that the value has been zeroed.

[16]The ODAS Matlab Library can also be used to plot the pressure time series using the command `show_ch(filename,'P')`.

A.4 Log files

Your instrument records events that occurred during data acquisition in a log file on the memory module. The log file is named `logfile.txt`. An example of such log file is shown below:

```
5e9f6e24 11 0000 Undefined  --- 2020-04-21 22:05:24.348 - "power applied"
5e9f6e56 10 0000 Undefined  --- 2020-04-21 22:06:14.352 - "start signal received"
5e9f6e56 0b 0001 dat_0002.p --- 2020-04-21 22:06:14.371 - "starting data file"
5e9f7065 0d 01d6 dat_0002.p --- 2020-04-21 22:15:01.030 - "bad buffer"
5e9f7082 11 0000 Undefined  --- 2020-04-21 22:15:30.205 - "power applied"
5e9f70ce 10 0000 Undefined  --- 2020-04-21 22:16:46.212 - "start signal received"
5e9f70ce 0b 0001 dat_0003.p --- 2020-04-21 22:16:46.236 - "starting data file"
```

A.4.1 Log-file Format

Each line in a log-file describes a single event. The first part of each line is in a machine-readable form to support automated scripts. The second part of each line is in human-readable form.

Events are recorded using the following format:

```
          EVENT = {MACHINE_FORMAT} --- {HUMAN_FORMAT}

 MACHINE_FORMAT = {time} {event_type} {record#} {data_file_name}
   HUMAN_FORMAT = {human_time} - "{event_description}" [additional_info]
```

The above fields are defined in Table 8.

Field	Description
`time`	Time of the event, as given by the UNIX "`time`" function. Value is in hexadecimal format and always uses the first 8 characters.
`event_type`	Type of event identified by a two digit hexadecimal number. See Technical Note 052 for a list of event types.
`record#`	The record number during which the event occurred. Formatted as a 4-character hexadecimal value.
`data_file_name`	Name of the data file. If a data file has not been created, the value "`unknown`" is used. This entry always has a width of 10 characters.
`human_time`	Time of the event (HH:MM:SS).
`event_desc`	The event type.
`additional_info`	Optional extra information for the event.

Table 8: Description of log file entries

Refer to Technical Note 052 (Section A.5) for the complete list of event types and differences with CF2 Persistor systems.

A.5 TN 052 – Rockland Data Logger (RDL)

Technical Note 052, which gives an overview of the Rockland Data Logger (RDL), is contained in the following Appendix. The Technical Note discusses important differences between instruments with the RDL and the CF2 Persistor.

RSI Technical Note 052

Rockland Data Logger (RDL)

Overview and Comparison with CF2 Systems

Peter Stern

2020-12-01

Rockland Scientific International Inc.
520 Dupplin Rd
Victoria, BC, CANADA, V8Z 1C1
www.rocklandscientific.com

Contents

1 Rockland Data Logger (P113 board) Overview 2

2 Computer Connection and File Transfer (USB Drive) 2

3 User Interface with Zissou Essentials 4

4 Boot-Up and LED Behaviour 4

5 Power Draw 5

6 System Shutdown Settings 5

7 Data Logging 6

8 Configuration File (`setup.cfg`) 7

9 Logfile (`logfile.txt`) 11

Version History

- 2020-11-06: Initial Version
- 2020-12-01: JMM - Removed extra item in table of event types. Fixed typos.

1 Rockland Data Logger (P113 board) Overview

The Rockland Data Logger (RDL) is a third-generation data logging board designed for instruments manufactured by Rockland Scientific Inc. (Rockland). The RDL is designed to replace second-generation data logging systems, which use a Persistor CF2 computer. The RDL is based on a Linux Operating System with custom data acquisition software. The standard mass storage for data is a proprietary 64 GB memory module that is referred to as the "RDL memory module". The Rockland Data Logger board has a built-in backup energy source (supercapacitor) to ensure that the data logging can shutdown properly when power is removed. There is also a small CR2032 3 V battery that maintains the onboard real-time clock. This battery should be replaced every 4 years. The recommended replacement date is labelled with a sticker at the production facility when the instrument is manufactured.

2 Computer Connection and File Transfer (USB Drive)

The RDL eliminates the need to connect to internally recording instruments using a terminal. Therefore, the only required interaction with the instrument is by viewing the contents of the RDL memory module by connecting to it via the built-in file manager found on any personal computer (i.e. File Explorer, Finder). This has been made possible on the RDL through USB Mass Storage capability. When the USB connector on the deck cable is plugged into the computer, a drive, referred to as the "RDL USB Drive", will appear in the file manager, similar to viewing a USB thumb drive or external hard drive. Subsequently, files can be opened, deleted or transferred (i.e. drag and drop) between the computer and the instrument.

To access files on the instrument from a computer with read and write permissions:

1. Ensure that the instrument is OFF.

   > ℹ To access the files with read and write permissions, the RDL board must be receiving power (5 V) only from the USB connection.

2. Connect the instrument to your computer (refer to Instrument User Manual).

3. After connecting the USB, wait for the RDL memory module to be detected by the computer. A notification from the computer should indicate when the connection has been established.

   > ℹ It can take up to 60 seconds for a connection to be established because the instrument's operating system must boot up first.

4. Access the files using the built-in file manager (i.e. File Explorer, Finder) on the computer.

> ⓘ When the deck cable USB is disconnected from the computer it is important to wait at least 10 seconds before re-connecting it. This allows time for the electronics to properly shut off.

> ⓘ If data logging is started while connected to the RDL USB Drive, the File Manager will reset and reconnect to the drive. Files on the RDL USB Drive will have read only permission while data acquisition is active. The new files will not be visible while they are being created by the data logging process.

> ⚠ If the RDL memory module becomes corrupted, the File Manager will detect the problem, likely indicating that the RDL USB Drive needs to be reformatted. Use the disk formatting tool of the computer's operating system to reformat the RDL USB Drive. This will delete all the files on the drive, so the `setup.cfg` file will need to be copied back to the RDL USB Drive. If data logging is started when there is no `setup.cfg` file on the drive, the RDL will use the factory default `setup.cfg` that is stored in the onboard memory. A file named `MISSING_SETUP_FACTORY_SETUP_USED.txt` will be placed on the RDL USB Drive if the factory default `setup.cfg` is used.

3 User Interface with Zissou Essentials

The Zissou Essentials software package[1] can be used to interact with the RDL and perform basic tasks. More specifically, the software can be used to:

- Set the instrument clock
- Check the battery voltage
- Display the software version on the instrument
- Review the instrument log file
- Determine the free space on the memory module
- Check for warnings or errors
- Display channel statistics from a record in a previously recorded data file

> Consult the Instrument User Manual for details on how to connect to the instrument with Zissou Essentials.

4 Boot-Up and LED Behaviour

Boot Time

The boot time of a RDL varies depending on the usage of the instrument. More specifically:

- The boot time can take up to two (2) minutes, when the instrument is booted for the first time, or after it has been in storage. This is because the backup energy source needs to charge.
- The boot time is about 40 seconds when the instrument is in regular use because the backup energy source is already charged.

Most instruments, particularly those with an internal battery (e.g. VMP-250-IR, MicroCTD) are configured to start data acquisition automatically, immediately after the boot process is complete.

Instruments that are managed by a host platform may be configured to wait for commands from the host to start and stop data logging. In these configurations, the host platform is connected via a serial port to the RDL.

[1] Version 1.6 released November 2020

LED Behaviour

Instruments that have an external LED installed (e.g. VMP-250-IR, MicroCTD) use the light to indicate the status of the RDL board. More specifically:

1. When the instrument is turned on, the LED will blink 1 second on and 1 second off until the boot process is complete (approximately 40 to 120 seconds).
2. When data logging starts, the LED will turn solid red.
3. After approximately 64 seconds of data logging, the LED will turn off, but data logging will continue.

> Rockland instruments that do not have an external LED installed (e.g. MicroRider-1000) follow the same boot up sequence.

5 Power Draw

The RDL draws approximately 0.4 W more power than the CF2 Persistor. For the power draw of a specific instrument and sensor configuration, consult your Instrument User Manual, or contact Rockland Support at support@rocklandscientific.com.

6 System Shutdown Settings

To protect the system from unexpected power loss there are software and hardware settings to shut the system down gracefully:

- The hardware setting is configured at the factory on the P050 Power Supply circuit board. This will shutdown the instrument when the supply voltage declines to the set cutoff limit.
- The software shutdown is enabled in the configuration file (`setup.cfg`) used for controlling data logging. There is a `minSystemVoltage` parameter that will be set to be slightly above the power supply hardware cutoff (Section 8). This software shutdown only works while the instrument is logging data.

> This software parameter will stop only the data logging. The RDL board and all other electronics will continue drawing power until the cutoff on the Power Supply is triggered.

7 Data Logging

For data logging to start the following conditions must be met:

1. Raw input power applied (7-18VDC)
2. Onboard super-capacitor is fully charged
3. `setup.cfg` file exists and it is correct
4. ON signal applied
5. instrument software is configured to start data logging automatically on boot

For both RDL and CF2 Persistor systems, data is logged in standard Rockland `*.P` format (See Technical Note 051 for more information). A `logfile.txt` is also created and updated to note key events during data acquisition (Section 9).

There are several notable differences between the RDL and CF2 Persistor systems. For RDL systems:

- The control settings for data acquisition are built into the system or are set in the `setup.cfg` configuration file. The user only has the ability to start or stop data acquisition. Unlike for CF2 Persistor systems, the user does not have to set any command line flags to begin data acquisition.
- Data is logged continuously when multiple files are created. This implies that there is no data lost when the software closes the current file and starts a new file.
- Damaged data records, i.e. "bad buffer" events, are now automatically flagged in the data file to reduce any errors during data processing.
- The `logfile.txt` has different event codes (Section 9).
- If data logging exits with an error, then an error log file is copied to the RDL USB Drive. This file will be named `error_log_YYYY-MM-DD_HH-MM-SS`. It contains a series of verbose statements from the different scripts. The file is human readable and may help in troubleshooting the error.

8 Configuration File (setup.cfg)

The `setup.cfg` file for a RDL system is very similar to the file used for the CF2 Persistor systems; however, they are NOT interchangeable. Differences between the `setup.cfg` file for RDL and CF2 Persistor systems are outlined below. A full description of the `setup.cfg` file can be found as an Appendix in the Instrument User Manual.

> ⚠ The `setup.cfg` file for an instrument with a RDL board **cannot** be used for an instrument with a CF2 Persistor (and vice versa).

Special Character

The special character, i.e. `ch=255`, is **not used** for RDL systems. This character was used to test the integrity of the communication in CF2 Persistor systems.

Root Section

The parameters used for data acquisition are specified in the `[root]` section of the `setup.cfg` file. The parameters used in RDL systems are different than those In CF2 systems. More specifically, the following parameters are **no longer used for RDL systems**:

- `disk`
- `recsize`
- `no-fast`
- `no-slow`
- `num_rows`
- `stop_after_release`
- `max_pressure`
- `man_com_rate`

The other significant difference in the `root` section is that for RDL systems, all parameters have default values that will be used for data acquisition if they are not specified.

> ⓘ For RDL systems, each parameter in the root section has a default value so it does NOT need to be specified.

For RDL systems, the available parameters in the `[root]` section, and their default values (in square brackets), are as follows:

- `prefix = [DAT_]`
  Controls the naming of the files written to the memory module. The files will be named incrementally with the prefix followed with an incremental number of the file.

- `maxFileDuration = [14400]` seconds (4 hours)
  Controls the length of each data file, in seconds. There is no time delay and therefore no data lost between closing and creating a new file. A new data file will automatically be started once the max file duration has been reached.

- `maxFileSize = [200]` MB (approximately 6.8 hours[2])
  Controls the maximum size of each data file, in megabytes. There is no time delay and therefore no data lost between closing and creating a new file. A new data file will automatically be started once the max size duration has been reached.

- `minSystemVoltage = [12]` Volts
  Controls the cut off battery voltage for data acquisition. The value of this parameter is determined by the type of battery in your instrument and **will be set in the configuration file shipped with your instrument**. Do not change this parameter without consulting Rockland Scientific.

> Both `maxFileDuration` and `maxFileSize` can be declared. The software will create a new file when the smaller of the two conditions is met.

SeaBird Sensor Coefficients

For instruments that have a Seabird SBE3/4 installed, the value of the coefficient `coef5` is different for RDL and CF2 Persistor systems due to hardware differences. More specifically:

- For RDL systems: `coef5 = 38.4e6`
- For CF2 Persistor systems: `coef5 = 24e6`

Pressure Sensor Coefficients (i.e. Zeroing the Pressure Sensor)

In both RDL and CF2 Persistor systems, the parameter `coef0` is used to zero the pressure sensor. For RDL systems, the following method is recommended to determine the coefficient, and hence zero the pressure sensor:

1. Take a one minute data file at the time and place where the pressure should be set to zero (e.g. in air at the deployment location). See the "Electronics Bench Test" section of the Instrument User Manual for detailed instructions.
2. Load the data file into Zissou Essentials and plot the pressure channel[3].

[2] For an address matrix with eight columns and a sample rate of 512 Hz
[3] The ODAS Matlab Library could also be used with the command `show_ch(filename,'P')`.

3. Estimate the average value of the pressure from the plot.
4. Use this value to adjust the `coef0` in the `P` channel section by subtracting from the existing value. The `setup.cfg` file can be modified using either Zissou Essentials or any text editor.
5. Save the updated `setup.cfg` file to the RDL.
6. Take another data file to verify that the value has been zeroed.

Release Parameters

For instruments that are using the release function, such as a VMP-6000 with a ballast release, the parameters in the `setup.cfg` file for RDL systems are all different from those for CF2 Persistor instruments.

To configure the release for RDL systems, the following options, and their default values (in square brackets), can be used:

- `ReleaseEnable = [NO]`
  The global release flag that either allows or prevents the generation of release events. When set to "NO", all release events are prevented. When set to "YES", all configured release mechanisms can generate release events. There is one exception to this rule in that the software can explicitly generate a release even when the release is disabled. All other release events are generated by the FPGA.
  Acceptable Values = `YES` or `NO`
- `PressureReleaseEnable = [YES]`
  Enables release events when pressure exceeds a specified value. This is the most common form of release.
  Acceptable Values = `YES` or `NO`
- `ReleasePressure = [500]` dbar
  Maximum operating pressure and the point at which a release signal should be generated. Value in dBar so it corresponds to approximately 1 count per meter.
  Acceptable Values = Number > 0 and $<$12,000
- `PressureChannel = [P]`
  Name of channel from which to acquire the pressure. The calibration coefficients and type of this channel must be correct in order to work as expected.
  Acceptable Values = String matching a channel name with known channel type and channel ID that is being sampled.
- `DeltaPressureReleaseEnable = [YES]`
  Trigger a release when an instrument is stuck and stops falling. Some instruments, such as those mounted on gliders, could appear stuck when they actually are not so this release event can be disabled.
  Acceptable Values = `YES` or `NO`

- `MinDeltaPressure = [0.2]` dbar per second
  The change in pressure required for an instrument to be considered moving. When the change of pressure is less then this value for a full second, a release can be triggered.
  Acceptable Values = Number < 10

- `StartDeltaPressure = [50] dBar`
  To prevent the release from triggering at the surface, a minimum pressure value is required to enable this release event.
  Acceptable Values = Number > 0 and $< 12{,}000$

- `PowerReleaseEnable = [NO]`
  Trigger a release when the input power drops to an unsafe level. Instruments with dedicated release batteries do not require this option and can use the loss of input power to trigger a release. However, some instruments have no such battery so the release must be triggered before the main battery power is fully depleted.
  Acceptable Values = `YES` or `NO`

- `ReleasePowerChannel = [V_Bat]`
  Channel on which the input power voltage can be observed.
  Acceptable Values = String containing channel name with a known type and sampled channel ID.

- `MinValidPower = [7]` Volts
  When the observed input power voltage is below this value for a full second, trigger a power release event.
  Acceptable Values = Number ≥ 0 and < 40

- `BrownoutReleaseEnable = [YES]`
  When the CPU stops interacting with the FPGA, a release can be triggered. This protects against software bugs that could prevent a release and expedites the retrieval of an instrument that, for some reason, is not recording data. This option is only valid when recording data. The mechanisms used to detect brownout conditions can change depending on the hardware in use.
  Acceptable Values = `YES` or `NO`

- `SoftwareReleaseEnable = [YES]`
  A software release is when the CPU triggers the release in place of the FPGA. An example would be the release generated when data acquisition exits. There could also be other future events covered by the software release label.
  Acceptable Values = `YES` or `NO`

A typical example of a `[release]` section for a VMP is:

```
[release]
ReleaseEnable = YES
ReleasePressure = 2200
```

With these settings, the release would be triggered when the instrument reaches a depth of 2200 dBar. A `P` channel with correct calibration coefficients is required.

9 Logfile (logfile.txt)

The log file is reported in the same format as is generated with a CF2 Persistor. An example of a RDL produced log file is shown below:

```
5e9f6e24 11 0000 Undefined  --- 2020-04-21 22:05:24.348 - "power applied"
5e9f6e56 10 0000 Undefined  --- 2020-04-21 22:06:14.352 - "start signal received"
5e9f6e56 0b 0001 dat_0002.p --- 2020-04-21 22:06:14.371 - "starting data file"
5e9f7065 0d 01d6 dat_0002.p --- 2020-04-21 22:15:01.030 - "bad buffer"
5e9f7082 11 0000 Undefined  --- 2020-04-21 22:15:30.205 - "power applied"
5e9f70ce 10 0000 Undefined  --- 2020-04-21 22:16:46.212 - "start signal received"
5e9f70ce 0b 0001 dat_0003.p --- 2020-04-21 22:16:46.236 - "starting data file"
```

A traditional log file `logfile.txt` is generated by the data acquisition software on the RDL. This log file is designed to have the same format as those on CF2 Persistor systems; however, there are some key differences in the log file event types due to differences in the data acquisition systems. These differences are highlighted below in Table 1. The colour scheme is as follows:

- White events can occur on both CF2 and RDL systems.
- Blue events can occur on CF2 only systems.
- Red events are no longer used on either system.

Table 1: Possible event types within your log file. Colors are such that white events can occur on both CF2 and RDL systems, red events are no longer used on either system, and blue events can occur only on CF2 systems.

Code	Event Name	Description
01	`pressure release`	Release triggered because the pressure exceeded max pressure.
02	`fall rate release`	Release triggered because the fall rate was less than 0.2 dbar/s for 4 consecutive seconds.
03	`timeout release`	Release triggered because the duration of data acquisition exceeded max time
04	`power is bad`	Release triggered due to insufficient supply voltage. The power-good signal from the power-supply board (PS) is disabled.
05	`power good signal received`	The power-good signal from the PS board received. This event has not been used since v4 of the ODAS5IR data acquisition software.
06	`switch is off`	The power ON/OFF switch was set to OFF.
07	`manual stop`	Acquisition was stopped manually by an operator.
08	`marker`	Not used.
09	`maximum file size`	Data file reached its maximum allowed size.
0a	`out of disk space`	Disk space was insufficient for data storage.
0b	`starting data file`	Data acquisition started. The event time corresponds with the creation of a new data file.
0c	`acquisition stop`	Data acquisition stopped.
0d	`bad buffer`	Record contains a bad buffer.
0e	`maximum file time`	Data file reached its maximum allowed time.
0f	`10s data timeout`	No data observed for 10 seconds. This indicates a serious error.
10	`start signal received`	A start signal was received. This occurs when data acquisition is first launched but before data acquisition starts.
11	`power applied`	Instrument switched on and power applied. There will be a delay of 1 to 2 seconds between when the power is applied and when the event is logged.
12	`data file trimmed`	This event corresponds with power being shut off before data acquisition has stopped. The last record in the data file is removed because it contains invalid data.
13	`release due to low voltage`	Release triggered because the input voltage fell below the minimum valid voltage specified in the configuration file.
14	`release triggered by software`	Release triggered by the CPU instead of the FPGA. An example is a release generated when data acquisition exits.

– End of document –

A.6 Spares Kit

The contents of the spares kit is outlined on the following page. Prior to any deployment or cruise it is recommended that you ensure your spares kit is complete. Contact Rockland at support@rocklandscientific.com if you need any replacement items.

11/3/2020

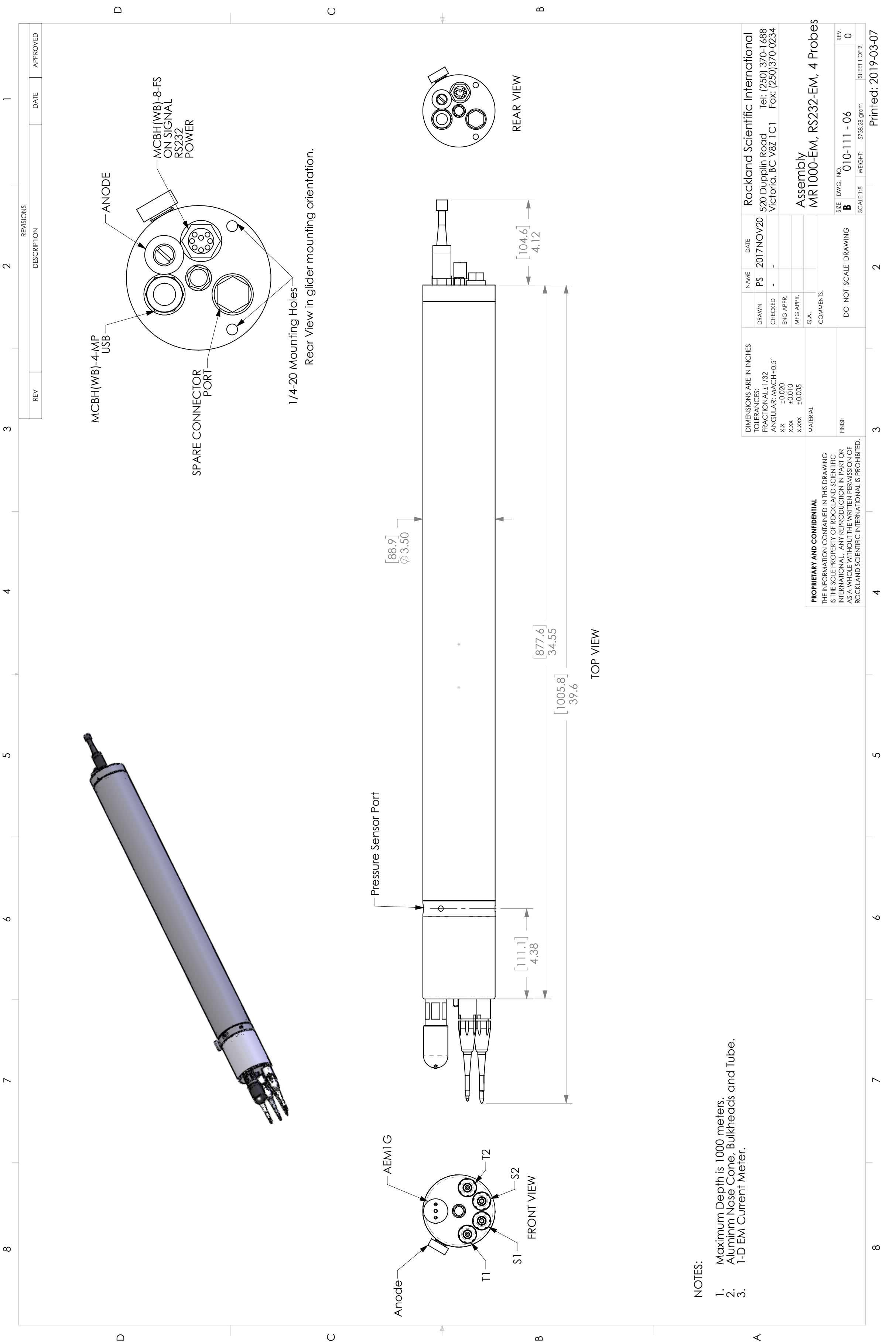
BILL OF MATERIALS
037-135-20 REV 0
Spares Kit, MR1000DL3

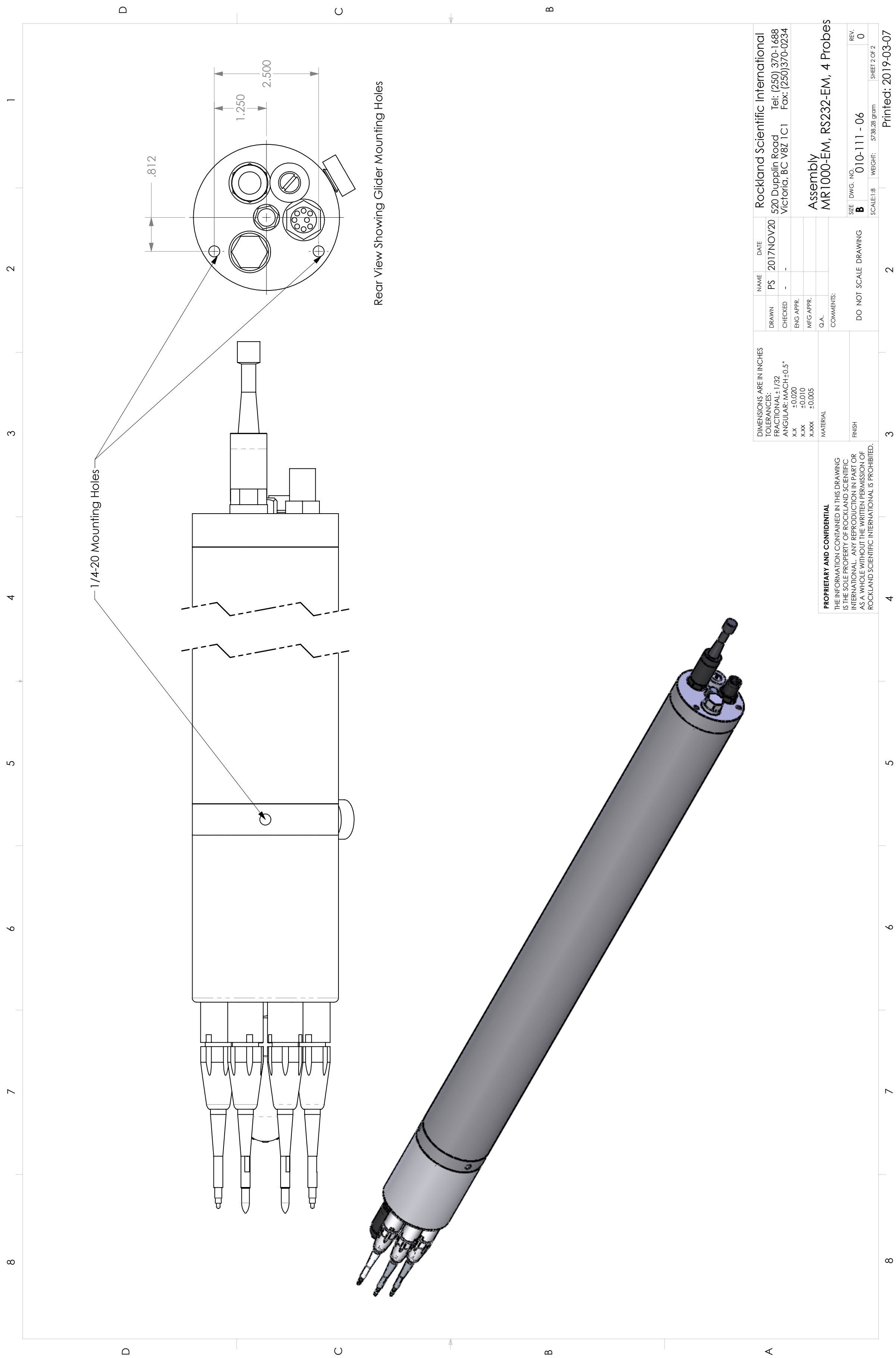
Item No.	Part Number	Revision	Description	Use	Qty
1	591-011-10	-	O-Ring, 2-012 Buna-N, 70A	Probe Holder Sensor Seals	10
2	591-099-10	-	O-Ring, 2-151 Buna-N, 70A	Main Bulkhead Face Seals	3
3	591-013-10	-	O-Ring, 2-014 Buna-N, 70A	Sealing Nut, MCBH Bulkheads, Plug	10
4	591-014-10	-	O-Ring, 2-015 Buna-N, 70A	Probe Holder Face Seals	6
5	592-013-10	-	Backup-Ring, 8-014 Buna-N, 90A	Sealing Nut	4
6	634-004-10	-	Nut, Hex, 1/4-20, SS316	Bulkhead Insertion Plate	2
7	240-005-10		Fuse, Glass, 1A, 250VAC, 5 X 20 mm	In-Line fuse for P113R01 instruments	2
8	240-001-10	-	250 mA, 125 V, fast blow SMF fuse	LP-Power Circuit Board ("F1" lower side)	2
9	240-002-10	-	1 A, 125 V, fast blow SMF fuse	LP-Power Circuit Board ("R1" upper side)	2
10	501-052-10	0	1/4 inch diameter clear heat shrink tubing x 8 mm length	Probe SMC cable connector insulation	4
11	500-027-10	3	Probe Holder Ferrules	Probe Holders	4
12	013-124-20	1	Assembly, Anode, Aluminum	Replacement Anode Assembly	2
13	037-060-20	-	USB Stick, MR1000	Data Files, Manuals, utilities, software	1
14	500-529-10	0	Instrument Assembly Plate, Micro-Rider	Assembling Instrument Pressure Case	1
15	013-175-20	-	Grease, 1oz Dow DC-4, Bottle with Yorker Cap	All O-Ring Seals	1
16	977-011-10	-	Container, Storage Box, 10 compartment,	Spares Kit Container	1
17	633-034-10		Washer, Sealing, 1/4 inch, 316SS with PVC Seal	For Anodes	2
OPTION, AEM1-G SENSOR					
30	651-000-10		Cable Tie, 4 inch	AEM1-G wiring	4
31	651-001-10		Twine, Lacing, Flat, "wax string"	AEM1-G wiring	12 inch
32	976-027-10		Tape, Conductive Shield	AEM1-G wiring shield	1
33	593-016-10	-	O-Ring, JIS-2401, P16 Buna-N, 70A	AEM1-G sensor, face seal	1
34	593-212-10	-	O-Ring, JIS-2401, S10 Buna-N, 70A	AEM1-G sensor, piston seal	1

Rockland Scientific International Inc.

A.7 Outline Drawing

The outline drawing on the following page(s) shows the components of the MicroRider-1000 and its dimensions.

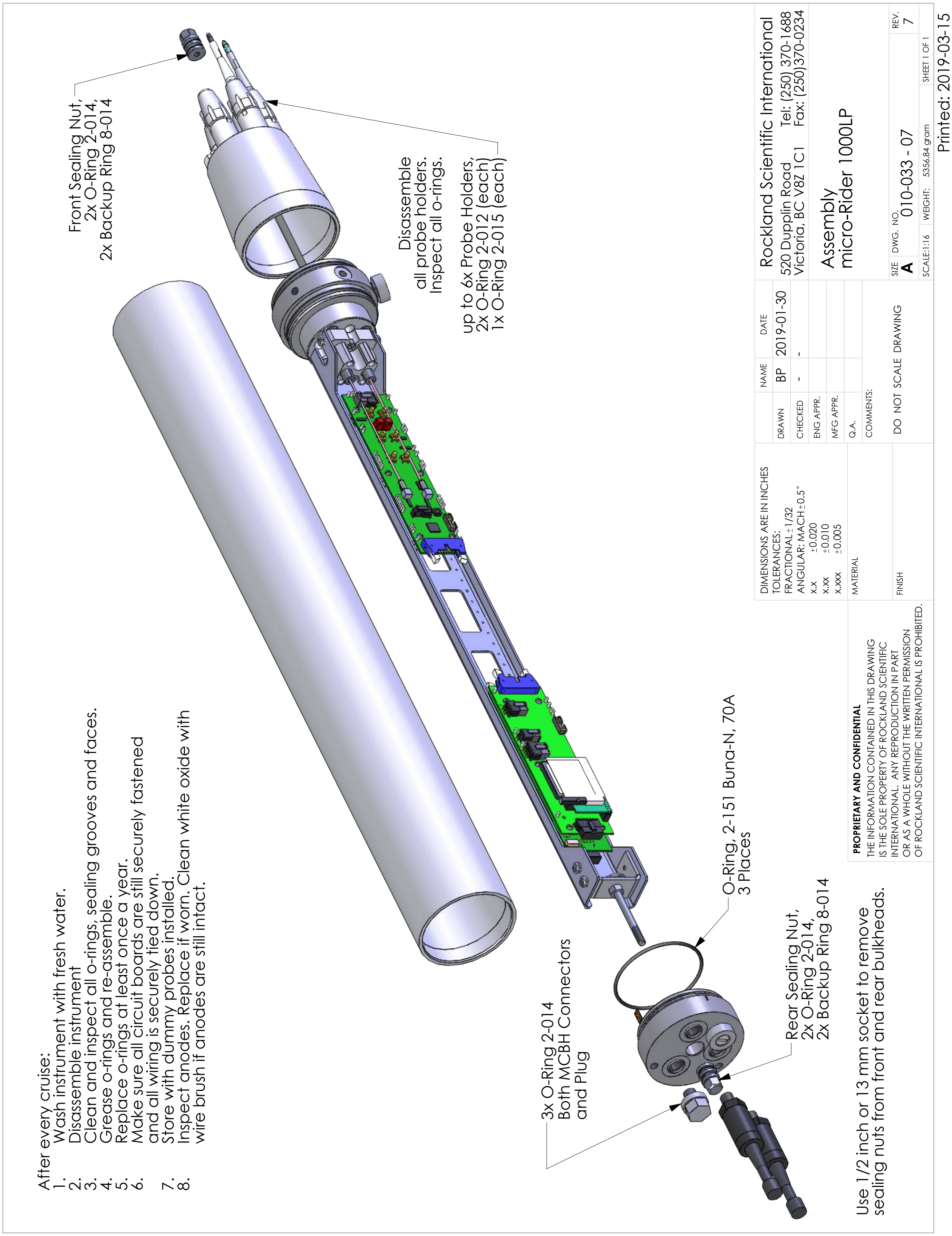

MCBH(WB)-4-MP
USB
ANODE
MCBH(WB)-8-FS
ON SIGNAL
RS232
POWER
SPARE CONNECTOR
PORT
1/4-20 Mounting Holes
Rear View in glider mounting orientation.
REAR VIEW
[104.6]
4.12
[88.9]
∅3.50
[877.6]
34.55
[1005.8]
39.6
TOP VIEW
Pressure Sensor Port
[111.1]
4.38
AEM1G
T2
S2
FRONT VIEW
S1
T1
Anode
NOTES:
1. Maximum Depth is 1000 meters.
2. Aluminm Nose Cone, Bulkheads and Tube.
3. 1-D EM Current Meter.
Rockland Scientific International
520 Dupplin Road
Victoria, BC V8Z 1C1
Tel: (250) 370-1688
Fax: (250)370-0234
Assembly
MR1000-EM, RS232-EM, 4 Probes
DRAWN PS 2017NOV20
DO NOT SCALE DRAWING
PROPRIETARY AND CONFIDENTIAL
B
010-111 - 06
REV. 0
Printed: 2019-03-07

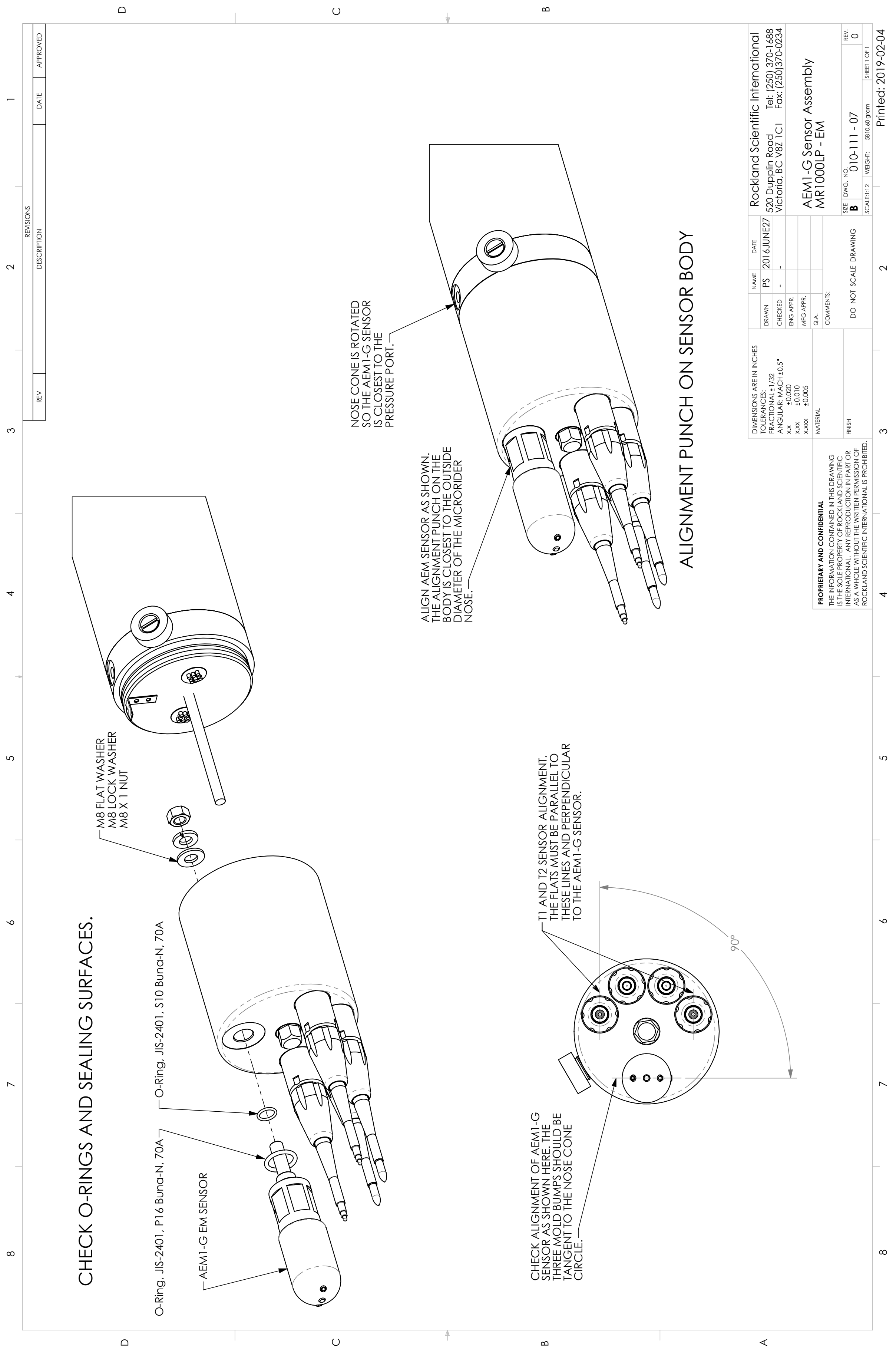


2.500
1.250
.812
Rear View Showing Glider Mounting Holes
1/4-20 Mounting Holes
Rockland Scientific International
520 Dupplin Road
Victoria, BC V8Z 1C1
Tel: (250) 370-1688
Fax: (250)370-0234
Assembly
MR1000-EM, RS232-EM, 4 Probes
DRAWN PS 2017NOV20
CHECKED - -
ENG APPR.
MFG APPR.
Q.A.
COMMENTS:
DO NOT SCALE DRAWING
SIZE B
DWG. NO. 010-111 - 06
REV. 0
SCALE:1:8
WEIGHT: 5738.28 gram
SHEET 2 OF 2
Printed: 2019-03-07
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/32
ANGULAR: MACH ±0.5°
X.X ±0.020
X.XX ±0.010
X.XXX ±0.005
MATERIAL
FINISH
PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF ROCKLAND SCIENTIFIC INTERNATIONAL. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF ROCKLAND SCIENTIFIC INTERNATIONAL IS PROHIBITED.

A.8 Maintenance Drawing

The maintenance drawing on the following page(s) shows the internal components of the MicroRider-1000. Locations of the O-rings are identified.


After every cruise:
1. Wash instrument with fresh water.
2. Disassemble instrument
3. Clean and inspect all o-rings, sealing grooves and faces.
4. Grease o-rings and re-assemble.
5. Replace o-rings at least once a year.
6. Make sure all circuit boards are still securely fastened and all wiring is securely tied down.
7. Store with dummy probes installed.
8. Inspect anodes. Replace if worn. Clean white oxide with wire brush if anodes are still intact.
Front Sealing Nut, 2x O-Ring 2-014, 2x Backup Ring 8-014
Disassemble all probe holders. Inspect all o-rings.
up to 6x Probe Holders, 2x O-Ring 2-012 (each) 1x O-Ring 2-015 (each)
O-Ring, 2-151 Buna-N, 70A 3 Places
3x O-Ring 2-014 Both MCBH Connectors and Plug
Rear Sealing Nut, 2x O-Ring 2-014, 2x Backup Ring 8-014
Use 1/2 inch or 13 mm socket to remove sealing nuts from front and rear bulkheads.
Rockland Scientific International
520 Dupplin Road Victoria, BC V8Z 1C1
Tel: (250) 370-1688 Fax: (250)370-0234
Assembly micro-Rider 1000LP
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/32
ANGULAR: MACH ±0.5°
X.X ±0.020
X.XX ±0.010
X.XXX ±0.005
MATERIAL
FINISH
NAME DATE
DRAWN BP 2019-01-30
CHECKED - -
ENG APPR.
MFG APPR.
Q.A.
COMMENTS:
DO NOT SCALE DRAWING
PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF ROCKLAND SCIENTIFIC INTERNATIONAL. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF ROCKLAND SCIENTIFIC INTERNATIONAL IS PROHIBITED.
SIZE A
DWG. NO. 010-033 - 07
REV. 7
SCALE:1:16
WEIGHT: 5356.84 gram
SHEET 1 OF 1
Printed: 2019-03-15


CHECK O-RINGS AND SEALING SURFACES.
M8 FLAT WASHER
M8 LOCK WASHER
M8 X 1 NUT
O-Ring, JIS-2401, S10 Buna-N, 70A
O-Ring, JIS-2401, P16 Buna-N, 70A
AEM1-G EM SENSOR
T1 AND T2 SENSOR ALIGNMENT. THE FLATS MUST BE PARALLEL TO THESE LINES AND PERPENDICULAR TO THE AEM1-G SENSOR.
90°
CHECK ALIGNMENT OF AEM1-G SENSOR AS SHOWN HERE. THE THREE MOLD BUMPS SHOULD BE TANGENT TO THE NOSE CONE CIRCLE.
NOSE CONE IS ROTATED SO THE AEM1-G SENSOR IS CLOSEST TO THE PRESSURE PORT.
ALIGN AEM SENSOR AS SHOWN. THE ALIGNMENT PUNCH ON THE BODY IS CLOSEST TO THE OUTSIDE DIAMETER OF THE MICRORIDER NOSE.
ALIGNMENT PUNCH ON SENSOR BODY
REVISIONS
REV
DESCRIPTION
DATE
APPROVED
Rockland Scientific International
520 Dupplin Road
Victoria, BC V8Z 1C1
Tel: (250) 370-1688
Fax: (250)370-0234
AEM1-G Sensor Assembly
MR1000LP - EM
DRAWN PS 2016JUNE27
CHECKED
ENG APPR.
MFG APPR.
Q.A.
COMMENTS:
NAME
DATE
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/32
ANGULAR: MACH±0.5°
X.X ±0.020
X.XX ±0.010
X.XXX ±0.005
MATERIAL
FINISH
DO NOT SCALE DRAWING
SIZE B
DWG. NO. 010-111 - 07
REV. 0
SCALE:1:12
WEIGHT: 5810.60 gram
SHEET 1 OF 1
Printed: 2019-02-04
PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF ROCKLAND SCIENTIFIC INTERNATIONAL. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF ROCKLAND SCIENTIFIC INTERNATIONAL IS PROHIBITED.

A.9 Impulse Connector Technical Bulletin

The Technical Bulletin for the impulse connector(s) on the rear bulkhead is included in the following appendix.

MICRO MINI WET
PLUGGABLE

TELEDYNE IMPULSE

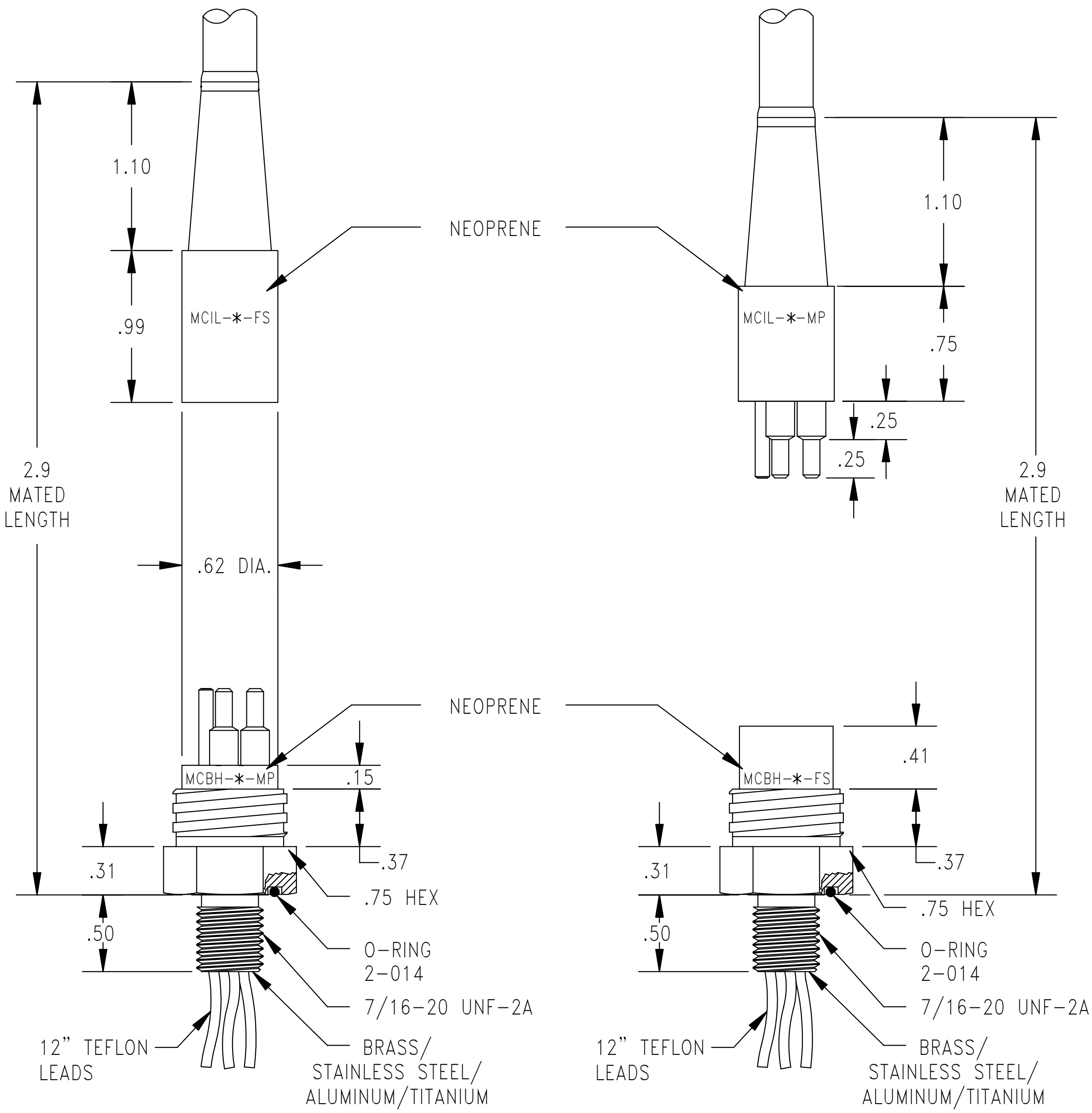
DESCRIPTION AND MATERIAL	• Molded neoprene or polyurethane. • Two to eight contacts. • Up to 750 VDC. • Up to 10,000 PSI, mated. • Bulkhead connector design open face pressure rated to 5000 PSI. • Contacts gold plated per MIL-G-45204.
CABLE	• Inline connectors in this series are molded on a standard 24" length of cable, 20 AWG, unless otherwise specified. • Bulkhead connectors have 12" teflon leads, Type E per MIL 16878/4, 20 AWG, (2-4, 9-18 contact) or 22 AWG (5-8 contact).
USES	• Light to medium duty applications. • Hazardous environments.
GUIDELINES	• All mounting surfaces require a 32 finish. • Lubricate mating surface with 3M Silicone Spray or equivalent, DO NOT grease! Connectors must be lubricated on a regular basis. • Lubricate o-ring with Dow Corning #111 Valve Lubricant or equivalent. • Replace o-rings when re-using connectors. • Avoid nicks and cuts around contacts as these are the sealing surfaces. • Elastomers can be seriously degraded if exposed to direct sunlight or high ozone levels for extended periods of time. • Do not over tighten bulkhead nuts. • Grip main body of connector during mating or unmating. Do not pull on cable to disconnect. • Avoid sharp bends at cable entry to connector.
ORDERING INFORMATION	• Bulkhead connectors do not come with nuts and washers. Nuts and washers should be ordered separately.

Technical Bulletin 65 109 1-800-327-0971 rev 0109

MCIL/BH-2/3/4

MICRO MINI WET
PLUGGABLE

TELEDYNE
IMPULSE



Technical Bulletin 65 110

1-800-327-0971

rev 0109

ROCKLAND SCIENTIFIC

MCIL/BH-2/3/4

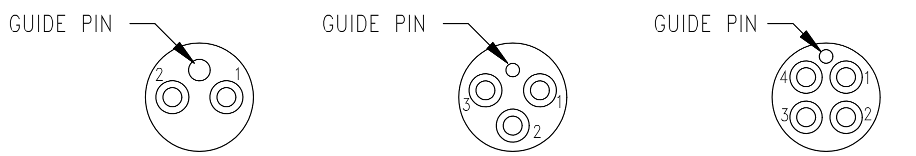
MICRO MINI WET
PLUGGABLE

TELEDYNE IMPULSE

MALE FEMALE

MCDLS–M MCDLS–F

CONTACT
CONFIGURATION
(MP FACE VIEW)



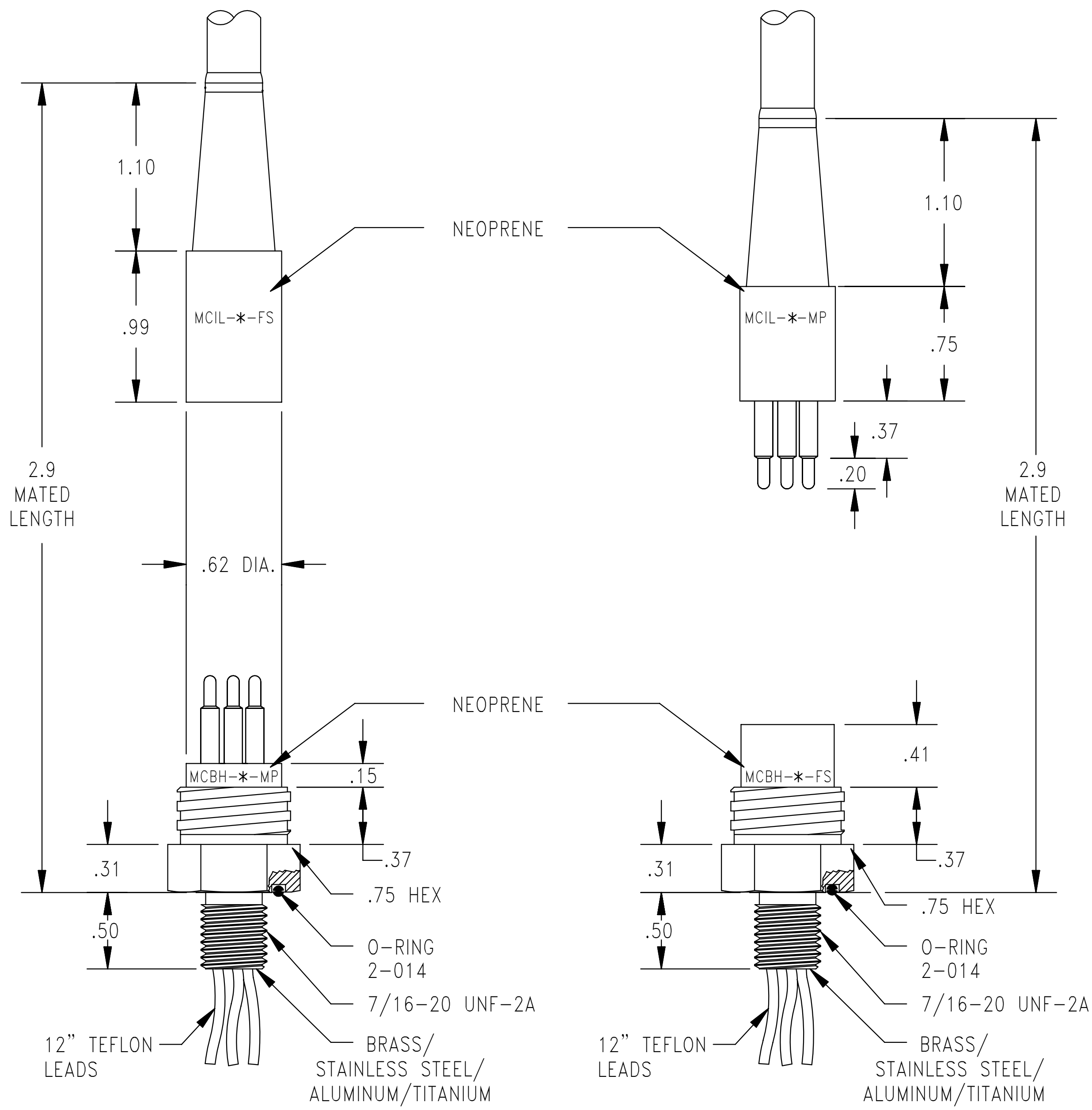
2 #12 W/ GUIDE PIN | 3 #12 W/ GUIDE PIN | 4 #12 W/ GUIDE PIN

MOUNTING TORQUE FOR MCIL/BH–FS/MP	not to exceed 100 in lbs
MATED PRESSURE RATING (psi)	10,000
DUMMY PLUG FOR MCIL/BH–FS	MCDC– * –MP
DUMMY PLUG FOR MCIL/BH–MP	MCDC– * –FS
* Specify number of contacts. * Dummy plugs found on page 65 125.	
NOTE: Bulkhead body available in Titanium. Standard 3/4" thread length.	

Technical Bulletin 65 111 1-800-327-0971 rev 0109

MCIL/BH-5/6/8 MICRO MINI WET PLUGGABLE

TELEDYNE IMPULSE



Technical Bulletin 65 120 1-800-327-0971 © 2009 Teledyne Impulse rev 0109

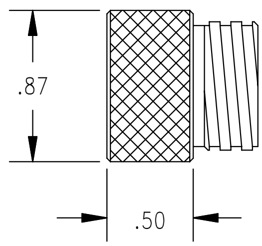
MCIL/BH-5/6/8

MICRO MINI WET
PLUGGABE

TELEDYNE IMPULSE

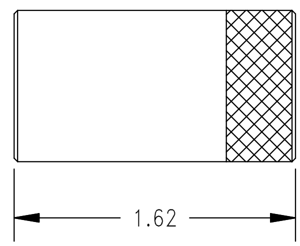
MALE

MCDLS−M

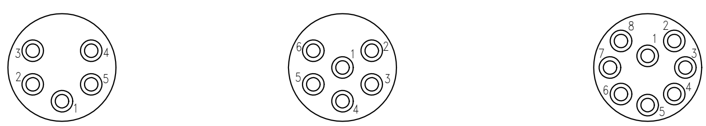


FEMALE

MCDLS−F



CONTACT
CONFIGURATION
(MP FACE VIEW)



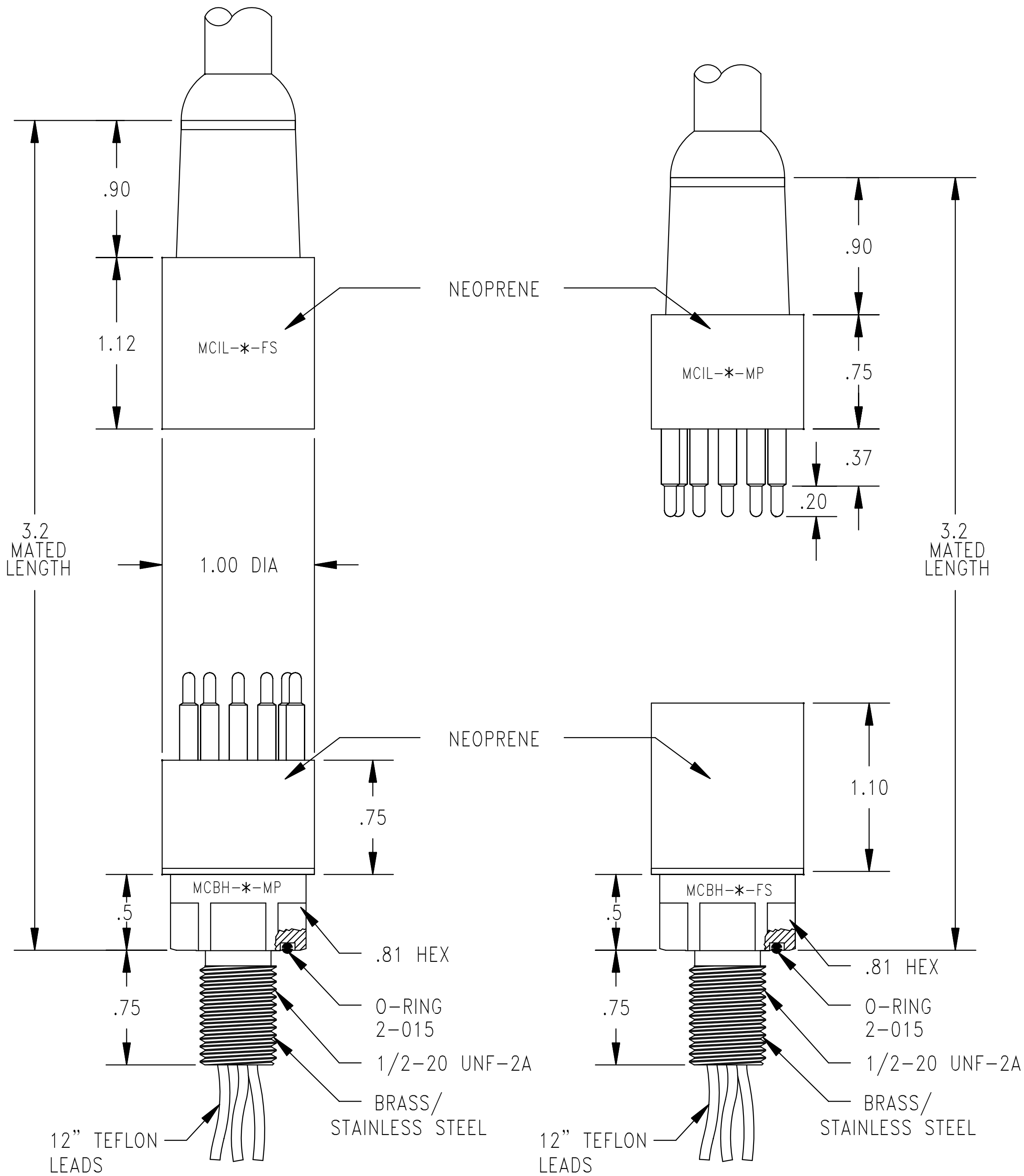
5 #15   6 #15   8 #15

MOUNTING TORQUE FOR MCIL/BH−FS/MP	not to exceed 100 in lbs
MATED PRESSURE RATING (psi)	10,000
DUMMY PLUG FOR MCIL/BH−FS	MCDC− * −MP
DUMMY PLUG FOR MCIL/BH−MP	MCDC− * −FS
* Specify number of contacts. * Dummy plugs found on page 65 125.	
NOTE: Bulkhead body available in Titanium. Standard 3/4" thread length.	

MCIL/BH-10/12/16/18

MICRO MINI WET
PLUGGABLE

TELEDYNE
IMPULSE

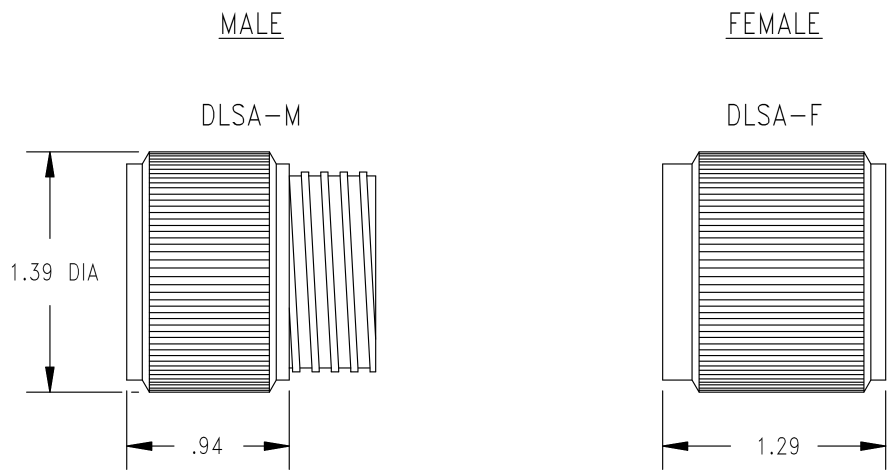


Technical Bulletin 65 122 1-800-327-0971 rev 0109

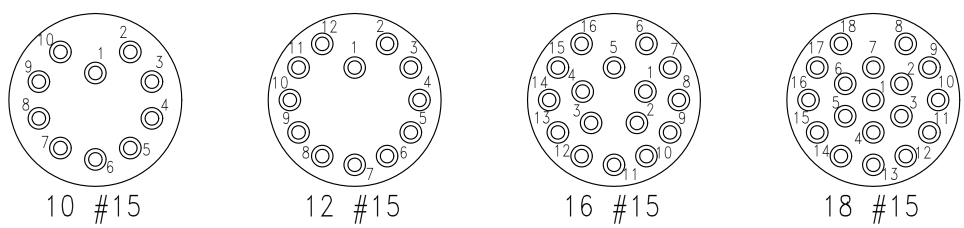
MCIL/BH-10/12/16/18

MICRO MINI WET
PLUGGABLE

TELEDYNE IMPULSE



CONTACT
CONFIGURATION
(MP FACE VIEW)



MOUNTING TORQUE FOR MCIL/BH–FS/MP	not to exceed 100 in lbs
MATED PRESSURE RATING (psi)	10,000
DUMMY PLUG FOR MCIL/BH–FS	MCDC– * –MP
DUMMY PLUG FOR MCIL/BH–MP	MCDC– * –FS
* Specify number of contacts. * Dummy plugs found on page 65 126	
NOTE: Bulkhead body available in Titanium. Standard 3/4" thread length.	

Index

Battery
- CR2032, 19

Bench Test
- checklist, 65
- method, 44

Communication
- deck cable, 39
- troubleshooting, 61
- USB Mass Storage, 40
- Zissou Essentials, 41

Configuration Files, 71
Coordinate System, 13

Data Storage, 20
Deployment, 47
- post-deployment, 47
- pre-deployment, 46, 69
- ship operations, 47

Drawings
- maintenance, 96
- outline, 93

Electronics, 17
- ASTP board, 17
- power supply board, 19
- Rockland Data Logger, 18, 77
- RS232 board, 18
- serial instrument bus, 17

Files
- `logfile.txt`, 76
- `setup.cfg`, 71

FP07
- calibration, 8
- installation/removal, 23
- maintenance, 57
- orientation, 26

Instrument, 7
- overview, 7
- specifications, 8

Log Files, 76

Maintenance, 48
- connectors, 55, 56
- corrosion prevention, 53
- storage, 50
- timeline, 48
- tools, 48

Nose Cone, 14
- AEM1-G EM current meter, 32
- assembly, 33
- probe holders, 31
- removal, 29

O-Rings, 51
- installation/inspection, 51
- locations, 51
- probes, 26

On/Off, 38, 60

Platform, 7
- assembly, 45

Pressure Case, 27
- assembly, 33, 36
- disassembly, 27
- maintenance, 53
- sealing surfaces, 53

Pressure Transducer
- maintenance, 59
- zeroing, 75

Rear Bulkhead, 16
- assembly, 35
- connectors, 16
- disassembly, 27

Requirements
- software, 10
- technical notes, 12

Sensors
- FP07, 14
- inclinometer, 15
- maintenance, 56
- pressure transducer, 14
- shear probes, 14
- specifications, 8
- test probes, 15
- vibration sensors, 14

Shear Probes
- installation/removal, 23
- maintenance, 56
- orientation, 26

Shipping, 50

Software
- data acquisition, 21
- ODAS Matlab Library, 21
- Zissou Essentials, 21, 41

Tools
- Recommended, 11
- Required, 10