# User Manual

## MicroRider-1000-G

**PN 010-158-20**

**Revision 1.1**

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### 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*. |

## 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-G is an instrument for measuring turbulence microstructure, designed to integrate with a variety of gliders and AUVs.

The following Getting Started section provides basic information to prepare the 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.

> It is expected that any user of the MicroRider-1000-G 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.3).
5. Conduct an electronics bench test (Section 4.3).

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

> 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 3.3) 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.
    - Confirm mechanical connection to the host platform or vehicle. See platform manufacturer's instructions for more details.
    - 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 2.5.4 and Figure 11), 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.6).

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

- Perform a bench test (Section 4.3).
- Confirm communication, integration, and configuration with host platform or vehicle. See platform manufacturer's instructions for more details.

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.3).
   - 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.

## 1.3 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.6).
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).
6. Complete any pre-deployment tests recommended by host platform manufacturer.

## 1.4 Several Minutes Before Deployment (on the ship)

1. Confirm mechanical integrity of all components:
   (a) Bulkhead retaining clamps are installed (Figure 18).
   (b) Connectors on rear bulkhead are tightened.
   (c) Sensor guard is secure.
   (d) 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 15).
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-G

## 2.1 What is the MicroRider-1000-G?

The MicroRider-1000-G is an internally recording, small instrument package for turbulence microstructure measurements, designed for nose-mounted integration on gliders and AUVs.


**Figure 1:** MicroRider-1000-G with probe guard.

## 2.2 General Specifications

### 2.2.1 Instrument Specifications

The basic specifications of the instrument are summarized in Table 1. Refer to Section A.4 for the Outline Drawing. All specifications are subject to change without notice.

**Table 1:** General Specifications

| | |
|---|---|
| **Model** | MicroRider-1000-G |
| **Depth Range** | 0–1000 m |
| **Weight in Air/Water** | 4.1 kg / 0.7 kg |
| **Housing Length/Overall Length** | 0.34 m / 0.47 m |
| **Sampling Rate** | 512 Hz / 64 Hz (fast channel / slow channel) |
| **Data Acquisition** | Internally Recording |
| **Data Storage** | Up to 2100 hours of data with 64 GB of storage. *based on continuous sampling, 8 columns in the address matrix* (Section 2.5.5) |
| **Power Consumption (Nominal)** | 1.5 W |

### 2.2.2 Configuration and Sensor Specifications

The MicroRider-1000-G 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.
- 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 | $5\times10^{-4}$ bar | 0–2.5 Hz |
| 1 | **inclinometer** | instrument tilt | Dual Axis, $\pm90°$ | 0.1° | 0.015° | |
| 2 | **piezo-accelerometer (1-axis)** | instrument vibrations | ±1 g | 2 % | $3\times10^{-3}$ g | 0.1–100 Hz |
| 2 | **Shear Probe** | velocity shear | 0–10 $s^{-1}$ | 5 % | $1\times10^{-3}$ $s^{-1}$ | 0.1–100 Hz |
| 2 | **FP07** | temperature | −5–35 °C | 0.005 °C | $1\times10^{-4}$ °C | 0–25 Hz |

## 2.3 Requirements

Proper use of the MicroRider-1000-G 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-G 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 |
|---|---|---|---|
| Adjustable Wrench | 0 - 1 inch (0 - 25 mm) | MCLPBH bulkhead connectors | 1 |
| Hex Driver, Ball End | 5/32 inch (4 mm) | O-Ring Compression Plate (microstructure sensors), Sensor Guard, Bulkhead Retaining Clamps, Front Anode Assembly | 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 | Flush Cutting | Cutting Cable Ties, Waxed Lacing | 1 |
| Waxed Lacing Tape | | Tying down Wiring Harnesses | 1 |
| Screwdriver, Phillips | Size #1 | Circuit Board Screws | 1 |
| Screwdriver, Slotted | 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-G 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**<br>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**<br>Gives a detailed explanation of how raw counts are converted to physical units. |
| **TN 015** | **Modeling the Spatial Response of the Air Foil Shear Probe Using Different Sized Probes**<br>A paper describing the wave number response of the shear probe. |
| **TN 022** | **Turbulence Measurements from a Glider**<br>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)**<br>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**<br>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**<br>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**<br>Provides a method for estimating the noise in measurements of the velocity shear obtained with a Rockland instrument. |
| **TN 046** | **RSI Inclinometers**<br>Describes the functionality of the inclinometer in Rockland instruments. |
| **TN 047** | **Why Calibrate the FP07 Thermistor?**<br>Describes the reasons for and against calibrating the FP07 thermistor. |
| **TN 048** | **Interpreting the Results of Calibrate All**<br>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**<br>Describes the anatomy and format of Rockland `.P` data files |
| **TN 052** | **Rockland Data Logger (RDL)**<br>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-G. Details of the operations – including assembly and disassembly of the instrument – can be found in Section 3.

### 2.4.1 Coordinate System

The coordinate system of the MicroRider-1000-G is as follows (Figure 2):

- x-axis: Is along the axis of the pressure case and positive forward.
- y-axis: Is defined as horizontal and positive in the "port" direction
- z-axis: Is nominally vertical from the horizontal plane defined by X and Y and through the centerline of the MicroRider-1000-G

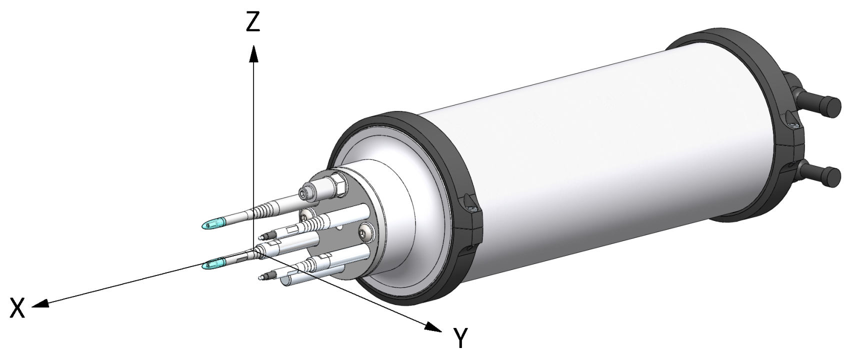



**Figure 2:** MicroRider-1000-G Coordinate System

### 2.4.2 Front Bulkhead

Located on the front bulkhead of the instrument are the following components (Figure 3):

- Five microstructure sensor ports
- A pressure transducer
- An O-ring compression plate (when tightened to the front bulkhead, seals the microstructure sensors)
- An active aluminium anode to help prevent corrosion to the external metallic compo-

nents on the MicroRider-1000-G.[2]

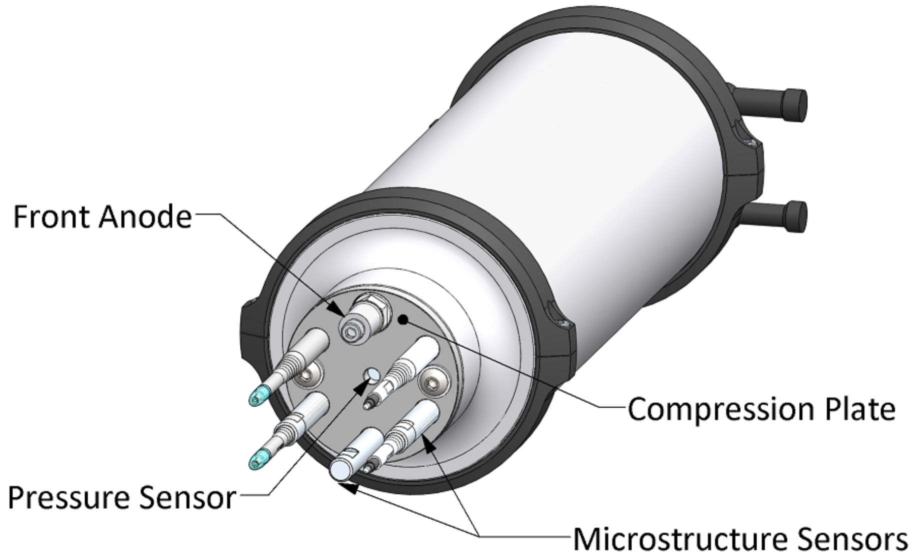



**Figure 3:** MicroRider-1000-G Front Bulkhead

The front bulkhead maintains a seal with the pressure tube using an o-ring. Further information on this seal can be found in Section 3.

### 2.4.3 Sensors

The front bulkhead of the MicroRider-1000-G contains all the external sensors on the instrument. The specifications for each sensor are detailed in Table 2.

Up to five microstructure sensors (shear, FP07, SBE7) can be installed to the front bulkhead. Typically the installed sensors are two shear probes and two FP07 fast response thermistors and one spare sensor port. When a sensor is not installed, a test probe is installed in its sensor port.Test probes are configured so that their signals are approximately at mid-scale for their sensor.

Depending on how many shear probes are equipped on the instrument, the location of the microstructure probes will vary. Figure 4 shows the location of the microstructure probes.

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

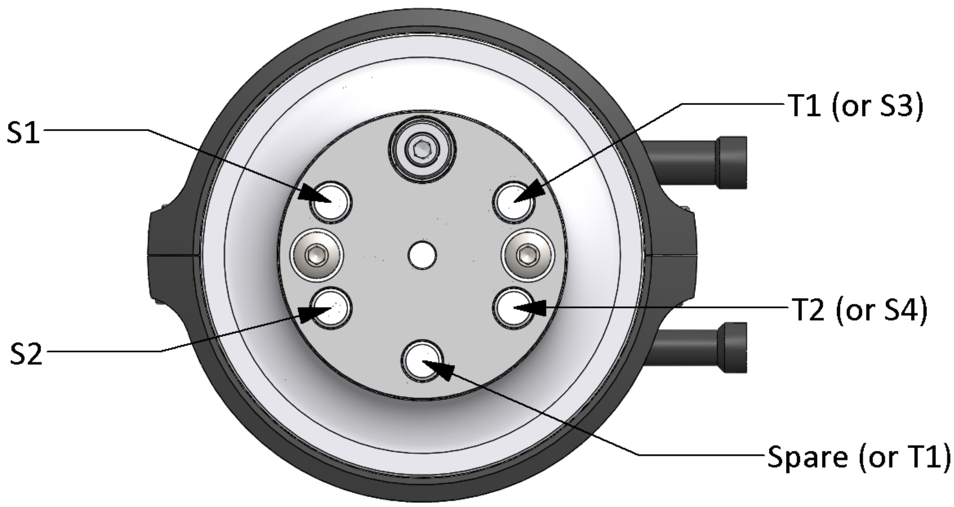



**Figure 4:** Location of the microstructure probes on the MicroRider-1000-G.

Two vibration sensors are installed on a mounting block that is located inside the instrument (Figure 5). 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.

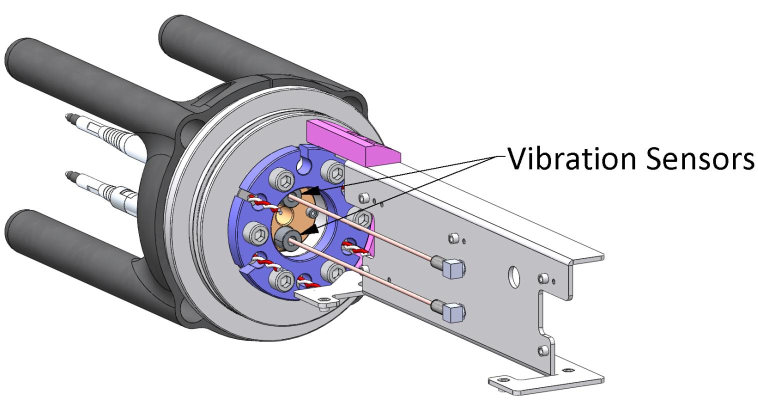



**Figure 5:** Vibration Sensors

There is 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-G, the inclinometer measures the rotation about the x-axis (roll) and y-axis (pitch), where the axes are defined in Figure 2.

### 2.4.4 Test Probes

Test probes (Figure 6) are used as place holders for real microstructure probes and must **always** be installed in place of real probes during deployment if measurements are not desired on a particular channel. They should **always** be used when storing or shipping your instrument, and when performing an electronics bench test (Section 4.3). The test probes protect internal wiring and electronics, as well as containing 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 6:** Test probe with an SMB connector.

### 2.4.5 Sensor Guard

The sensor guard clamps to the front bulkhead (Figure 7). It is designed to:

- Provide protection to the external sensors on the front of the instrument, including the microstructure probes
- Not interfere with the sensor measurements.
- Minimize vibrations from vortices shedding around the guard

**Figure 7:** Sensor Guard on a MicroRider1000-G

### 2.4.6 Rear Bulkhead

Located on the rear bulkhead of the instrument are the following components (Figure 8):

- A MCLPBH7M connector which provides the USB connection to the deck cable and a power connection to the 12 W converter.
- A MCLPBH9M 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-G.[3]

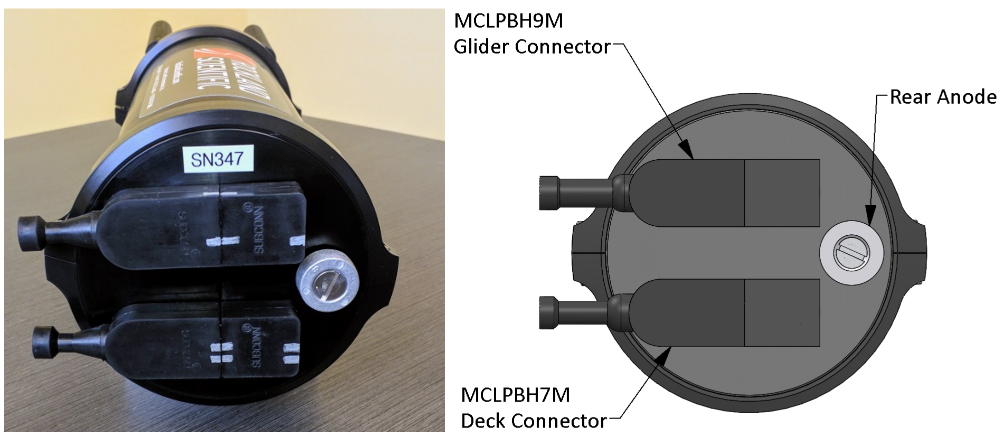



**Figure 8:** Rear Bulkhead

[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/

### 2.4.7 Bulkhead Retaining Clamps

The front and rear bulkheads are secured to the pressure tube using two sets of custom plastic clamps (Figure 9). The retaining clamps allow the MicroRider-1000-G to be disassembled easily to gain access to the internal electronics, even when the robotic platform front fairing is fully assembled.

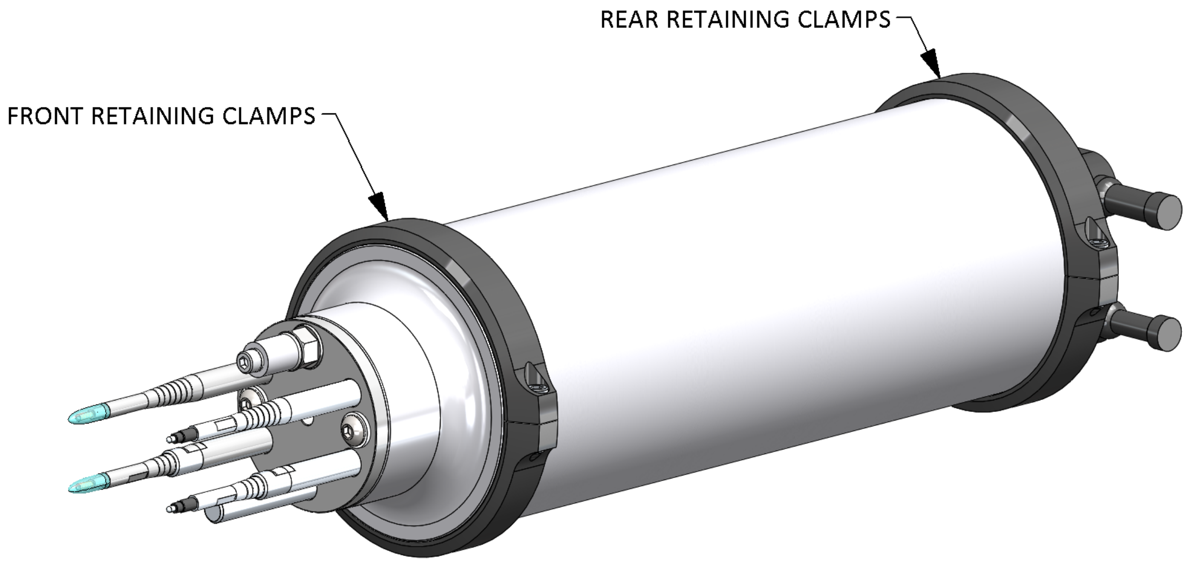



**Figure 9:** MicroRider-1000-G Bulkhead Retaining Clamps

## 2.5 Electrical Systems Overview

The electrical system that is present within the MicroRider-1000-G 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 10 and each of the components are described in the following subsections.

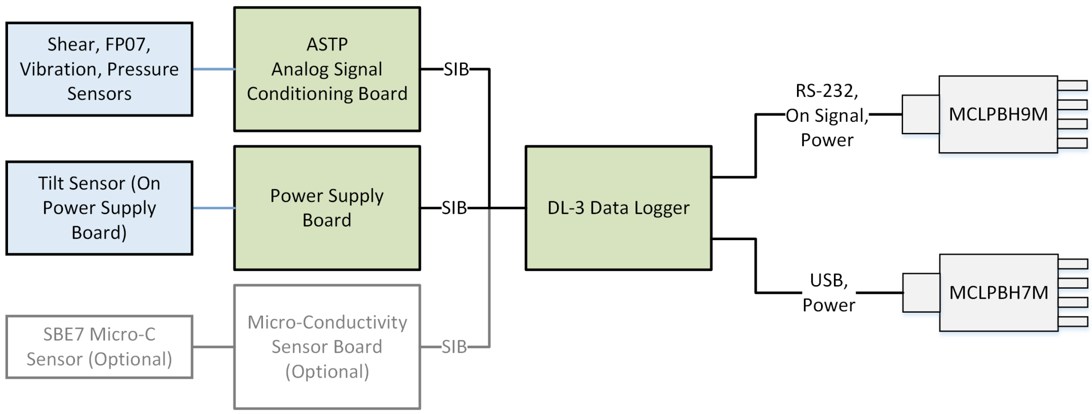



**Figure 10:** Instrument sensor and electronics system block diagram

### 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 10). Its conductors are used for the distribution of digital power, clocking signals, addresses (request for data) and for the data itself.

### 2.5.2 ASTP Analog Signal Conditioning Board

The analog signal conditioning (ASTP) 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 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 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.6 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).

Instruments with P113R01 or P113R02 boards will have a 5x20mm cartridge fuse wired between the electronics and the rear bulkhead. The P113R03[4] instruments have a polyswitch resettable fuse on the P113R03 board itself.

The Rockland Data Logger board also carries a 3V CR2032 lithium battery (Figure 11). 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.

[4] In general, new instruments with SN400 to SN418 will have R01 or R02 boards. SN419 and greater will have R03.

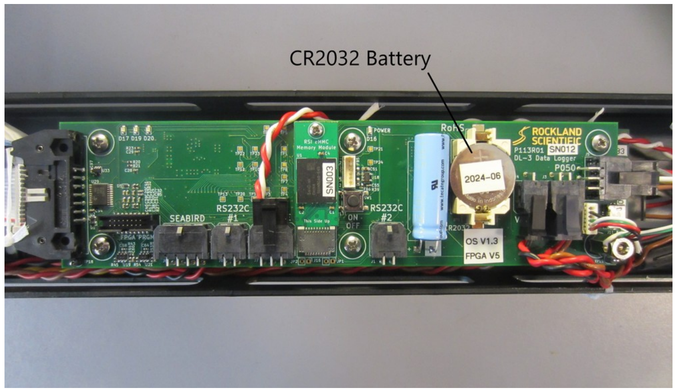



**Figure 11:** CR2032 Battery on Rockland Data Logger board

### 2.5.4 Power Supply Board (P050)

The power supply board provides a +5 VDC power rail to all analog components, a 3.3 VDC rail for all digital components, and provides "switch 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. Approximately 30 seconds 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.

### 2.5.5 Data Storage

Data acquired by the instrument are recorded on an internal storage module that can be accessed like any USB thumb drive using the instrument deck cable (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-G, 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 memory module before any deployment.

## 2.6 Software Systems Overview

### 2.6.1 Data Acquisition and Data Download

The MicroRider-1000-G acquires data with the custom Rockland Data Logger board (P113) using the data acquisition software. The configuration file `setup.cfg` sets the parameters for the data acquisition, for example which channels to log and their calibration coefficients. For more information, refer to Section A.6.

Data can be collected either on the bench under user control (bench testing) or on the vehicle during deployments. For bench testing the MicroRider-1000-G is configured to launch data acquisition when the deck cable is connected, power is supplied and the USB is connected. For vehicle operations the MicroRider-1000-G is configured to boot up and wait for the vehicle to control data acquisition. There is about a 40 second delay between power on and ready to acquire data.

Refer to Section 4.1 for details on the behavious when using the Deck Cable or the vehicle connection

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

The Zissou Essentials software package[5] 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 Data 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

[5] Version 2.0 released April 2022

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
- 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[6] 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 by emailing support@rocklandscientific.com.

[6]Version 4.4 released July 2019

# 3 Assembly and Disassembly

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

> The MicroRider-1000-G is shipped fully assembled with test probes. To prepare the instrument for deployment, connect the instrument to the vehicle, 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

> Before removing any probes, use canned clean air to blow away all water around the probe holder, probe, and bulkhead.
> When the probe is removed, immediately dry the SMC cable, and blow out the inside of the probe holder cavity.
> IT IS CRITICAL THAT THE CAVITY, CABLE, AND SMC CONNECTOR REMAIN DRY!

The microstructure probes on the MicroRider-1000-G are both retained and sealed using a seal compression plate (Figure 12). Before removing or installing probes, place the instrument horizontally on a stable platform.

> Do not allow any water or debris to enter into the probe cavity. Even a small amount of moisture in the probe cavity can lead to signal degradation and require repair at Rockland.

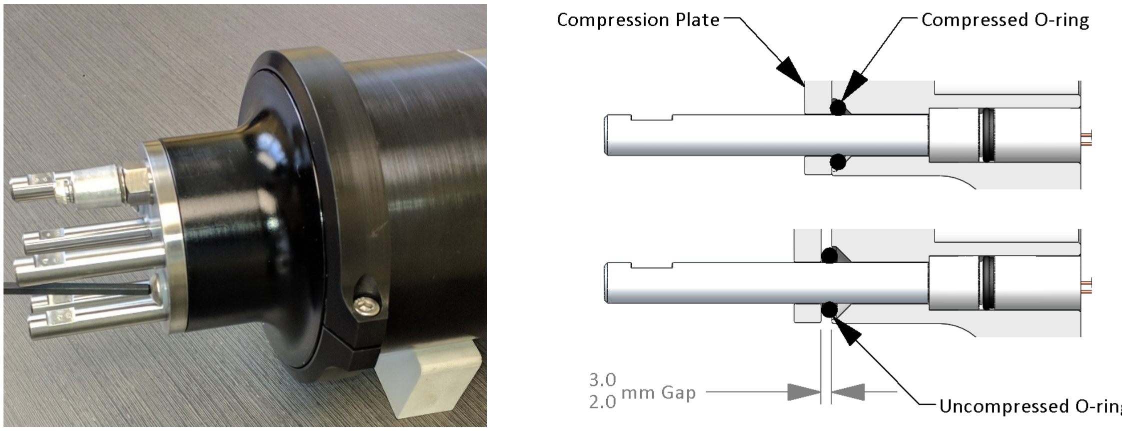



**Figure 12:** Front view (left) and side view (right) of the seal compression plate that both retains and seals microstructure probes.

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

⚠ Before removing a probe, make sure the area around the seal compression plate is dry. This will reduce the risk of water entering the probe cavity. Clean dry compressed air can be blown between the plate and the nose cone to remove any water before removing probes.

1. Loosen both screws located on the ends of the plate (Figure 13). A gap of 2 – 3 mm between the plate and the front bulkhead is required to completely decompress the O-ring.

   ⓘ Loosening the screws as much as 4 mm is not advised since it allows the O-rings to slip out of their respective cavities once their test probe is removed.

   ⚠ Removing a probe while the O-ring is compressed will create a vacuum within the probe cavity causing any water around the probe cavity to disperse inside the probe cavity and onto the SMB plug connector.

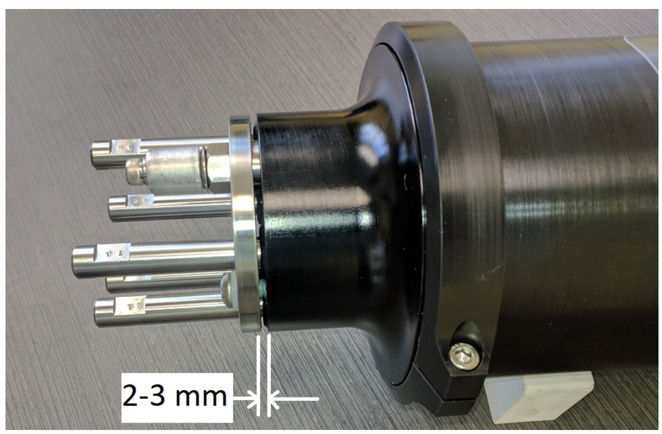



**Figure 13:** Loosening the Seal Compression Plate

2. Once the seal compression plate has been sufficiently loosened, gently pull on the probe to free it from its connection inside the bulkhead (Figure 14). Be careful to avoid contacting other sensors during the removal of a probe. Then remove the plate and o-rings and dry everything off with kimwipes. Be careful to not scratch the probe sting on the com-

pression plate when removing probes.

It is very important to install and remove probes in as straight a line as possible. Tilting the probe could cause the probe to scratch the front bulkhead or the probe itself. Be careful to avoid contacting other sensors during the removal of a probe.

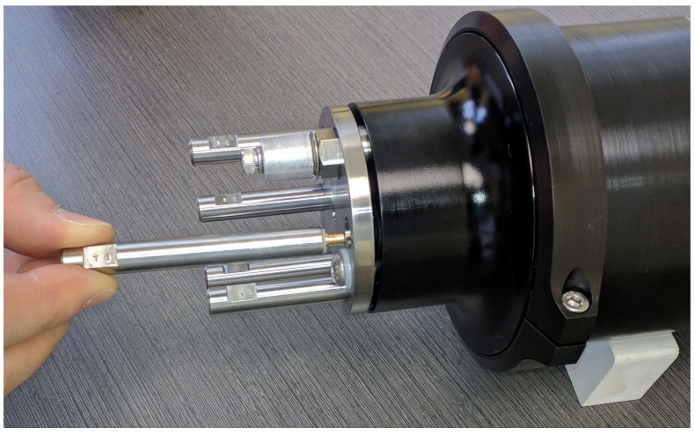


**Figure 14:** Removal of a test probe

*In the event an O-ring slips out of its cavity* while the probes are being removed, the O-ring will need to be re-inserted into the countersunk bore. The best method to re-insert the O-ring is to remove the compression plate completely, inspect sealing surfaces and O-rings to ensure they are clean and free of debris, place the properly greased O-rings in their countersunk bores and then replace the compression plate.

Ensure these O-rings have only a very thin coating of grease. Excessive grease can cause the O-rings to stick to the bulkhead and will increase the risk of a vacuum within the probe cavity.

**To install a probe:**

1. Insert the probe, leading with the connector end of the probe, into the microstructure port. You should be able to feel a click when the probe is fully seated into the connec-

tor. **Note that you must insert the correct type of sensor into each port.** The ports are labelled on the seal compression plate. (i.e. “S1”, “S2”, “T1”, depending on your instrument’s configuration).

> It is advised that you insert the temperature probes LAST because they are the most fragile.

2. Orient the shear probes’ axes of sensitivity relative to the instrument axes (Figure 2). Typically, “S1” is aligned with the z-axis and “S2” is aligned with the y-axis.

   The sensitivity on a shear probe is in the direction normal to the flat surface that indicates the probe’s serial number (i.e. M1234), which is highlighted in Figure 15. Note: The orientation of other microstructure sensors (FP07 temperature probes, SBE7 micro-conductivity probes) do not matter.

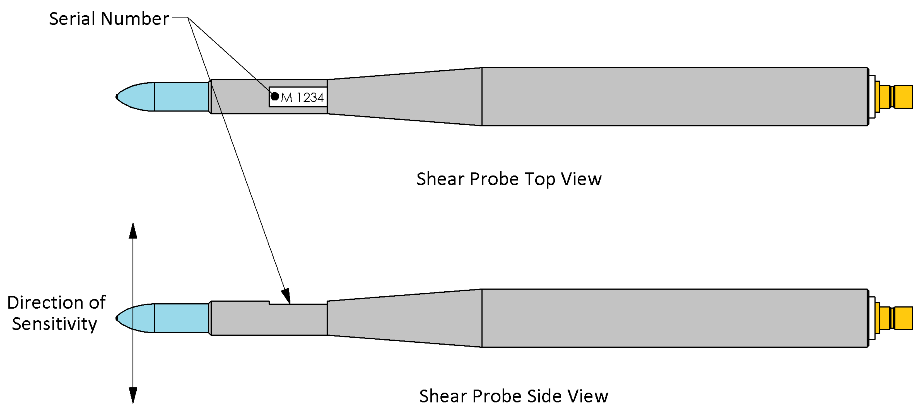



**Figure 15:** Shear probe direction of sensitivity.

3. Once all microstructure sensors have been installed, fully seated and properly oriented, tighten the screws on the seal compression plate ONLY until NO gap exists between the

plate and the front bulkhead.

> ⚠ The following details are critical to avoid water ingress into the probe cavity:
> (a) Probes must be fully seated in their port.
> (b) O-ring must be present for each probe.
> (c) Compression plate must be tightened ONLY until there is no gap visible between the plate and the front bulkhead.
> (d) The plate must not be over-tightened. Once it is tightened properly in step three the compressed o-rings will prevent accidental loosening of the screws

4. In your deployment notes, record the serial numbers of the microstructure sensors you have installed in each port. If possible, update your configuration file with their respective serial numbers and their sensitivities (if they are provided for that given sensor). *Note: The setup file can be modified post-deployment, if necessary*.

## 3.2 Assembling the Sensor Guard

The sensor guard is clamped to the front bulkhead using a #10-32 x 3/4-inch length socket head cap screw. To remove the sensor guard, loosen the screw using a 5/32-inch size hex driver (Figure 16). To install the guard, ensure the screw has been loosened, slide the guard over the sensors until the guard is fully seated on the front bulkhead. Tighten the socket head cap screw until the guard is secured.

> ⓘ If microstructure sensors are installed, be careful to prevent contact between the guard and the tips of the sensors.

> ⚠ Be aware that applying a high torque to the screw can risk damaging the guard. Tighten the screw until friction holds the guard in place. A 2-105 O-ring is placed inline with the screw in the gap in the guard to help prevent overtightening.

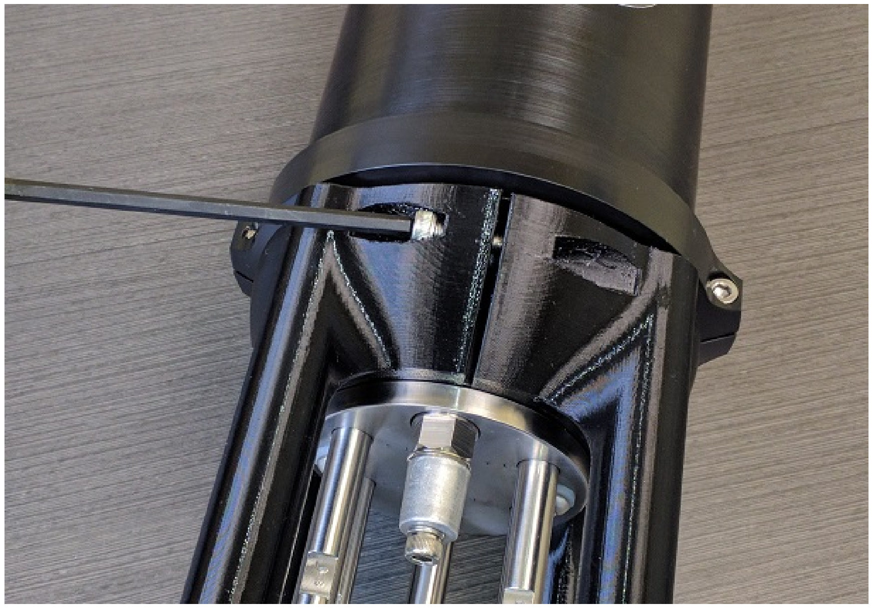


**Figure 16:** Removing the sensor guard.

## 3.3 Disassembling the Pressure Case

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

### 3.3.1 Removing The Compression Plate

Remove the compression plate from the front bulkhead (Figure 17). 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).

**Figure 17:** Removal of the compression plate from the front bulkhead.

### 3.3.2 Removing the Front Bulkhead

The MicroRider-1000-G pressure tube is to be disassembled by:

1. First removing the front bulkhead retaining clamps Figure 18. The clamps are held together using #10-32 x 3/4-inch length socket head cap screws, which require a 5/32-inch hex driver to loosen.

**Figure 18:** Removing the front bulkhead retaining clamp.

2. Once the front retaining clamps have been removed, gently rock the front bulkhead free from the tube to slowly expose the o-ring . Once this seal has been broken, the bulkhead should be able to be easily removed (Figure 19).

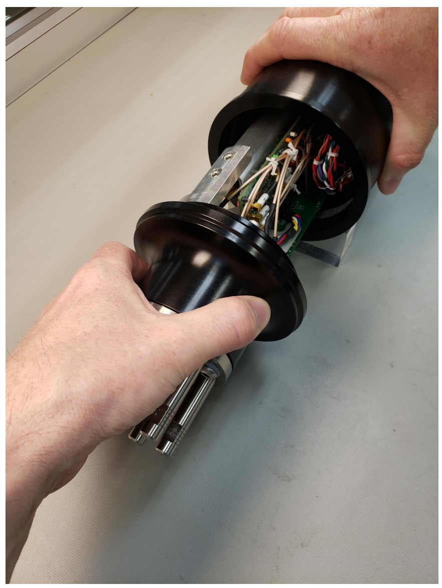


**Figure 19:** Removing the pressure tube.

> ⚠ Be careful to avoid contact between the electronics and the inside of the pressure tube.

3. Once the bulkhead is free from the tube, disconnect the harnesses extending from the

internal electronics frame to the rear bulkhead. These are the electrical connections to the platform and deck connectors (Figure 20).

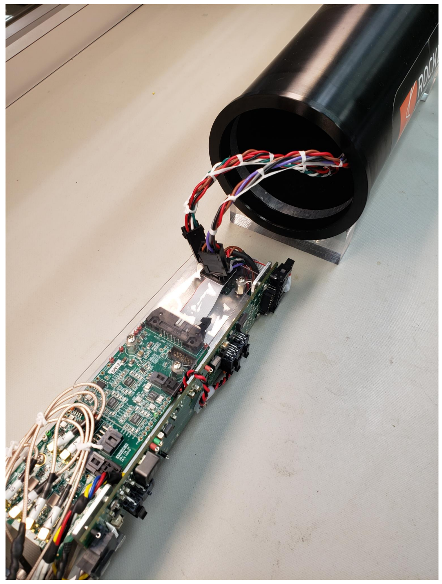


**Figure 20:** Disconnecting the wiring from the rear bulkhead.

### 3.3.3 Removing the Pressure Tube

The pressure case can be removed from the rear bulkhead by gently rocking the tube relative to the rear bulkhead until the o-ring is exposed (Figure 21).

**Figure 21:** Removing the rear bulkhead from the pressure tube.

### 3.3.4 Removing Components from the Rear Bulkhead

During instrument maintenance (Section 5.1.2), it is recommended that you remove the two bulkhead connectors on the rear bulkhead to service the O-rings. Use the supplied 6-inch adjustable wrench to remove the jam nuts that secure the bulkhead connectors. Refer to the appendix (Section A.9) for the step by step instructions on how to change these o-rings.

## 3.4 Reassembling the Pressure Case

Reassembly of the pressure case (bulkheads and tube), is a reversal of the disassembly procedure.

> ⚠ Before reassembling the pressure case, refer to Section 5 to ensure the integrity of the o-ring seals is maintained.

When inserting the electronics back into the pressure tube, arrange the wiring harnesses away from the edge of the P050 power supply board (Figure 22). Doing so should help avoid pinching the wiring harnesses when inserting them into the tube. Exercise caution as well to prevent the harnesses from being tangled with the coaxial connectors on the ASTP board (Figure 20).

There are markings on the pressure case components (front and rear bulkheads, tube) for proper alignment of the pressure case (Figure 21).

**Figure 22:** Looping the wire harnesses for smooth assembly and disassembly.

# 4 Operations

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

The standard MicroRider-1000-G has the following setup:

1. The ON signal is permanently jumpered on the P050 Power Supply board
2. When power only is connected the MR1000G will boot up and wait for commands on the RS232 serial lines.
3. When the Deck Cable power and USB are connected the MR1000G will boot up and start datalogging.

To safely connect to the instrument, first connect the deck cable to the instrument, then connect usb and/or power supply. To safely disconnect, disconnect the USB and/or power, and wait 10 seconds to allow a complete shutdown.

## 4.1 Turning the Instrument ON/OFF

The MicroRider-1000-G can be turned on and off by the following methods:

- **Platform:** Applying (or removing) power to the instrument from the platform. When power is applied the MicroRider-1000-G will energize and boot up to the command prompt. Datalogging does not start. There is about a 45 second delay between power on and the system becoming ready to accept commands. When power is removed an onboard energy source provides enough energy to allow for a proper stop to datalogging before full shutdown. This takes about 3 seconds.

  Due to the way the connector pins are oriented on MCLPBH connectors, it is possible to connect the 9-pin female connector on the platform cable to the 7-pin male connector on the deck cable. The instrument has been designed with some electronic protection, should this occur, however please exercise caution to prevent this from happening. Refer to Figure 8 for the locations of each connector.

- **Deck Cable (to start datalogging):**
  1. Disconnect the platform from the MicroRider-1000-G to ensure that the platform is definitely not powering the MicroRider-1000-G.
  2. Connect the deck cable to the MCLPBH7M connector on the rear bulkhead of the MicroRider-1000-G (Figure 8).
  3. Connect the barrel connector on the other end of the deck cable to the 12 W converter (Figure 23) and plug the AC power into your AC outlet. Then connect the USB to your computer using the supplied USB hub. The MicroRider-1000-G will turn on and Datalogging will start after 45 seconds.

  > ⚠ When powering the instrument using the deck cable, power supplied from the platform must be removed (and vice versa).

  > ⓘ Remember to wait 10 seconds after removing cables to allow the system to properly shutdown.

- **Deck Cable (to stop datalogging):** Disconnect the barrel connector on the other end of the deck cable from the 12 W converter (Figure 23) or unplug the AC plug from your AC outlet.

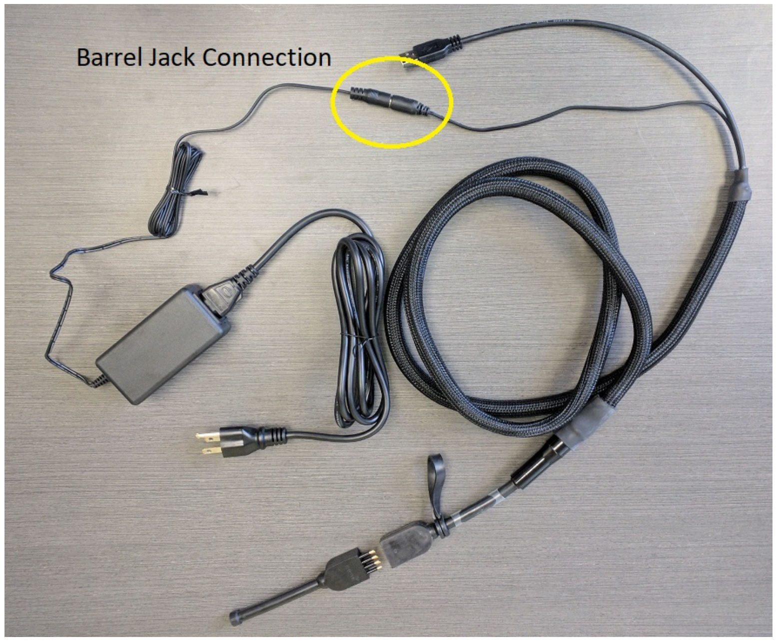



**Figure 23:** Instrument Deck Cable

## 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 Data 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)
- Computer (with a USB-A connection)

The connection can then be established as follows:

1. Ensure that the instrument is OFF (Section 4.1).

> The instrument must be OFF when connecting the instrument to a computer. Unexpected behaviour can occur otherwise. Remember to wait 10 seconds after turning the instrument off so the system can gracefully shutdown.

2. Remove the Dummy Cap from the MCLPBH7M connector on the rear bulkhead.
3. Connect the deck cable to the MCLPBH7M connector.
4. Do NOT connect the power.
5. Connect the deck cable to a USB port on your computer. Use the supplied 4-port USB hub between the deck cable and your computer to ensure a reliable USB connection. This will turn ON the Rockland Data Logger (RDL) computer, 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 24:** 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 "Data Drive").

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

1. Connect the deck cable to the MicroRider-1000-G .
2. Make sure no external power is supplied from either the platform or the deck cable.
3. Connect the USB to your computer using the supplied 4-port USB hub between the cable and computer.

> ⚠ Never connect an instrument to a deck cable that is already connected to a computer. Doing so can result in damage. Disconnect the deck cable from all devices before connecting it to an instrument.

4. The USB connection will power the onboard computer only to allow for file transfer.
5. Wait for the Data Drive to be detected. A notification from the computer should indicate when the connection has been established.

> ⓘ It can take up to 30 seconds for a connection to be established because the instrument's operating system must boot up first.

6. 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 Data Drive.
7. Double click on the Data Drive to open it and view the contents of the RDL Memory Module on the instrument (Figure 25).

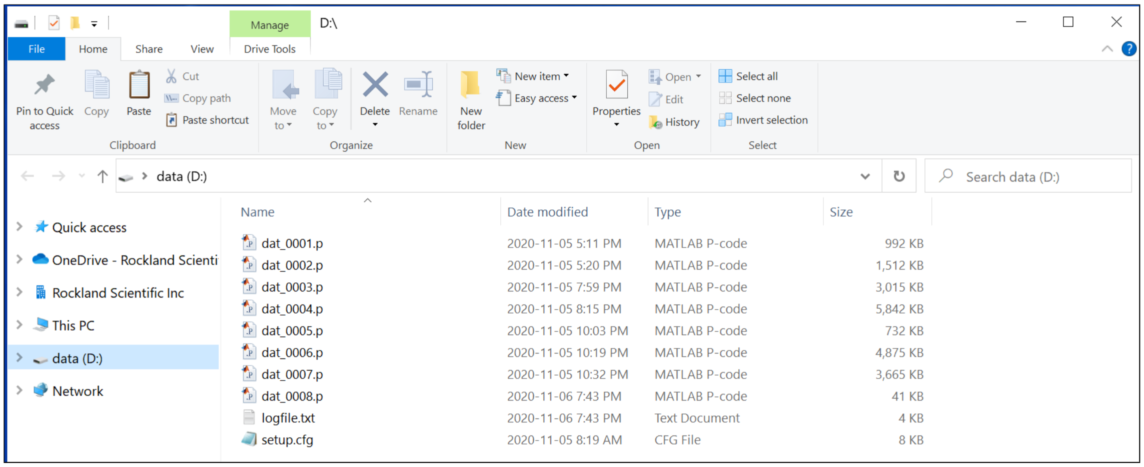



**Figure 25:** Connecting to the instrument as a mass storage device.

8. 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).

> Remember to periodically delete files and empty the trash on the drive to ensure reliable performance. The drive is in exFAT format and good practice will stop the file system from being damaged.

9. When ready, instruct your computer to properly eject the Data Drive before physically disconnecting the instrument from the computer.

> Ensure that you instruct your computer to properly eject the Data 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 26). 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 Data 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

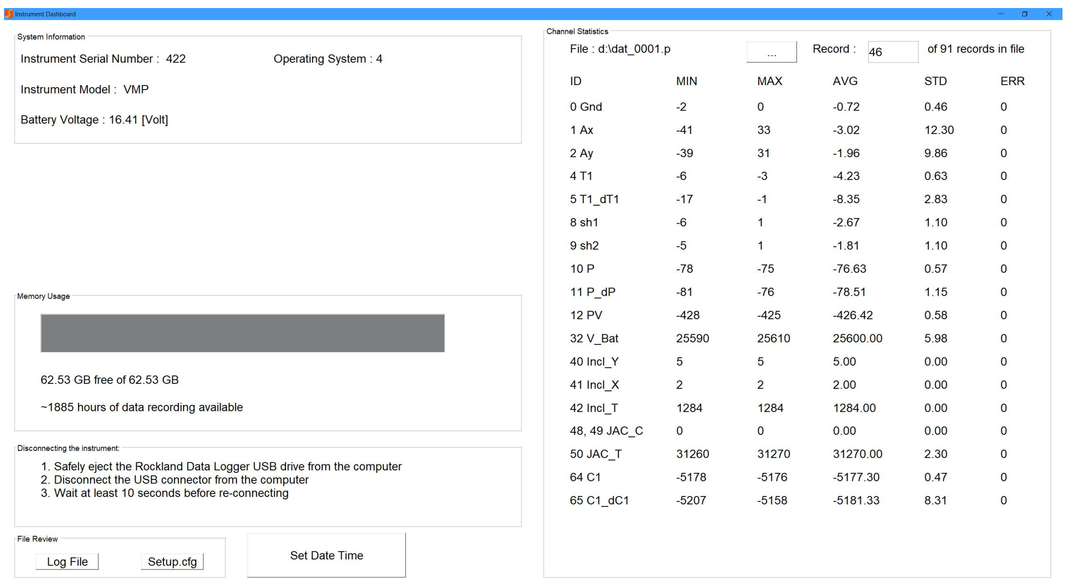



**Figure 26:** Viewing the Rockland Data Logger status with Zissou Essentials.

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 27). The option is also available under the “Tools” drop-down menu.

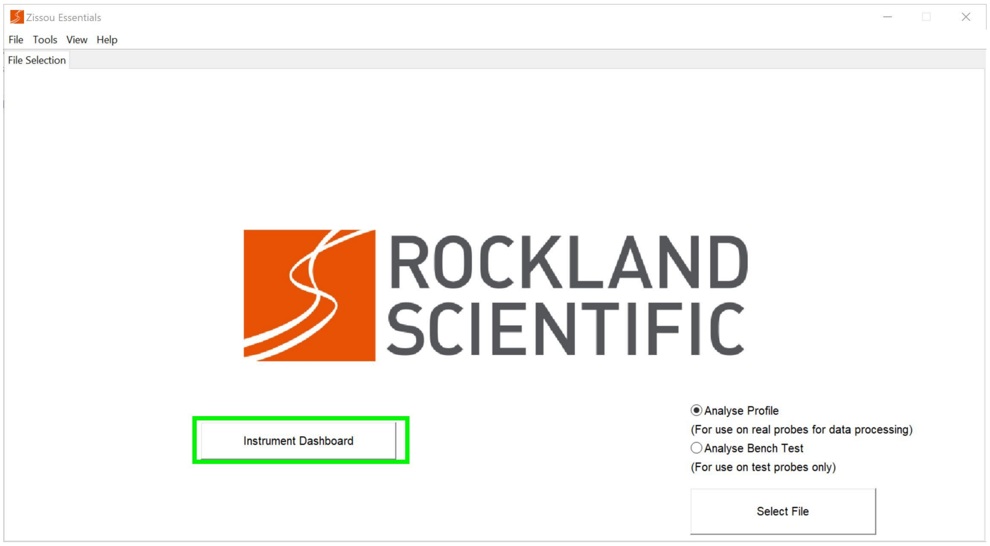



**Figure 27:** The “Instrument Dashboard” button (green) on the Zissou Essentials home page.

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 28).

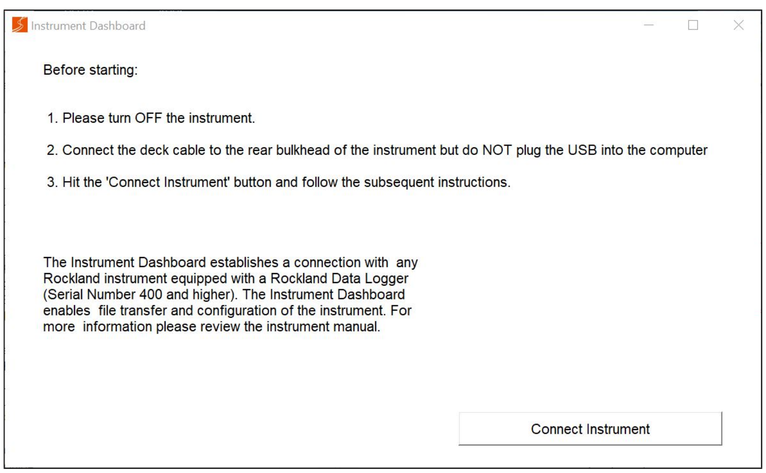



**Figure 28:** Connecting to the instrument with Zissou Essentials.

6. When prompted (Figure 29), 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.

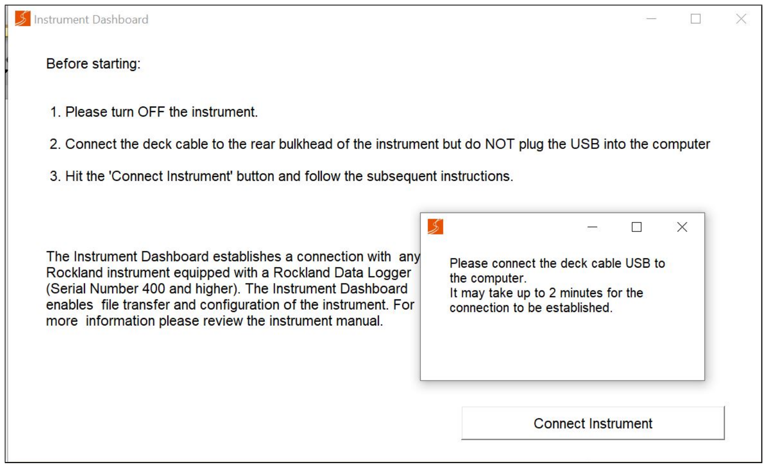



**Figure 29:** Zissou Essentials Prompt to Connect USB to Computer.

7. The Instrument Dashboard will appear and provide you information about your instrument and your Rockland Data Logger (Figure 26). 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 2.4.4) are installed. To ensure consistent results, make sure the probe clamp plate has been properly tightened down to secure the test probes, and make sure the clamp rings that hold the pressure case together are properly installed and secured.

> ⚠ **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 6).

2. Rest the MicroRider-1000-G horizontally on a table or bench, preferably on something soft like open cell foam.
3. Connect the Deck Cable, Power, and USB as described in Section 4.1 “Deck Cable”.
4. Leave connected for 3 minutes to ensure a good amount of data is collected.
5. Stop data logging by disconnecting both Power and USB.
6. Wait 10 seconds, ensure the power is disconnected, and then connect only the USB to download the data file.
7. Once the mass storage device appears on your computer, transfer the latest data file to your computer.
8. 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[7] – time series of the signals measured by the ASTP and inclinometer channels, and spectra computed from the ASTP signals.
9. Verify that the sensor signals are as expected[8]. Values and expected ranges are provided in the Bench Test Checklist (Section A.1).

[7] Additional figures may be generated depending on the installed sensors.
[8] 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; 4 years after insallation.
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 gaps between pressure case components (nose cone, bulkheads, tube).
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-G 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.
9. Complete any pre-deployment checks recommended by the robotic platform manufacturer.

## 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 MCLPBH9M connector. Put the dummy on the MCLPBH7M connector.
4. Confirm the communication and control interface between the platform and the MicroRider-1000-G is working properly.
5. Select and install your microstructure sensors (Section 3.1). Visually inspect each sensor to ensure that there is no obvious damage (Section 2.4.3).
6. Verify the sensors are fullly seated and the clamp plate has been properly secured by giving the sensors a gentle tug.
7. Record the serial numbers of the sensors (Figure 15) 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.

8. Ensure that you have discussed deployment and recovery with the crew and captain before proceeding (Section 4.5.2).
9. 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.5.

> ⚠ 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-G

| 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 (Spares Kit) | Replacing anodes (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-G 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 at the pressure transducer.

### 5.1.2 Immediately after Last Deployment

On deck, after the last deployment:

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

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

5. Install test probes (Section 3.1).
6. Flush pressure port with fresh water, soak for 60 seconds then blow dry with clean dry air. Ready for storage.
7. Loosen the clamps that hold the pressure case together. Flush through and around the clamps with fresh water. This removes any residual salt water and material from the flanges surfaces which would cause corrosion and damage if left in place. Tighten the clamps again for shipping.

### 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 O-ring compression plate (Section 3.3.1). Clean O-rings.

iii) Remove the front bulkhead (Section 3.3.2). Clean the main piston seal O-ring on the front bulkhead.

iv) Remove the rear bulkhead (Section 3.3.3). Clean the main piston seal O-ring on the rear bulkhead.

v) Remove components from the rear bulkhead (Section 3.3.4) and clean O-rings. Refer to Section 5.2.2 for particular guidance on removal of the bulkhead connector O-rings.

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-G. 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).
- Replace the CR2032 battery on the Rockland Data Logger board (Figure 11).
- Perform a 60 second electronics bench test on the MicroRider-1000-G. See Section 4.3 for detailed instructions.

> Rockland provides an annual instrument maintenance package for the MicroRider-1000-G. 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-G 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-G are summarized in Table 7 and identified in Section A.5.

> ⚠ 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-G

| O-ring location | Qty. | Specification | Replacement Interval |
|---|---|---|---|
| Pressure tube to bulkheads | 2 | 2-152 Buna-N, 70A | Annually or pre-deployment |
| Microstructure probes | 5 | 2-204 Buna-N, 70A | Annually or pre-deployment |
| 1/4-28 Anode Adapter Plug | 1 | 2-011 Buna-N, 70A | Annually or pre-deployment |
| MCLPBH7M/9M to rear bulkhead | 2 | 2-014, Buna-N, 70A | Annually or pre-deployment |

> Refer to the maintenance drawing (Section A.5) 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-G O-rings

- **Microstructure Probes**: The one O-ring in each of the microstructure sensor ports should only have a **VERY LIGHT** coating of grease; there should be no excess.

> This seal design relies on using friction to prevent the probe from easily spinning. Excessive grease will reduce the friction between the O-ring and the probe.

Excess grease on microstructure probe O-rings can prevent air from escaping the probe port cavity when removing the probes. This will create a vacuum inside the probe port cavity and increase the risk of saltwater droplets being suctioned into the cavity after complete removal of the probe.

- **Bulkhead Connector(s)**: To replace the bulkhead connector o-rings please refer to the appendix (Section A.9) for step by step instructions.
- **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 30). 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. VMP500

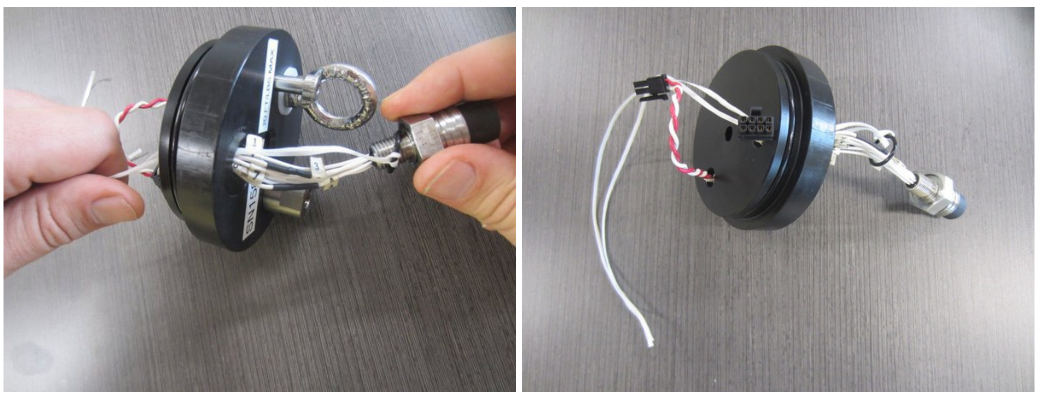


**Figure 30:** Removal of an O-ring from an MCBH connector (a MicroCTD is pictured).

## 5.3 Sealing Surfaces

Sealing surfaces are the surfaces that O-rings contact to create a water tight seal (Figure 31). 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.

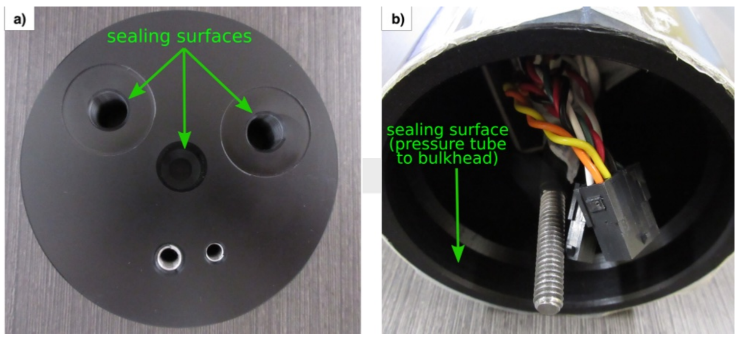



**Figure 31:** Typical sealing surfaces for a (a) rear bulkhead, and (b) pressure tube. (Note: A MicroCTD bulkhead and tube are pictured.)

## 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 and bulkheads of the MicroRider-1000-G are made of aluminum and are, therefore, susceptible to corrosion. Three components of the MicroRider-1000-G that are designed to protect it against corrosion are:

1. **Black anodization layer:** The pressure tube and bulkheads 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 pressure tube and bulkheads. More specifically, check the connections between:

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

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

   (iii) the anode on the rear bulkhead and the copper tab

   The anode assembly consists of a screw, the anode, and a rubber washer. These components must be assembled correctly with the rubber side of the washer facing the bulkhead to create a seal; see figure (Figure 32).

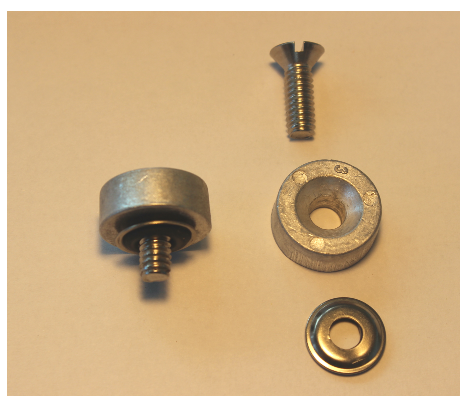


**Figure 32:** Sacrificial aluminum anode assembly. Assembled on left, seperated on right.

Additional information on corrosion protection is provided in a detailed blog post on Rockland Scientific's website[9].

> ⚠ 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 33, left) the affected component should be replaced, whereas pitting on the exterior surface of your instrument (Figure 33, 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.

**Figure 33:** Extreme corrosion on a MicroRider1000 after a long-term deployment

### 5.4.2 Probe SMB Connectors

Each probe connects to a SMB connector (Figure 34). The connector is susceptible to corrosion because it is frequently in proximity of water. To minimize the likelihood of corrosion, it is

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

recommended that you:

- Always ensure the area around the probe nut is dry before removing the probe from the instrument.
- Avoid handling the probe connectors with wet hands.
- Avoid installing or removing probes when there is risk of water entering the probe port.
- Avoid installing or removing probes when there is a large difference in temperature between the instrument and the surrounding air. This will prevent condensation on the SMB connectors.

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)[10].

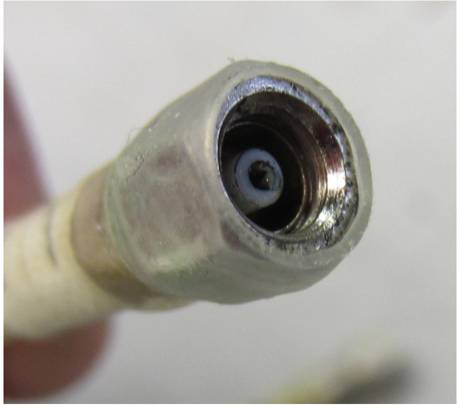


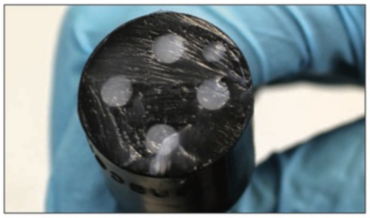
**Figure 34:** SMB connectors visible inside probe ports

### 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-G can be treated with O-ring grease as per the manufacturer's specifications (Figure 35).

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



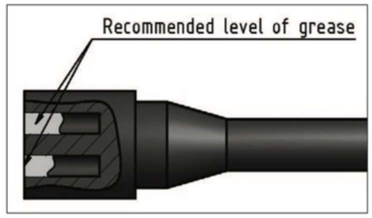



**Figure 35:** Applying grease to a MCBH connector. (Image source: SubConn and McCartney Underwater Connector Group (2018). *Underwater and Harsh Environment Connectors.* p. 122.[11])

## 5.5 Probes and Sensors

The probes and sensors on the MicroRider-1000-G 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 36).

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

**Figure 36:** 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 37).

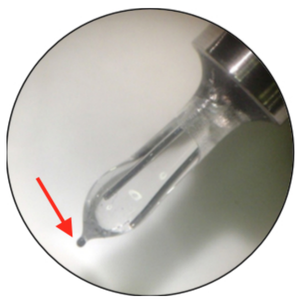


**Figure 37:** FP07 thermistor. The small sensing tip is indicated by the red arrow.

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 sensor (transducer) is located on the nose of the instrument (Figure 3), it is protected by the probe clamp plate. The front face of the transducer contains a thin diaphragm that is very delicate. Care should be taken to prevent accidental puncture or damage to this sensor (Figure 38). Rinsing with fresh water is sufficient to clean this sensor. If you suspect that your pressure sensor is damaged, contact support@rocklandscientific.com.

> Do not wipe or poke the pressure sensor.

**Figure 38:** A dent visible on the thin diaphragm of a PA10L pressure sensor

# 6 Troubleshooting

This section discusses how to troubleshoot some commonly reported issues you may experience. 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 Data 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.

To troubleshoot the issue, it is recommended that you:

1. For the instruments equipped with a R01 or R02 P113 RDL board there is an input power fuse wired between the rear bulkhead and the Rockland Data Logger board (Figure 39). Check the fuse on a R01 or R02 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. For instruments equipped with the R03 P113 board there is a resetting fuse on the board. There is no in-line cartridge fuse in the wiring. If the instrument fails to turn on when the main battery is fully charged this fuse may have tripped. Wait 15 minutes for the fuse to reset before trying again. If the resetting fuse trips again there is a problem elsewhere in the electronics that is causing the high current draw. Contact Rockland for support.

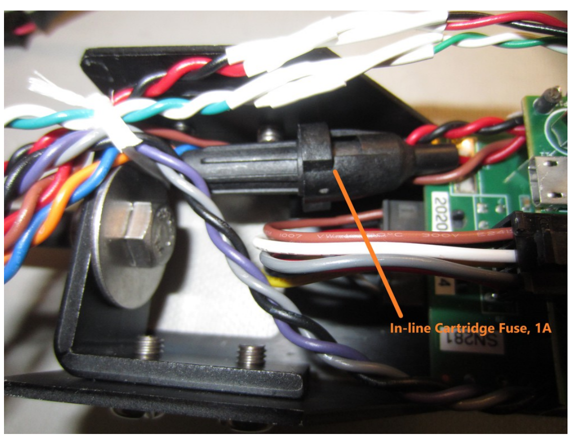



**Figure 39:** Input fuse wired in-line between the rear bulkhead and the Rockland Data Logger board for instruments with R01 or R02 RDL boards.

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 40). To check while the fuse is installed, first disconnect the main battery and then use your multi-meter to measure the resistance of the fuse. It should be greater than 0 Ω.

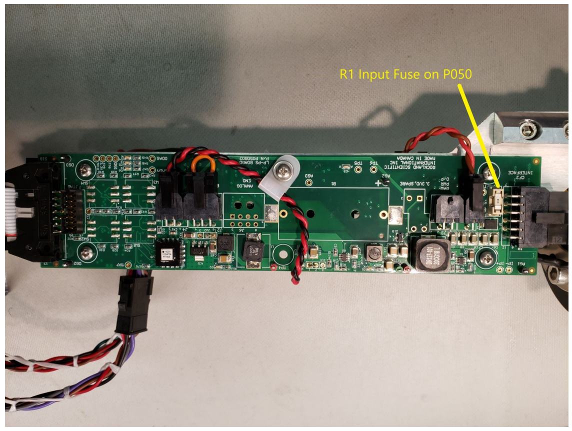



**Figure 40:** R1 fuse on the Power Supply board (P050).

## 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 as `exFAT`. This will result in all files on the drive being deleted.

- Copy back your `setup.cfg` file onto the Data 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 (SMB)**. To check for the presence of moisture and/or salt:

1. Visually inspect the probe port.
2. Inspect the gold SMB connector inside the probe port and look for signs of discolouration (i.e. biological growth, corrosion).
3. Check each probe port o-ring and ferrule assembly. Verify the o-rings are in good shape and the ferrules are not distorted. Check the o-ring sealing surface in the port.
4. 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.
5. 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) <u>Remove</u> 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, contact Rockland support[12].
    - If you observe increased noise on one of the **thermistor** channels, then we suggest the following tests if you have two T test probes:
        (i) <u>Swap</u> the T1 and T2 test probes and do a bench test. If the noise is now on the

[12] support@rocklandscientific.com

opposite channel, then the *test probe 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.

## 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.

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**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:

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**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.

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**(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.

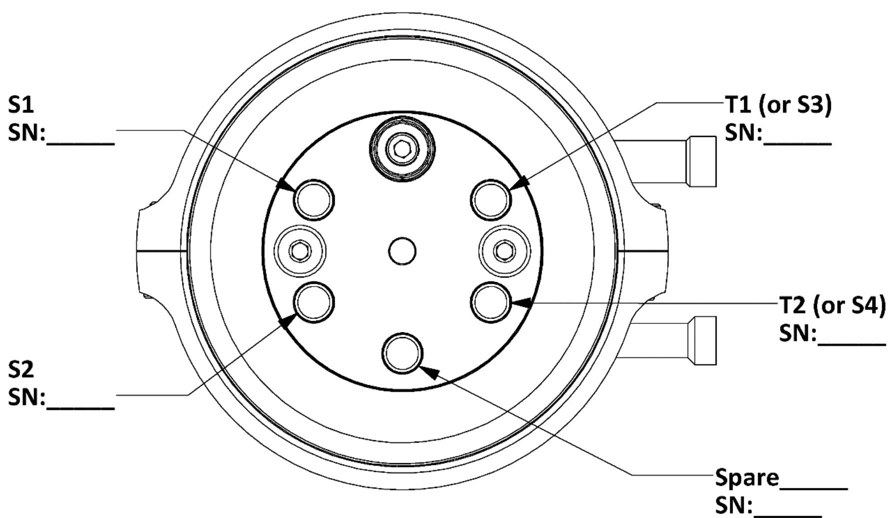
**PRE-DEPLOYMENT CHECKLIST**

*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-G**

- ☐ 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
- ☐ Ensure all probe ports have a greased o-ring
- ☐ Ensure bulkhead retaining clamps are installed and secure – consult manual
- ☐ Ensure that all bolts & connectors are secure (consult manual for safe torque rating)
- ☐ Ensure probes are fully inserted and o-ring compression plate is properly seated – consult manual
- ☐ Confirm all probes are oriented correctly
- ☐ Ensure sensor guard is secure – consult manual
- ☐ Consult platform manufacturer for correct/safe integration instructions (if applicable)
- ☐ Turn on instrument and confirm communication via deck cable or platform interface



## A.3 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.

**2/18/2022** **037143_R1 Kit_Spares_MR1000-G-RDL.xlsx** **Page 1 of 1**

Created:
2021-03-30

Bill of Materials
037-143-20 Rev1
Spares Kit, MR1000-G-RDL

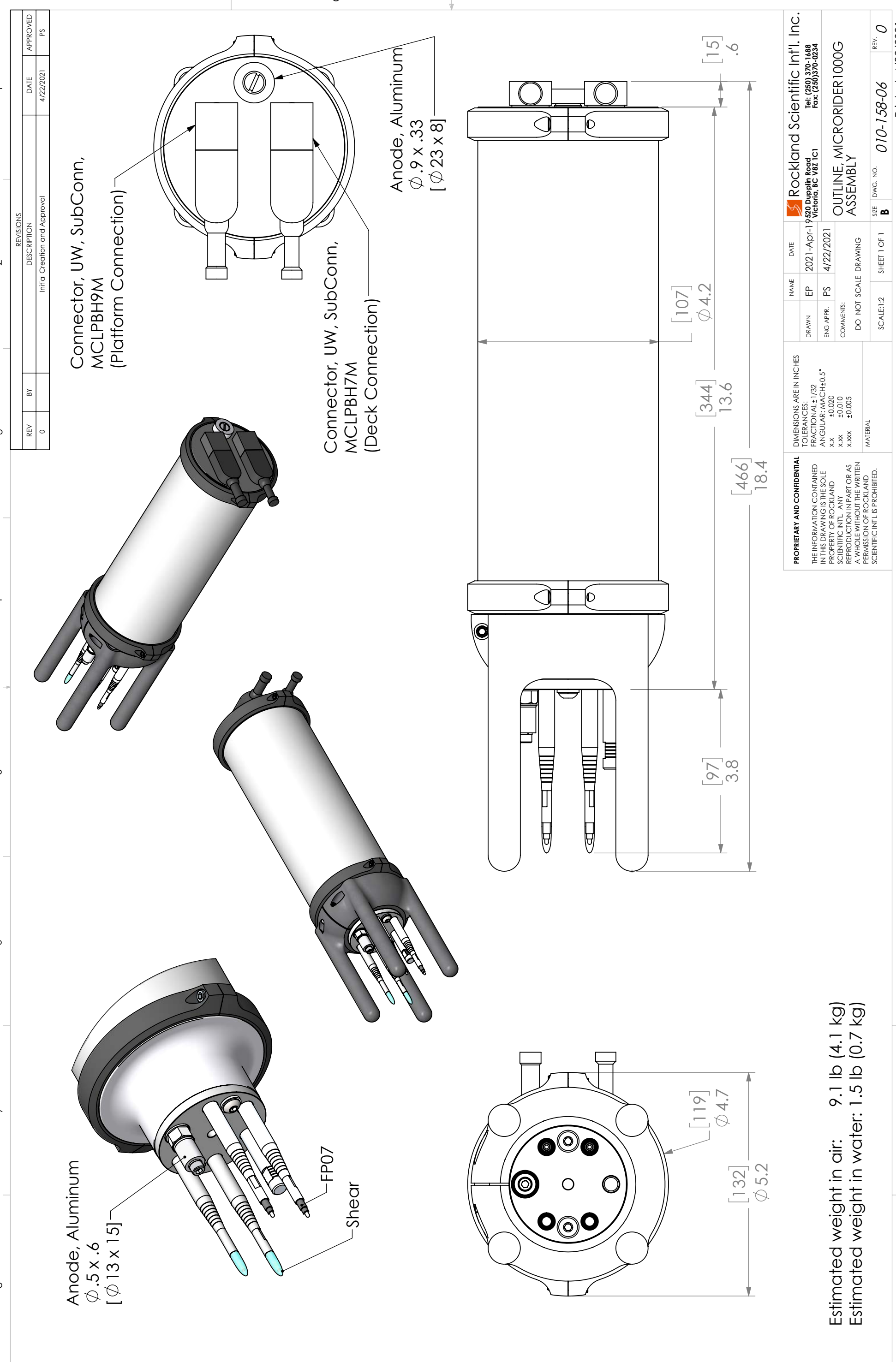
| Item No. | Part Number | Rev | Description | Use | Qty |
|---|---|---|---|---|---|
| 1 | 013-124-20 | 0 | Assembly, Anode, Aluminum, 0.9 inch O.D. x 0.25 inch I.D. x 0.4 inch height | Rear Anode Assembly | 1 |
| 2 | 013-174-20 | 0 | Assembly, Anode, Aluminum, 0.5 inch O.D. x 0.2 inch I.D. x 0.6 inch height | Front Anode Assembly | 1 |
| 3 | 013-175-20 | - | Grease, 1oz Dow DC-4, Bottle with Yorker Cap | All O-Ring Seals | 1 |
| 4 | 023-016-10 | - | Kingston 32GB USB Thumbdrive, DTX32GBCR | Data Files, Manual | 1 |
| 5 | | | See Option List | | |
| 6 | 240-002-10 | - | 1 A, 125 V, fast blow SMF fuse | LP-Power Circuit Board ("R1" upper side) | 2 |
| 7 | 591-010-10 | - | O-Ring, 2-011 Buna-N, 70A | Anode Adapter Plug | 1 |
| 8 | 591-013-10 | - | O-Ring, 2-014 Buna-N, 70A | MCLPBH Connector Seals | 2 |
| 9 | 591-053-10 | - | O-Ring, 2-105 Buna-N, 70A | Sensor Guard Spacer | 2 |
| 10 | 591-100-10 | - | O-Ring, 2-152 Buna-N, 70A | Main Bulkhead Face Seals | 2 |
| 11 | 591-130-10 | - | O-Ring, 2-204 Buna-N, 70A | Probe Seals | 5 |
| 12 | 651-000-10 | | Cable Tie, 4" x 0.1" White | Secure Wiring inside | 6 |
| 13 | 630-392-10 | - | Screw, Cap, 10-32 x 3/4, Socket Head, SS316 | Bulkhead Retaining Clamps, Sensor Guard | 5 |
| 14 | 630-624-10 | - | Screw, 1/4-20 x .75, Button Hd, Socket | Probe Compression Plate | 2 |
| 15 | 633-040-10 | - | Washer, Flat, 1/4, Nylon (0.51 OD) | Probe Compression Plate | 2 |

**OPTIONAL FOR INSTRUMENTS WITH P113R01 OR R02 BOARDS ONLY**

| | | | | | |
|---|---|---|---|---|---|
| 5 | 240-005-10 | | Fuse, Glass, 1A, 250VAC, 5 X 20 mm Fast Blow | In-Line fuse for P113R01/R02 equipped instruments | 2 |

## A.4 Outline Drawing

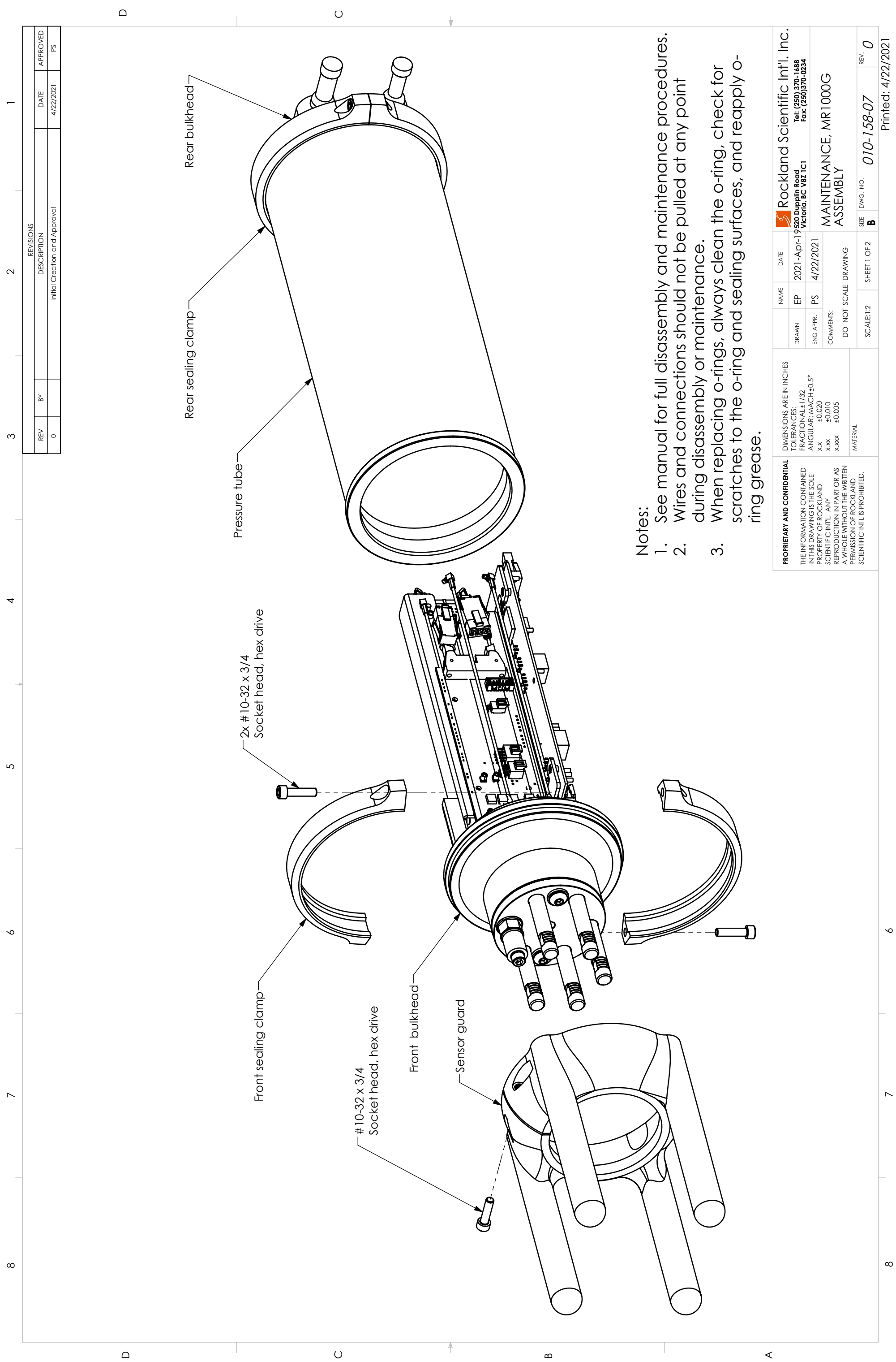
The outline drawing on the following page(s) shows the components of the MicroRider-1000-G and its dimensions.

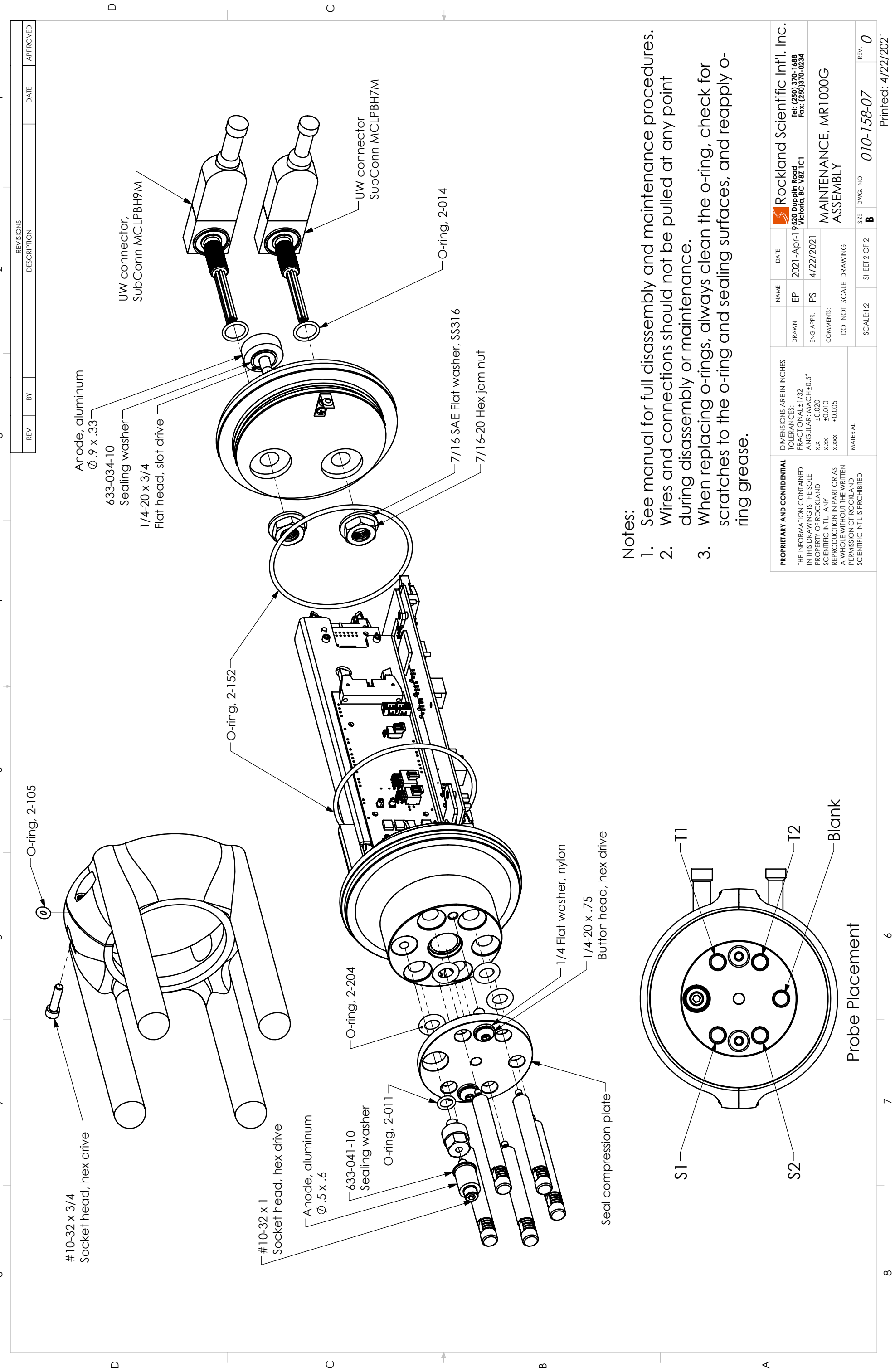


Connector, UW, SubConn, MCLPBH9M (Platform Connection)
Connector, UW, SubConn, MCLPBH7M (Deck Connection)
Anode, Aluminum Ø.9 x .33 [Ø23 x 8]
Anode, Aluminum Ø.5 x .6 [Ø13 x 15]
FP07
Shear
[15] .6
[107] Ø4.2
[344] 13.6
[466] 18.4
[97] 3.8
[119] Ø4.7
[132] Ø5.2
Estimated weight in air: 9.1 lb (4.1 kg)
Estimated weight in water: 1.5 lb (0.7 kg)
Rockland Scientific Int'l. Inc.
OUTLINE, MICRORIDER1000G ASSEMBLY
010-158-06
Printed: 4/22/2021
DO NOT SCALE DRAWING
SCALE:1:2
SHEET 1 OF 1

## A.5 Maintenance Drawing

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


REVISIONS
REV | BY | DESCRIPTION | DATE | APPROVED
0 | | Initial Creation and Approval | 4/22/2021 | PS
Rear bulkhead
Rear sealing clamp
Pressure tube
2x #10-32 x 3/4
Socket head, hex drive
Front sealing clamp
# 10-32 x 3/4
Socket head, hex drive
Front bulkhead
Sensor guard
Notes:
1. See manual for full disassembly and maintenance procedures.
2. Wires and connections should not be pulled at any point during disassembly or maintenance.
3. When replacing o-rings, always clean the o-ring, check for scratches to the o-ring and sealing surfaces, and reapply o-ring grease.
Rockland Scientific Int'l. Inc.
9520 Dupplin Road
Victoria, BC V8Z 1C1
Tel: (250) 370-1688
Fax: (250)370-0234
MAINTENANCE, MR1000G ASSEMBLY
DRAWN EP 2021-Apr-19
ENG APPR. PS 4/22/2021
DO NOT SCALE DRAWING
SIZE B
DWG. NO. 010-158-07
REV. 0
SCALE:1:2
SHEET 1 OF 2
Printed: 4/22/2021


UW connector,
SubConn MCLPBH9M
UW connector
SubConn MCLPBH7M
O-ring, 2-014
Anode, aluminum
Ø .9 x .33
633-034-10
Sealing washer
1/4-20 x 3/4
Flat head, slot drive
7/16 SAE Flat washer, SS316
7/16-20 Hex jam nut
O-ring, 2-152
O-ring, 2-105
O-ring, 2-204
1/4 Flat washer, nylon
1/4-20 x .75
Button head, hex drive
#10-32 x 3/4
Socket head, hex drive
#10-32 x 1
Socket head, hex drive
Anode, aluminum
Ø .5 x .6
633-041-10
Sealing washer
O-ring, 2-011
Seal compression plate
T1
T2
Blank
S1
S2
Probe Placement
Notes:
1. See manual for full disassembly and maintenance procedures.
2. Wires and connections should not be pulled at any point during disassembly or maintenance.
3. When replacing o-rings, always clean the o-ring, check for scratches to the o-ring and sealing surfaces, and reapply o-ring grease.
Rockland Scientific Int'l. Inc.
MAINTENANCE, MR1000G ASSEMBLY
DRAWN EP 2021-Apr-19
ENG APPR. PS 4/22/2021
DO NOT SCALE DRAWING
SIZE B
DWG. NO. 010-158-07
REV 0
SCALE:1:2
SHEET 2 OF 2
Printed: 4/22/2021

## A.6 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.6.1 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
```

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

```
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 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.
; The [root] section determines the data acquisition parameters.
[root]
; maxFileDuration = 3600 ; in seconds
; maxFileSize = 1 ; in MB
```

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 2.5.5

- `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]
```

[15] for an address matrix with eight columns and a sample rate of 512 Hz, see Section 2.5.5

```
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 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-RDL   ; 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.6.2 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.6.1. 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 Data 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.7 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.7.1 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.8) for the complete list of event types and differences with CF2 Persistor systems.

## A.8 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

2021-11-30

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

# Contents



# 1 Revision History

| Revision | Date | Description |
|---|---|---|
| 1.0 | 2020-11-06 | Initial Version |
| 1.1 | 2020-12-01 | Minor typos and phrasing corrections |
| 1.2 | 2021-01-07 | JMM - Removed extra item in table of event types. Fixed typos. |
| 2.0 | 2021-11-30 | Updated for P113R03 hardware and OSv4 Image. |



## 2 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.

Previous versions of this TN052 related to the R01 and R02 versions of the RDL hardware and software. This v2.0 adds the P113R03 and OSv4 software capabilities released in the fourth quarter of 2021. The new version of the RDL (R03 for short) adds the capability for ”sleep” mode while datalogging to reduce average power draw; the use of ”interface” software modules to better organize the commands used to interact with the datalogging software; and several other extensions of previous functions.

## 3 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.

   > 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.

> 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.

# 4 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.

# 5 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.

# 6 Power Draw

The RDL draws approximately 0.4 W more power than the CF2 Persistor. The P113R03 hardware and OSv4 software allow for a "sleep" mode to be enabled. When sleep is enabled the system will reduce power consumption when actively datalogging by shutting down the CPU when the data buffers are filling up. The system will wake up to transfer data or when interrupted by external requests. For the power draw of a specific instrument and sensor configuration, consult your Instrument User Manual, or contact Rockland Support at support@rocklandscientific.com.

# 7 System Shutdown Settings

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

For R01 and R02 boards:

- 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.
- In the configuration file (`setup.cfg`) there is a `minSystemVoltage` parameter which is set to 6 V. This is done to allow the hardware setting to be the primary shutdown control (Section 9). In the R01/R02 systems this software setting only stops datalogging, it does not power off the electronics.

> 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.

For R03/OSv4 boards:

- The P050 hardware setting is set to 7.3 V by default. This is the fail-safe shutdown used if the shutdown signal from the P113 does not work.
- The software controlled shutdown signal is set in the P113-DAQ-INI file with `vbat_cutoff`. This will be appropriately set at the factory for the instrument and its application. The user should not have to change or override this and should not do so without consulting Rockland Support. This software shutdown signals the P050 Power Supply to shutdown the instrument, and only works when the system is awake and logging data.

## 8 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 10).

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 10).

- 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.

Instruments can be controlled through the command line accessed through the RS232 port. This is typically done with MicroRider class instruments where the supporting vehicle starts and stops datalogging, sets the date/time, and so on.

# 9 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 = [xx]` Volts
  For R01/R02 systems this is set to 6 V. For R03 systems this parameter overrides the factory shutdown setting and therefore it is not defined and not used. Do not use this without consulting Rockland Support.

> 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] For an address matrix with eight columns and a sample rate of 512 Hz

2. Load the data file into Zissou Essentials and plot the pressure channel[3].
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

[3]The ODAS Matlab Library could also be used with the command `show_ch(filename,'P')`.

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 $\geq$ 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.

# 10 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.

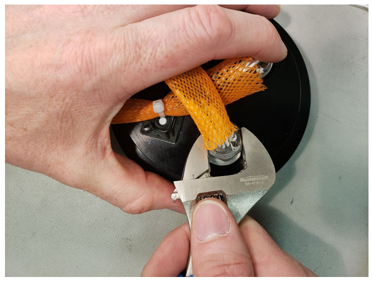
**Table 1:** Possible event types within your log file. Colors are such that white events can occur on both CF2 and RDL systems, red events are no longer used on either system, and blue events can occur only on CF2 systems.

| 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 –

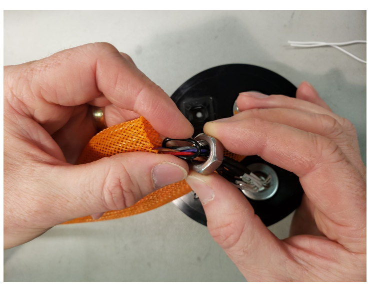
## A.9 MCLPBH O-Ring Change

**1.** Rear bulkhead assembly before maintenance. Note the way the two harnesses are criss-crossed at the tiedowns on the bulkhead. Some harnesses will not have the orange sleeve. Cut the zip ties securing the harnesses to the tie-downs.



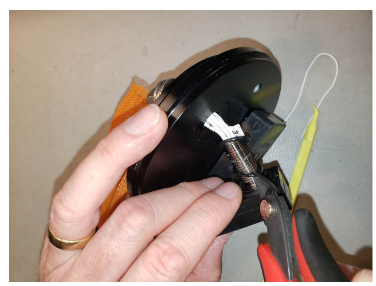
**2.** Remove Jam Nut that secures the connector. Hold onto the body of the connector while removing the nut.

**3.** Carefully slide the new o-ring over the connector and onto the wire harness.

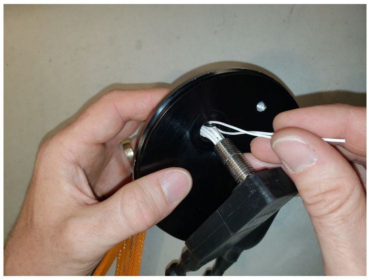


**4.** Carefully feed new o-ring through the nut.

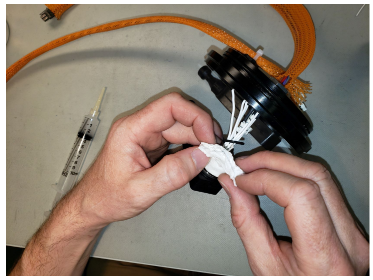
**5.** Carefully feed the new o-ring through the washers.



**6.** Remove the old o-ring from the connector and cut it off.



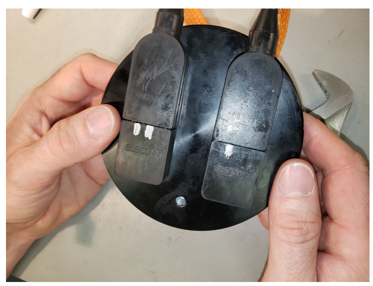
**7.** Use a length of wire or string to help pull the new o-ring through the hole in the bulkhead. Be gentle and careful.



**8.** Clean o-ring groove on connector and clean and lightly grease new o-ring. Make sure there is no Loctite residue in sealing areas, use compressed clean dry air to blow away material.

**9.** New o-ring installed on connector. Clean and check the spot face sealing surface on the bulkhead. Insert the connector into the bulkhead.

**10.** Slide washers into place. Apply some Blue Loctite 242 (removable) to the threads on the connector. Caution - use a small amount of Loctite, enough for 3 threads coverage. Install the Jam Nut.



**11.** Orient the connector as shown. Tighten jam nut while holding the connector body to maintain the correct orientation.

**12.** Secure the wire harnesses to the tie-downs. Remember they cross each other.

# Index