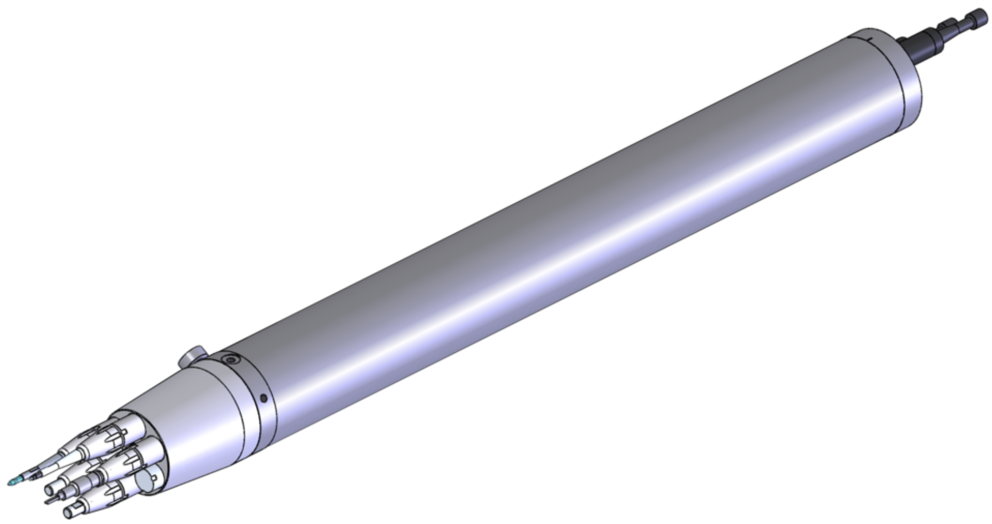


User Manual

MicroRider-1000

PN 010-033-20

Revision 6.2

2021-01-07

Rockland Scientific International Inc.
520 Dupplin Road, Victoria BC V8Z 1C1 Canada
tel +1-250-370-1688
fax +1-250-370-1688
toll free 1-877-370-1688
e info@RocklandScientific.com
w www.RocklandScientific.com

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

Contents

List of Figures

List of Tables

Revision History

Revision	Date	Description
6.0	2019-04-24	Updated format of MicroRider-1000 Manual
	2019-04-24	Updated format of MicroRider-1000-EM Manual
	2019-10-17	Updated format of MicroRider-1000-WW Manual (Wirewalker Integration)
6.1	2020-01-02	Addition of an index and Bench Test Checklist. Updated System Block Diagrams. Updated Spares List. Change of JAC to JFE Advantech. Addition or Zissou Essentials reference. Updated format of appendices for consistency with other manuals. Minor typo and phrasing corrections.
6.2	2021-01-07	Added part number, rearrangement of Assembly section, updated Tools List and added pre-deployment checklist. Other minor updates.

Warnings

Symbol Description

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

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

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

Information that is *helpful*.

Pressure buildup due to flooding of nose cone

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

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

Limitations

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

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

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

Contact Information

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

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

For support, including emergencies, contact us via:

- Email: support@rocklandscientific.com
- Phone: 250-370-1688 (9am - 5pm, Pacific Time)

1 Getting Started

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

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

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

1.1 Receipt of Goods

Immediately after you receive your instrument, you should:

1. Inspect all equipment for possible damage incurred during shipping. If damage is found, contact the shipper immediately to start the claims process. *Most shippers have a time limit on claims, so start the process promptly.*
2. Check the contents of the shipping case(s) against the packing list. Confirm that all items on the list are in the case(s) to ensure you have received all items ordered.
3. Confirm that you have received the tools/equipment for operating the instrument (Section 2.3.2).
4. Confirm that you have received a kit that includes spare components (i.e. O-rings, fasteners) for your instrument (Section A.3).
5. Install the required software on your computer (refer to the ODAS5-IR User Guide).
6. Establish communication with your instrument (refer to the ODAS5-IR User Guide). This will involve connecting with the instrument via the supplied deck cable (Section 4.2).
7. Ensure your memory card contains the proper files (refer to the ODAS5-IR User Guide).
8. Conduct an electronics bench test (Section 4.4).

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 3.2) and inspect all components for evidence of bio-fouling, corrosion, and physical damage.
   - Inspect the O-rings (Section 5.2) and sealing surfaces (Section 5.3). Replace your O-rings annually or before every cruise.
   - Inspect all anodes and replace worn anodes (Section 5).
2. **Check and/or replace batteries:**
   - Ensure that you have a fresh CR123 battery installed (Section 2.5.5 and Figure 39).
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.
   - SBE7 micro-conductivity sensors: Check that the tips of the electrodes are black. If necessary, clean the probe using the Triton cleaning solution (Section 5.5.3).
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 ODAS5-IR User Guide).
   - Perform a bench test (Section 4.4).
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).

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

- 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. Establish communication with the instrument (Refer to the ODAS5-IR User Guide).
3. Verify the contents in the configuration file, `setup.cfg`, match the configuration of the instrument.
4. Complete an electronics bench test (Section 4.4).
5. Inspect the O-rings and sealing surfaces (Section 5.2 and Section 5.3).
6. Discuss the ship operations with the captain and crew (Section 4.6.2).

1.4 Several Minutes Before Deployment (on the ship)

1. Confirm mechanical integrity of all components:
   (a) Sealing nut is tightened to 25 in · lb (Section 3.3).
   (b) Connectors on rear bulkhead are tightened.
   (c) There are no loose components that could cause unwanted vibrations.
2. Install the microstructure probes into the correct probe ports (Section 3.1).
3. Record the serial numbers of the probes in your deployment notes (Figure 13).
4. Turn the instrument on (Section 4.1).

⚠ A detailed pre-deployment checklist is provided in Section 4.6.1.

2 Overview of the MicroRider-1000

2.1 What is the MicroRider-1000?

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

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

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

2.2 General Specifications

2.2.1 Instrument Specifications

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

Table 1: General Specifications

Model	MicroRider-1000
Depth Range	0–1000 m (6000 m optional)
Weight in Air/Water	5.5 kg / 0.0 kg
Housing Length/Overall Length	0.88 m / 1.11 m
Sampling Rate	512 Hz / 64 Hz (fast channel / slow channel) *up to 2048 Hz available*
Data Acquisition	Internally Recording
Data Storage	Up to 540 hours of data with a 16 GB card *based on continuous sampling, 8 columns in the address matrix* (Section 2.5.6)
Power Consumption (Nominal)	1 W

2.2.2 Configuration and Sensor Specifications

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

Notes:

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

Table 2: Sensor specifications and instrument configuration.

Quantity	Sensor	Parameter Measured	Range	Accuracy	Resolution	Bandwidth
1	**PA-10L**	pressure	0–100 bar	0.1 % of FS	5×10^{-4} bar	0–2.5 Hz
1	**inclinometer**	instrument tilt	Dual Axis, $\pm 90°$	0.1°	0.015°	
2	**piezo-accelerometer (1-axis)**	instrument vibrations	±1 g	2 %	3×10^{-3} g	0.1–100 Hz
2	**Shear Probe**	velocity shear	0–10 s^{-1}	5 %	10^{-3} s^{-1}	0.1–100 Hz
2	**FP07**	temperature	-5–35 °C	0.005 °C	10^{-5} °C	0–25 Hz
Optional	**SBE7**	conductivity	0–70 mS cm^{-1}	0.005 mS cm^{-1}	0.001 mS cm^{-1}	0–100 Hz
Optional	**SBE4C**	conductivity	0–70 mS cm^{-1}	0.003 mS cm^{-1}	0.004 mS cm^{-1}	
Optional	**SBE3F**	temperature	-5–35 °C	0.001 °C	0.0001 °C	n/a

2.3 Requirements

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

2.3.1 Minimum Required Software and Documentation

Instrument communication requires:

- PC running Windows 7 (or newer) with at least one USB connection
- 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
- Motocross Terminal Software
- RSI Link Software
- ODAS5-IR User Guide

2.3.2 Minimum Required Tools

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

Table 3: Minimum Required Tools (supplied by Rockland)

Tools	Description/Size	Application/Use	Qty
Wrench	Custom Rockland wrench	Probe Holder	1
Torque Wrench	25 in · lb 1/4” drive	Sealing Nut	1
Deep Socket	1/2 inch 1/4” drive	Sealing Nut	1
Wrench, Adjustable	0-1 inch (0-25 mm)	Bulkhead Connectors	1

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
Compact Flash Card Reader		Reading information directly from the CF card	1
Wire Cutting Pliers	Side Cutting	Cutting Cable Ties, Waxed Lacing	1
Waxed Lacing Tape		Tying down Wiring Harnesses	1
Screwdriver, Phillips	Size #1	Circuit Board Screws	1
Screwdriver, 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 measures turbulence data, as well as information for data processing using Rockland's software products. These technical notes are available for download from the "Technical Notes" section of Rockland's website www.rocklandscientific.com.

Table 5: Recommended Technical Notes

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

2.4 Mechanical Systems Overview

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

2.4.1 Coordinate System

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

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

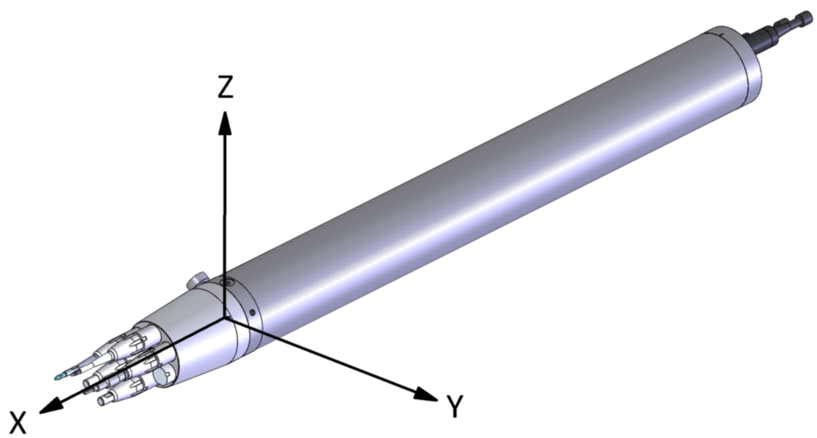


Figure 2: Coordinate System

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

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

2.4.2 Sensors

The nose cone of the MicroRider-1000 contains all the microstructure probes on the instrument (Figure 3). The specifications for each sensor are detailed in Table 2.

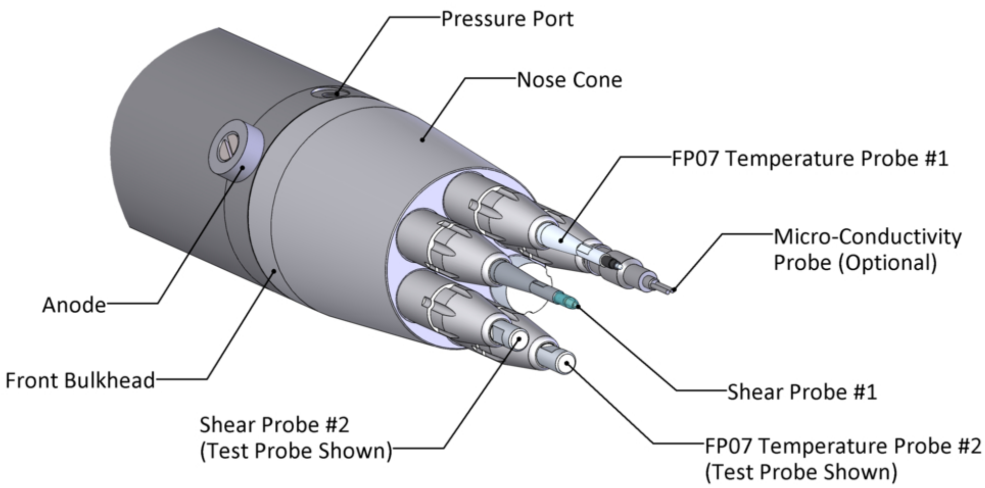


Figure 3: MicroRider-1000 Sensors

Up to six microstructure probes (shear, FP07, SBE7) can be installed on the nose cone in probe holders. The probes are electrically connected to the instrument via SMC coaxial cables. Typically the instrument is configured with electronics that support two shear probes and two FP07 fast response thermistors. An SBE7 micro-conductivity probe is commonly added as an optional sensor and the sixth port is a spare port. Test probes (Section 2.4.3) can be installed in place of real probes if the measured signals are not desired.

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

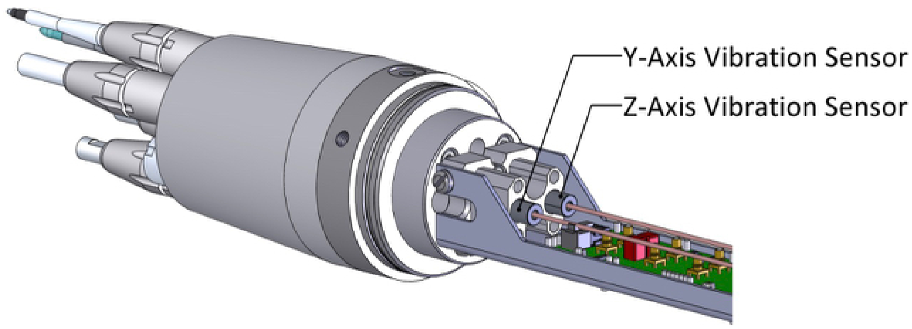


Figure 4: Vibration Sensors

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

2.4.3 Test Probes

Test probes (Figure 5) are used as place holders for real microstructure probes. They can be used during deployments if measurements are not desired on a particular channel, and should **always** be used when storing or shipping your instrument, and when performing an electronics bench test (Section 4.4). The test probes have internal electronics that bring measured values to approximately mid-scale. More specifically, the temperature and conductivity test probes have internal termination resistors whereas, shear test probes are un-terminated.

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

Figure 5: Test probe with an SMC connector.

2.4.4 Rear Bulkhead

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

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

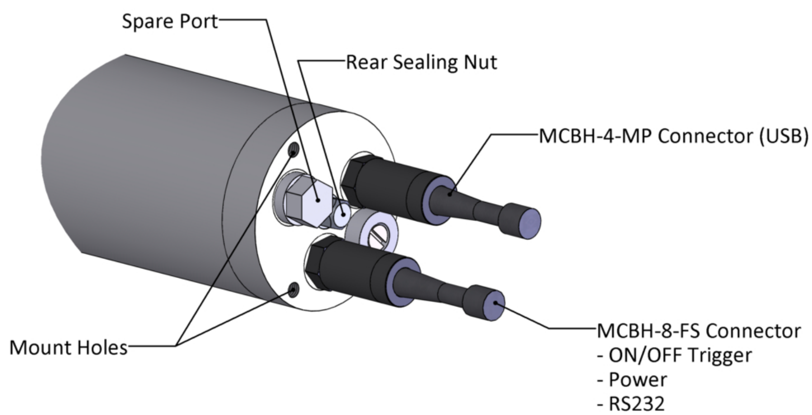


Figure 6: Rear Bulkhead

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

2.5 Electrical Systems Overview

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

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

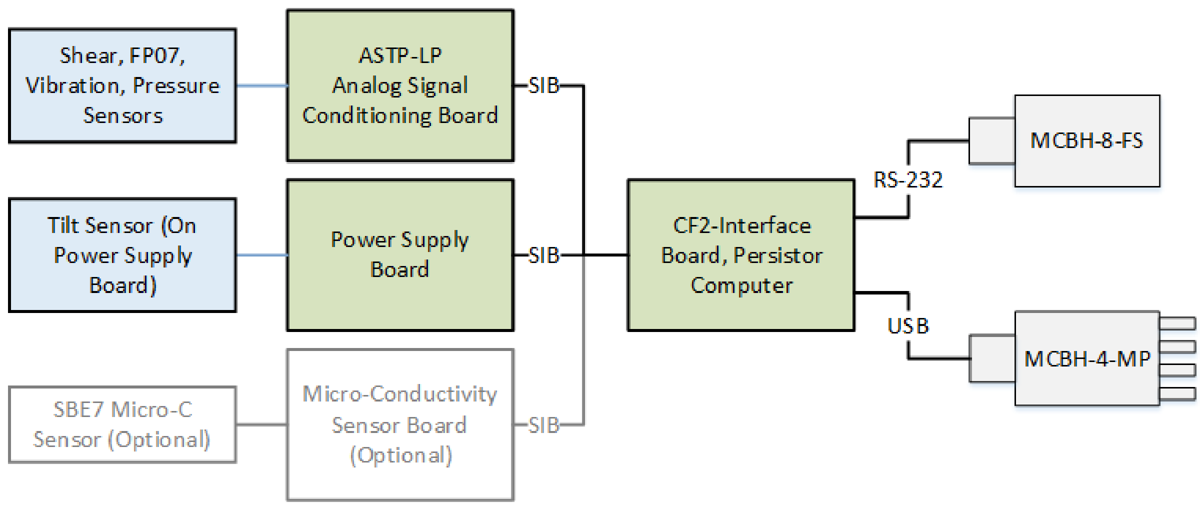


Figure 7: Instrument sensor and electronics system block diagram

2.5.1 Serial Instrument Bus (SIB)

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

2.5.2 ASTP Analog Signal Conditioning Board (P049)

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

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

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

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

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

2.5.3 Micro-Conductivity Board (P059) – Optional

This board is used to convert the analog output from the SBE7 micro-conductivity sensor to a 16-bit digital signal and to transfer that signal to the SIB. It is ONLY present in instruments that are configured to have the optional SBE7 sensor.

2.5.4 CF2-Interface Board (P040) and Persistor computer

The CF2-Interface board holds the Persistor computer that runs the PicoDOS operating system and handles the data acquisition. The CF2-Interface and its Persistor controller are sometimes called the data logger.

The Persistor processor 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 the ODAS5-IR User Guide for more information.

The CF2-Interface board handles all communication of data samples using the SIB. The interface board works closely with the power supply board to provide a graceful shutdown of the instrument after it is signaled to turn off. The computer setup is done through the RS-232 serial connection and the data download is done over USB.

2.5.5 Power Supply Board (P050)

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

The power supply board monitors the ON/OFF switch. Shortly after the instrument is turned on, it will start recording a new data file[4]. 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 and a 3V lithium battery (CR123). The CR123 battery (Figure 39) powers the monitoring circuit that is used to turn the instrument on/off.

> The CR123 battery should be replaced annually, or before every cruise.

[4]Provided the instrument has an auto-executable file (autoexec.bat) located in the same directory as the data acquisition software

2.5.6 Data Storage

Data acquired by the instrument are recorded internally on a CompactFlash card. The rate of data recorded is approximately:

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

For the MicroRider-1000, with a typical address matrix of 8 columns and a sampling rate of 512 Hz, this works out to just greater than 8 kB/s. In this configuration, a 16 GB CompactFlash card would allow for approximately 540 hours of recorded data.

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

2.6 Software Systems Overview

2.6.1 Data Acquisition and Data Download

The MicroRider-1000 acquires data with a Persistor CF2 processor using the ODAS5-IR software.

The ODAS5-IR User Guide provides a full description of communication and file transfer, and gives all details regarding the data acquisition software, including user configuration files. Effective use of the instrument requires a full understanding of the ODAS5-IR software. The ODAS5-IR User Guide is provided on the USB key that was shipped with your instrument.

2.6.2 Data Viewing and Processing

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

- analyze bench test data collected with test probes
- convert P files to MATLAB format
- convert acquired data to physical units
- visualize data for a customized range of interest
- calibrate FP07 thermistors using in-situ CTD data
- compute spectra for a segment of data and estimate the rate of dissipation for the chosen range

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

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

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

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

[5] Version 4.4 released July 2019

3 Assembly and Disassembly

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

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

3.1 Installing Microstructure Probes

Each of the microstructure probes on the MicroRider-1000 are retained using a probe holder, and sealed using a ferrule and several O-rings (Figure 8). Before removing or installing probes, place the instrument on a stable platform such that it is fully supported and cannot roll.

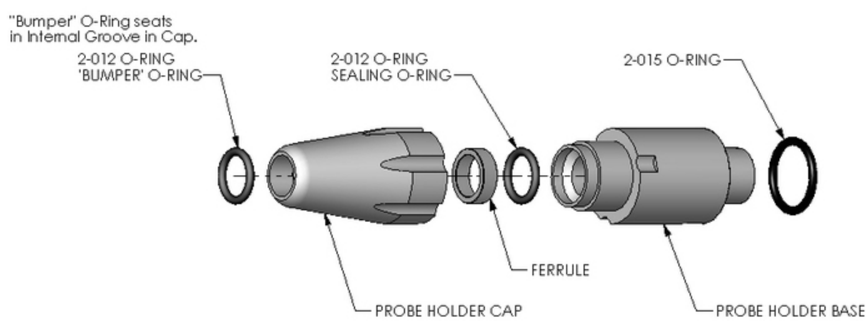


Figure 8: Probe holder assembly (exploded view of probe holder).

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

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

1. Loosen the probe holder cap using the probe wrench (Figure 9). Usually a half to three-quarter turn (counter-clockwise) is enough. You do not need to fully remove the cap.

Figure 9: Loosening the probe holder using the custom probe wrench.

2. Remove the test probe by pulling on it until the label on its SMC cable is visible (Figure 10). **A gentle pull is all that is required.** Pulling with higher force or a distance beyond the label could cause damage to the cable.

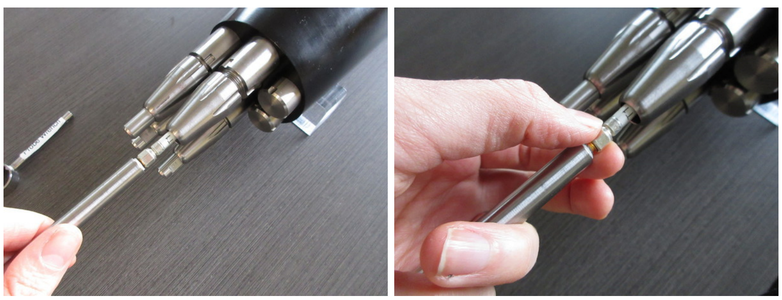


Figure 10: Removing the test probe. Note the clear heat shrink tubing around the SMC connector.

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

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

4. Inspect the SMC cable on each probe port. A layer of clear heat shrink tubing should cover all exposed metallic components on the connector, electrically isolating the connector from the front bulkhead. **Damaged heat shrink must be replaced.** Detailed instructions are provided in Technical Note 023 and in a blog post[6]. Also check for any tarnishing, corrosion or biofouling on the cable, around the connector, or beneath the label (Section 5.4.2). If found, contact Rockland Scientific.

To install a probe:

1. Connect and tighten the microstructure probes to their appropriate SMC cables. Insert the sensors into the probe holders (Figure 11). **Make sure the probes are fully seated.**

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

You should be able to hear the metal base of the probe contacting the base of the probe port. If the probe does not easily seat, try rotating the probe and reseating. Make sure the probe holder caps are loosened so that the O-ring is not being squeezed around the probe.

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

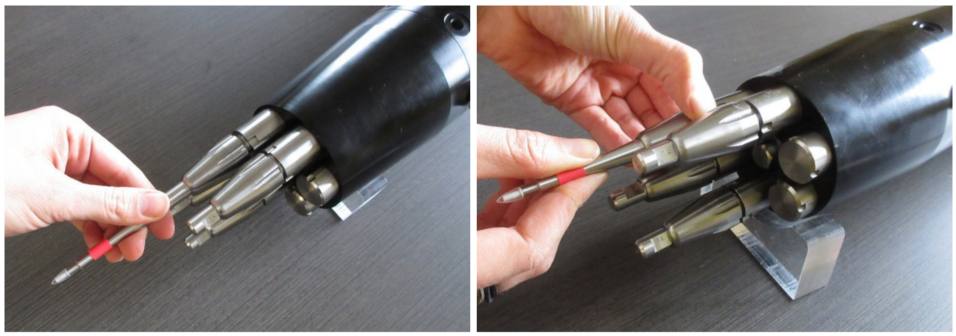


Figure 11: Inserting a probe into a probe holder.

2. Tighten the probe holder caps using your fingers until they can no longer be easily tightened by hand. Then, use the probe wrench to tighten the caps an additional **1/8 or 1/4 turn** (Figure 12). At the proper tightness, it should be difficult to rotate the probes by hand.

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

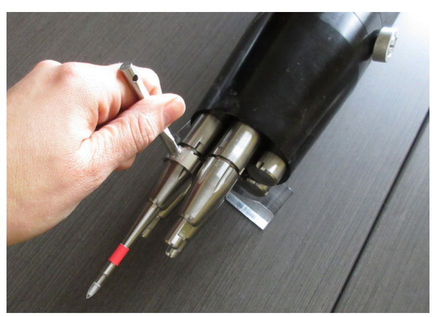


Figure 12: Tightening the probe holder.

3. As you tighten the probe holders, ensure that the shear probes are oriented correctly. Typically, one shear probe is aligned with the instrument's z-axis, and the other with its y-axis (Figure 2). The sensitivity on a shear probe is in the direction normal to the flat section of the sensor's serial number (Figure 13). Note: The orientation of other microstruc-

ture sensors (FP07 temperature probes, SBE7 micro-conductivity probes) do not matter.

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

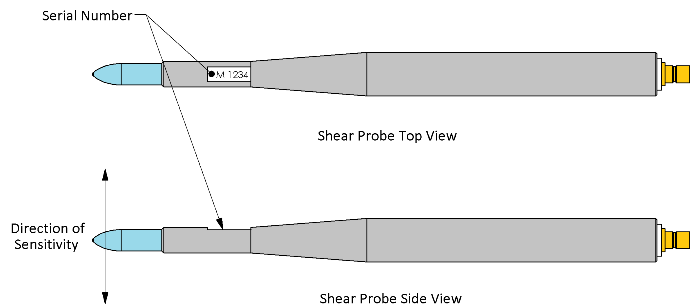


Figure 13: Shear probe direction of sensitivity.

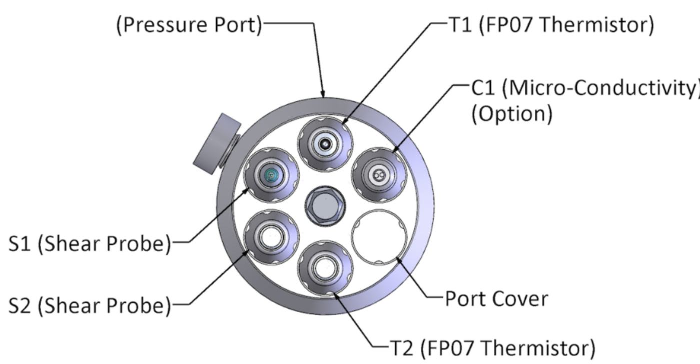


Figure 14: Nose cone sensor layout

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

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

3.2 Disassembling the Pressure Case

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

3.2.1 Removing the Rear Bulkhead

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

1. Remove the sealing nut from the rear bulkhead using the provided 1/2-inch (13 mm) deep socket and torque wrench (Figure 15). Alternatively, a socket wrench with extension or a nut driver can be used.

Figure 15: Removing the sealing nut.

2. Gently rock the rear bulkhead as you slowly separate it from the pressure tube. If extra leverage is required, install two 1/4-20 $\times$ 3 or 4 inch bolts into the two mounting points on the rear bulkhead (Figure 16). Hold onto the pressure tube and gently wiggle the rear bulkhead out of the tube by holding onto the bolts.

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

Figure 16: Leverage to Remove the Rear Bulkhead

3. Slowly slide the rear bulkhead out over the threaded rod.
4. Gently disconnect the Molex connectors on the wiring harnesses between the rear bulkhead and the internal electronics (Figure 17).

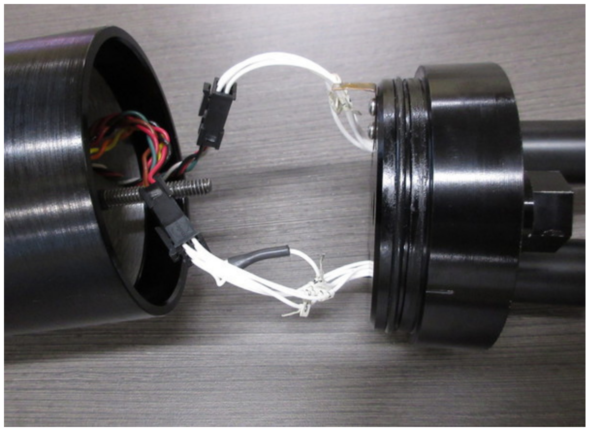


Figure 17: Disconnecting the rear bulkhead connections

3.2.2 Removing Components from the Rear Bulkhead

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

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

3.2.3 Removing the Pressure Tube

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

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

Figure 18: Separating the front bulkhead from the pressure tube.

2. Slowly slide the pressure tube past the internal frame (Figure 19), exposing the internal electronics. This step is best completed with two people to prevent damaging the electronics when removing the tube from the front bulkhead.

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

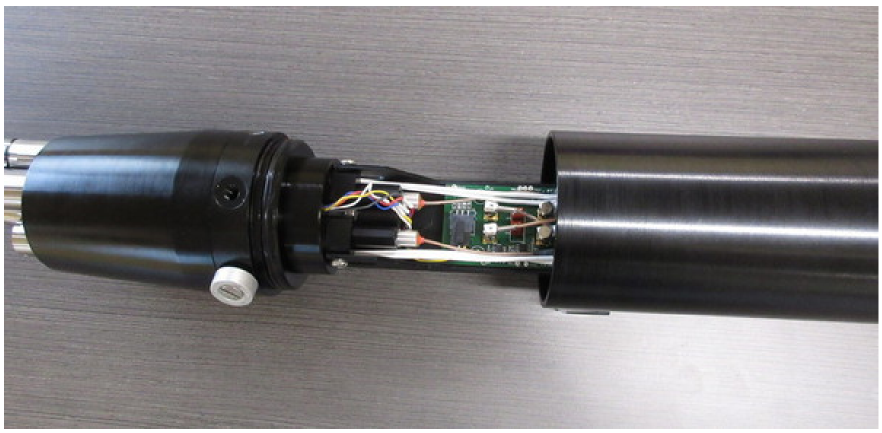


Figure 19: Sliding electronics out of pressure tube

3.2.4 Removing the Nose Cone

The procedure to remove the nose cone is as follows:

1. Remove the test probes (Figure 20). See Section 3.1 for probe removal instructions.

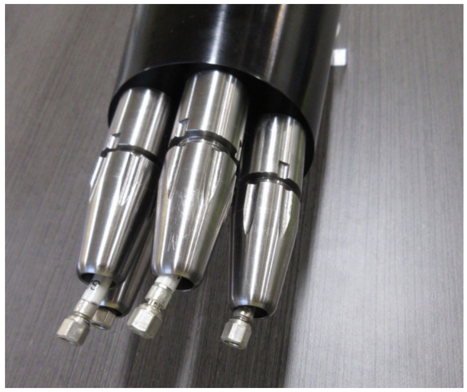


Figure 20: Nose cone after removal of test probes.

2. Remove the sealing nut with the provided 1/2” deep socket and provided torque wrench. Alternatively, a socket wrench with extension (Figure 21), or nut driver can be used.

Figure 21: Loosening the front sealing nut with a socket wrench (with extension).

3. Slide the nose cone over the threaded rod, allowing the SMC cables to pass through the holders. Fully remove the nose cone from the front bulkhead (Figure 22).

Figure 22: Nose cone removed, revealing the SMC cables and the threaded rod.

3.2.5 Removing Probe Holders from the Nose Cone

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

1. Remove each probe holder cap, ferrule and O-ring (Figure 23, left).
2. Remove the probe holder base from the nose cone using the custom wrench (Figure 23, right).

Figure 23: Removal of the probe holders from the nose cone.

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

3.3 Reassembling the Pressure Case

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

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

3.3.1 Reassembling the Nose Cone

To reassemble the nose cone do a reversal of the disassembly procedure. The reassembly is usually completed in the following order, however steps 1 and 2 may be interchanged depending on the user's preference:

1. Attach nose cone to front bulkhead.
   (i) Inspect the O-ring and the groove on the outer side of the front bulkhead.
   (ii) Inspect the sealing face on the nose cone.
   (iii) Feed the sensor cables through the holes in the nose cone (Figure 24). We recommend the layout shown in Figure 25. Passing the SMC cables through each probe holder port is most easily accomplished by positioning the nose cone next to the front bulkhead at a ninety degree angle to the instrument. The cables are just long enough to reach all the way through the holders.

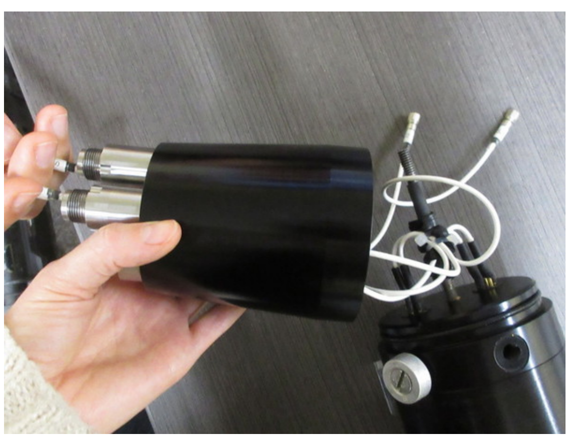


Figure 24: Feeding the SMC cables through the nose cone. The picture shows the probe holders already installed on the nose cone. It is recommended that you first install the nose cone, and then install the probe holders.

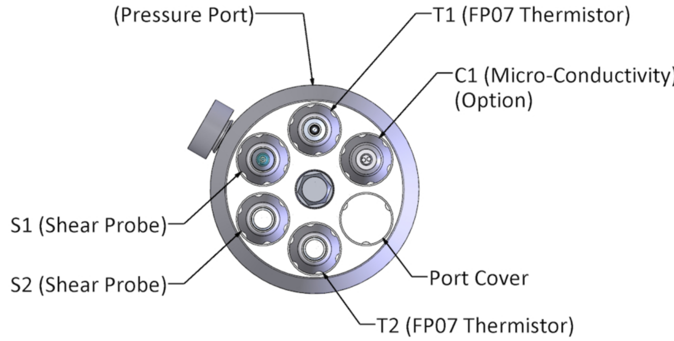


Figure 25: Nose cone sensor layout.

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

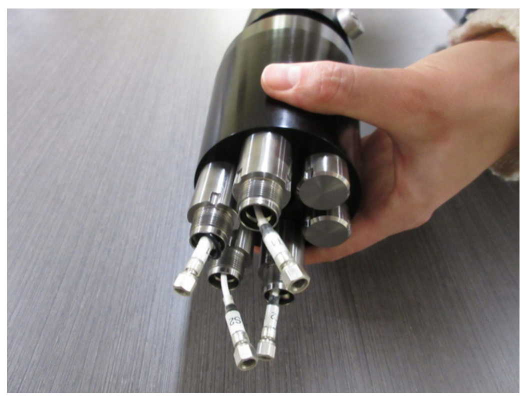


Figure 26: Sliding the nose cone onto the front bulkhead. Note: The picture shows the probe holders already installed on the nose cone. It is recommended that you first install the nose cone, and then install the probe holders.

2. Install probe holders onto the nose cone.

   (i) Ensure that the 2-015 O-ring is installed in the probe holder base. Also, inspect the groove on the bottom of the probe holder base and the matching seal face on the nose cone.

   (ii) Feed the SMC cable through the probe holder base and attach the base to the nose cone. Use the custom wrench to securely tighten the probe holder caps.

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

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

⚠ Place the O-ring first, followed by the ferrule (Figure 8).

(iv) Attach the probe holder cap.

3. Install the test probes (Section 3.1).

3.3.2 Reassembling the Rear Bulkhead

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

3.3.3 Reassembling the Pressure Tube

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

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

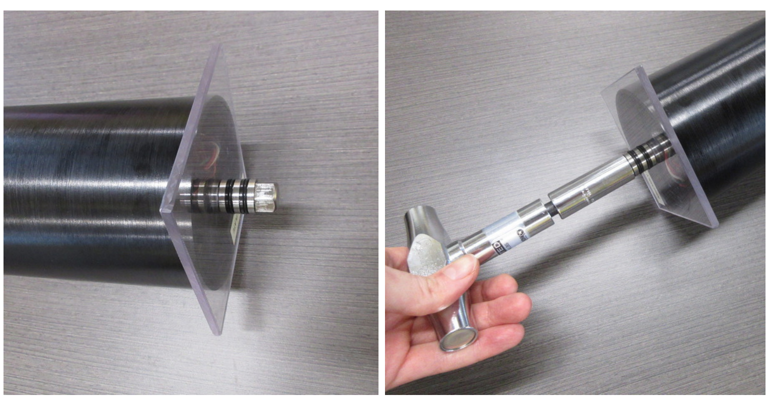


Figure 27: Sliding electronics into the pressure tube using the plastic plate.

4. Attach rear bulkhead to the pressure tube.
   (i) Inspect the O-ring and groove on the rear bulkhead.
   (ii) Connect the Molex connectors between the rear bulkhead and the internal electronics.
   (iii) Clean and inspect the sealing nut, sealing nut O-rings (and backup rings) and grease if necessary.

(iv) Insert the rear sealing nut into the bore on the rear bulkhead. This will ensure that it engages the threaded rod.

(v) Push the rear bulkhead into the pressure tube until it is possible to turn the sealing nut onto the threaded rod.

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

(vi) Tighten the sealing nut with the provided torque wrench (Figure 28) to a torque of 25 in · lb (3 N m).

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

Figure 28: Tightening the sealing nut on the rear bulkhead.

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

4 Operations

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

4.1 Turning the Instrument ON/OFF

4.1.1 Turning the Instrument On

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

1. **deck cable:** Connect one end of the deck cable to the 8-pin MCBH connector on the instrument, and the other end to wall power. The instrument will automatically turn ON (Figure 29).

> The MicroRider-1000 is supplied with an auto-executable file `autoexec.bat` on the CF card and therefore will automatically start data acquisition. Please refer to the ODAS5-IR User Guide for details on starting/stopping data acquisition

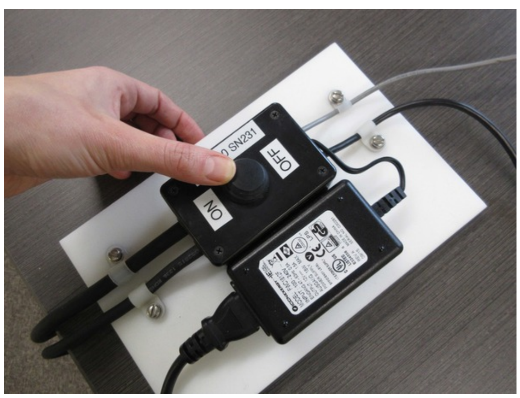


Figure 29: Sending the ON signal using the deck unit switch.

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

> Once the instrument has been turned on, it will complete a boot up sequence, and then start data acquisition.

[8]When connected to a Slocum glider, the ON signal is achieved by sending a 2 mA current to the power supply board. Other platforms may be configured to use different signals.

4.1.2 Turning the Instrument Off

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

4.2 Connecting the Instrument to a Computer

Connecting the MicroRider-1000 to a computer allows for instrument communication and data transfer. The connection requires the following:

- Instrument
- Deck Cable with Deck Unit (power supply and ON switch)
- Computer, with two USB-A 2.0 ports (or one USB-A 2.0 port and one 9-pin D-sub connector)
- FTDI Serial to USB converter (CHIPI-X10 or UC232R-10), if your computer does not have an RS232 port

The connection can then be established as follows:

1. Connect the deck cable to the instrument by connecting the two underwater connectors (Figure 30):
   (i) Impulse MCIL-8-MP connector (RS232 serial connection, 12 V DC power and the ON switch)
   (ii) Impulse MCIL-4-FS connector (USB serial data connection)

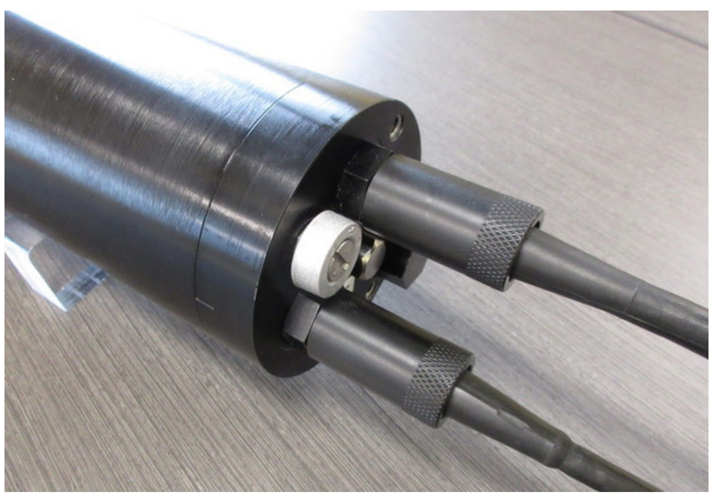


Figure 30: Connecting the deck cable to the instrument

2. Connect the deck cable to your computer (Figure 31) by connecting:
   (a) the USB connector on the deck cable, and

(b) the 9-pin D-sub connector on the deck cable to a second USB port on your computer (via the FTDI Serial to USB converter). **Note: If your computer has an RS232 serial port, you can connect the 9-pin D-sub connector directly.**

Figure 31: Connecting the deck cable to the computer.

3. Turn the instrument ON using the ON switch on the deck unit (Figure 29).

4.3 Communicating with the Instrument

Instrument communication and data acquisition are achieved using the ODAS5-IR software. Please refer to the ODAS5-IR User Guide for details on the following:

- Establishing communication with the instrument
- Generation of data files
- Structure of data files and log files
- Transferring files between the instrument and your computer
- Anatomy of a configuration file

4.4 Performing an Electronics Bench Test

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

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

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

2. Rest the MicroRider-1000 horizontally on a table or bench, preferably on something soft like open cell foam.
3. Connect your computer to the instrument using the deck cable (Section 4.2).
4. Establish communication with the instrument and take a **minimum 60 second** data file (See ODAS5-IR User Guide). During this time, ensure that the instrument remains stationary and that any sources of vibration have been minimized.
5. Transfer the data file to your computer using RSI Link (See ODAS5-IR User Guide).
6. 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[9] – time series of the signals measured by the ASTP and inclinometer channels, and spectra computed from the ASTP signals.
7. Verify that the sensor signals are as expected[10]. Values and expected ranges are provided in the Bench Test Checklist (Section A.1).

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

4.5 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 CR123 battery.
2. Ensure all O-rings and sealing surfaces are clean and undamaged (no scratches). O-rings should be lightly greased.
3. Ensure the instrument is fully assembled and that all fasteners are tight.
4. Ensure that there is no visible gap between the pressure tube and the bulkheads and between the nose and the front bulkhead.
5. Connect the instrument to your computer (Section 4.2).
6. Confirm that you can communicate with the instrument. If you are unable to communicate with the instrument, refer to the ODAS5-IR User Guide.
7. Ensure that the CF card contains the necessary data acquisition files. Check the time of day clock to make sure that it is set to the proper time. Refer to the instrument ODAS5-IR User Guide.
8. Run ODAS5-IR in "calibration" mode to confirm successful data acquistion on all desired channels (refer to the ODAS5-IR User Guide).
9. Record a 1-minute data file and perform an electronics bench test (Section 4.4).
10. If you have a SBE7 micro-conductivity sensor, check that the tips of the electrodes are black. You may need to clean the probe using the Triton cleaning solution (Refer to Section 2.4.2).
11. Modify the `setup.cfg` file with the probe serial numbers and sensitivities or calibration coefficients (if known). Note: The `setup.cfg` file can be modified post deployment, but be sure to record the serial numbers in your deployment notes.

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

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

4.6 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.

4.6.1 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 4.5).
2. The instrument is now ready for assembling onto the platform. Refer to the platform documentation for instructions on assembly and pre-deployment using the platform.
3. Ensure that the instrument is correctly and securely mounted on the platform. Connect the instrument to the platform through the MCBH-8-FS connector. Put the dummy on the MCBH-4-MP connector.
4. Select and install your microstructure sensors (Section 3.1). Visually inspect each sensor to ensure that there is no obvious damage (Section 2.4.2).
5. Record the serial numbers of the sensors (Figure 13) on the pre-deployment checklist (Section A.2) to include in your records. For the shear probes, you should also note the orientation with respect to the instrument coordinate system (Figure 2).

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

6. Ensure that you have discussed deployment and recovery with the crew and captain before proceeding (Section 4.6.2).
7. The instrument should now be ready for deployment.

4.6.2 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.

4.7 Deployment

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

4.8 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
- 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

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

5.1 Timelines

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

5.1.1 During Cruises

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

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

5.1.2 Immediately after Last Deployment

On deck, after the last deployment:

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

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

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

5.1.3 Post-Cruise Disassembly and Maintenance

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

1. Gather maintenance supplies (Table 6). Have a pail of clean fresh water available.
2. Disassemble the instrument. As you disassemble the instrument, place small components into the fresh water to remove any residual salt or debris. The disassembly sequence is as follows:
   i) Remove the test probes (Section 3.1).
   ii) Remove the probe holders (Section 3.2.5). Clean O-rings.
   iii) Remove the nose cone (Section 3.2.4). Clean pressure tube O-ring.
   iv) Remove the rear bulkhead (Section 3.2.1). Clean pressure tube O-ring.
   v) Remove components from the rear bulkhead (Section 3.2.2) and clean O-rings. Refer to Section 5.2.2 for particular guidance on removal of the bulkhead connector O-rings.
   vi) Remove pressure tube (Section 3.2.3). Clean O-ring on front bulkhead. (Note: You will have to slide it over the internal electronics frame.)
3. Wipe sealing surfaces with a damp, lint-free cloth or towel using fresh water to remove residual salt. Clean sealing surfaces with isopropyl alcohol.
4. Inspect O-rings and replace any that are no longer in good working condition (see Section 5.2).
5. Once components are rinsed and dry, reassemble the instrument in the reverse order. As necessary:
   - Inspect sealing surfaces for debris, corrosion and/or scratches (Section 5.3).
   - Re-grease and re-install O-rings.

5.1.4 Annually

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

- Complete the post cruise maintenance disassembly procedure (Section 5.1.3).
- **Replace O-rings with new O-rings** (See Section 5.2 for more details).
- Replace the CR123 battery on the power supply board (Figure 39).
- Connect your computer to the instrument and perform a 60 second electronics bench test on the MicroRider-1000. See Section 4.4 for detailed instructions.

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

5.1.5 Preparation for Storage and Shipping

To prepare your instrument for **storage**:

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

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

2. Place in a clean and dry storage area.

To prepare your instrument for **shipping**:

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

5.2 O-Rings

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

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

> ⓘ 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 O-rings

- **Probe Holders:** Each probe holder has three O-rings (Figure 8). The sealing O-rings adjacent to the probe holder base should only have a very light coating of grease; there should be no excess. Grease can be applied to the "bumper" O-ring using the non-connector end of the test probe. Note: the purpose of the bumper O-ring is to minimize vibrations and it does NOT provide a seal.

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

- **Bulkhead Connector(s)**: To remove the connector O-rings, thread string around the O-ring and pass both ends of the string through the threaded hole (Figure 32). Gently pull on the string to pass the O-ring through the hole and around the wiring harness. Reverse these steps to replace this O-ring.

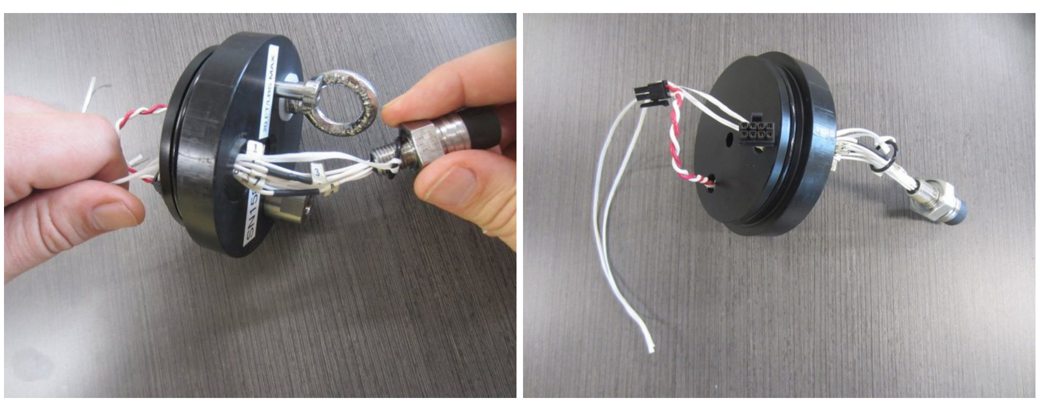


Figure 32: Removal of an O-ring from an MCBH connector (a MicroCTD is pictured).

5.3 Sealing Surfaces

Sealing surfaces are the surfaces that O-rings contact to create a water tight seal (Figure 33). 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.

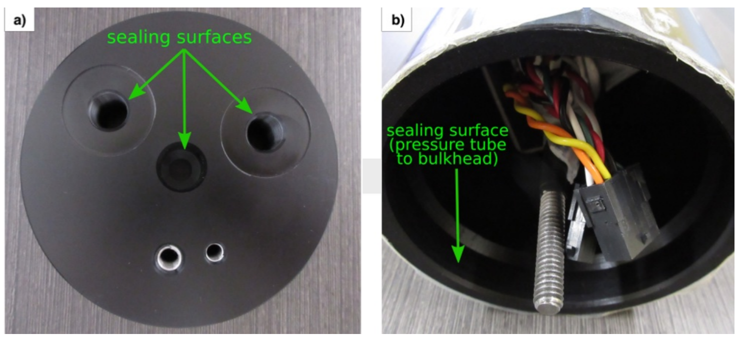


Figure 33: Typical sealing surfaces for a (a) rear bulkhead, and (b) pressure tube. (Note: A MicroCTD bulkhead and tube are pictured.)

5.4 Corrosion Prevention

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

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

5.4.1 Pressure Tube and Bulkheads

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

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

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

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

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

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

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

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

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

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

Additional information on corrosion protection is provided in a detailed blog post on Rockland Scientific's website[11].

> ⚠ 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 34, left) the affected component should be replaced, whereas pitting on the exterior surface of your instrument (Figure 34, 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.

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

Figure 34: Extreme corrosion on a MicroRider1000 after a long-term deployment

5.4.2 Probe SMC Connectors

Each probe connects to a SMC connector (Figure 35). The connector is susceptible to corrosion because it is frequently in proximity of water. To minimize the likelihood of corrosion, it is recommended that you:

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

Conducting a bench test with test probes installed (Section 4.4), 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)[12].

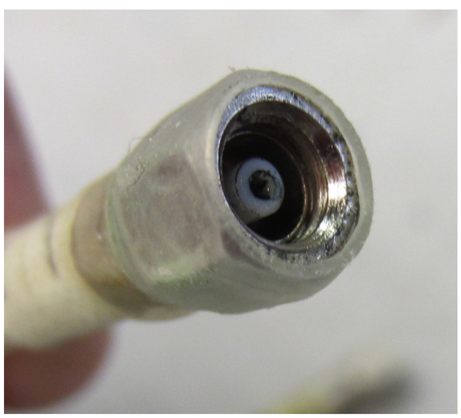


Figure 35: Green corrosion on the inside pin of an SMC connector. Without corrosion, the pin would appear shiny and gold.

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

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

5.4.3 Underwater Connectors

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

The bulkhead connectors on the MicroRider-1000 can be treated with O-ring grease as per the manufacturer's specifications (Figure 36).

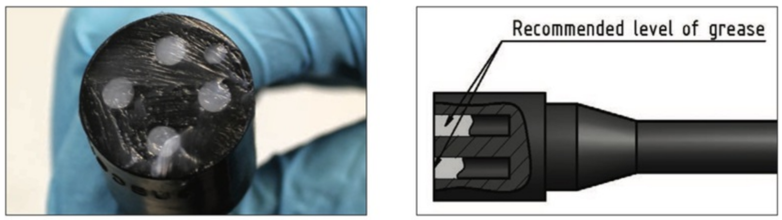


Figure 36: Applying grease to a MCBH connector. (Image source: SubConn and McCartney Underwater Connector Group (2018). *Underwater and Harsh Environment Connectors.* p. 122.[13])

5.5 Probes and Sensors

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

5.5.1 Shear Probe

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

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

To determine if a probe is broken, first conduct a visual inspection to check if the white mantle housing the peizo ceramic beam inside the probe tip is straight in line with the main axis of the probe. A bent mantle and beam almost certainly means the probe is broken (Figure 37).

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

Figure 37: 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 38).

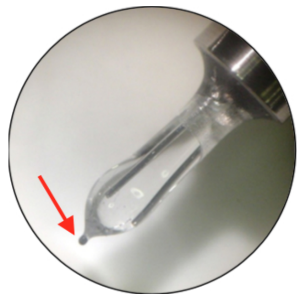


Figure 38: FP07 thermistor. The small sensing tip is indicated by the red arrow.

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 SBE7 Micro-Conductivity Sensor (Optional)

The SBE7 sensor is manufactured by Sea-Bird and their recommendations for preparing and storing their conductivity sensors are described in Technical Note 033.

To determine if the micro-conductivity sensor is broken, first do a visual inspection. Bent or broken probe tips are a clear sign of damage. Check (with a magnifying glass or microscope) for any deposits on the black contact surfaces of the tips.

If the micro-conductivity sensors have visible discoloring on their tips (e.g. gray or brown spots), we recommend cleaning the micro-conductivity sensor as follows:

1. Soak the sensors in 1% Triton X-100[14] for 10 minutes. Triton X-100 is a powerful wetting agent that quickly removes particulate stains and some oils and greases.
2. Rinse the sensors with distilled water and let them dry.
3. Conduct a visual inspection with magnifying glass and confirm that the electrodes return to a "jet black" appearance.
4. Soak the sensors in 0.1% Triton X-100 for 16 hours.
5. Rinse with distilled water. Air dry for one hour.
6. The micro-conductivity sensors should be stored with their "syringe" style protectors and kept dry.

> ⚠ Subsequent reuse of these sensors should be preceded with a soaking in 0.1% Triton X-100 for one hour, followed by a quick rising with clean water. Pre-soaking the probe tips is essential for retaining the sensitivity of the probe.

5.5.4 Pressure Sensor

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

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

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

[14] Triton X-100 is Octyl Phenol Ethoxylate produced by the J.T. Baker Company. This, or its equivalent, should be readily available from a local chemical supplier.

6 Troubleshooting

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

6.1 Unable to turn the instrument on

If the instrument refuses to turn on, see Section 4.1. If you are still unable to turn on the instrument, then it is likely that the CR123 battery (Figure 39) is depleted, or a fuse on the Power Supply board has blown.

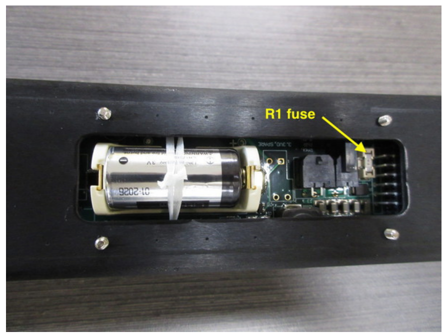


Figure 39: CR123 battery and R1 fuse (Power Input)

A 1 A fuse for the input power to the instrument, labelled “R1”, can be found on the same side of the power supply board as the CR123 battery (Figure 39). In the event that the instrument is unable to be switched on and the CR123 has been replaced, replace this fuse. If the instrument is still unable to be switched on, contact Rockland Scientific.

A second fuse of 0.25 A, labelled “F1”, is located on the opposite side of the power supply board (Figure 40). This fuse is to prevent damage if the user accidentally installs the CR123 battery backwards.

> ⓘ After a battery replacement, the time and date of the clock in the Persistor computer must be reset to its proper value.

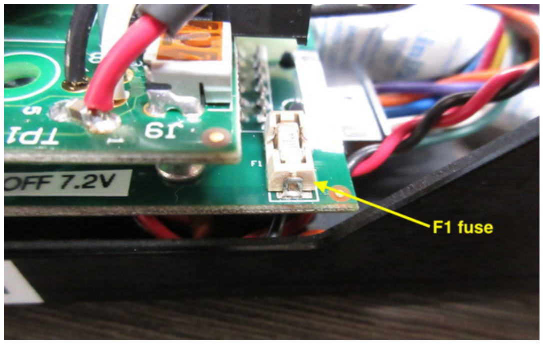


Figure 40: 0.25 A Fuse (for CR123 battery)

6.2 Cannot establish a connection to the instrument

If the instrument turns on, but are unable to communicate with it, refer to the ODAS5-IR User Guide for information on how to communicate with the instrument. If you are still unable to communicate with your instrument, contact Rockland Scientific.

6.3 Data corruption

The operating system on the Persistor computer (PicoDOS) utilizes a File Allocation Table (FAT) for identifying the physical location of data on the memory card. Reducing the number of changes made to the FAT will reduce the amount of fragmentation on the card and reduce the risk of FAT corruption. It also takes a long time to erase files and there is no on screen feedback during the deletion progress so it is easy to believe that the Persistor has frozen. If you cycle power during this time, you will likely corrupt the FAT. For these reasons, we recommend that you keep your data files on the card instead of erasing individual data files when downloaded. When your cruise is complete or you have an extended time, and have the files downloaded, use the `RESTORE` command to format the card and reinstall the system files. This will reduce the amount of changes made to the FAT, reducing the risk of FAT corruption. Refer to the ODAS5-IR User Guide. If your FAT is corrupted, contact Rockland Scientific. In some cases, it is possible for Rockland to recover your data and the chances of recovering your data is increased if there is less fragmentation of data on the card.

6.4 Noisy data on microstructure channels

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

1. Visually inspect the probe port.
2. Inspect the SMC connector and cables and the feedthrus for signs of discolouration (i.e. biological growth, corrosion).
3. Conduct an electronics bench test with the test probes installed (Section 4.4). Ensure that your test probes do not show signs of damage and/or corrosion.
4. Review your bench test and compare it with the bench test in your ASTP Calibration Report. Water damage to your connectors will result in increased noise across the frequency spectrum.
   - If you observe increased noise on a **shear** channel, then we suggest the following tests:
     (i) Remove the test probe and do a bench test. If the problem is resolved by the removal of the probe, then the *test probe may need to be replaced*. On the other hand, if the noise still persists, proceed with test (ii).
     (ii) Open up the instrument and disconnect the shear probe's SMC connection to the ASTP board (Figure 41). Do a bench test. If the problem is resolved, then the SMC connector is likely damaged and the *SMC cable assembly may need to be replaced*.
   - If you observe increased noise on one of the **thermistor** channels, then we suggest the following tests:
     (i) Swap the T1 and T2 test probes and do a bench test. If the noise is now on the opposite channel, then the *test probe may need to be replaced*. On the other hand, if the noise still persists on the same channel, proceed with test (ii).
     (ii) Open up the instrument and swap the two thermistor SMC connections to the ASTP board (Figure 41). Do a bench test. If the noise is now on the opposite channel, then the SMC connector is likely damaged and the *SMC cable assembly may need to be replaced*.

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

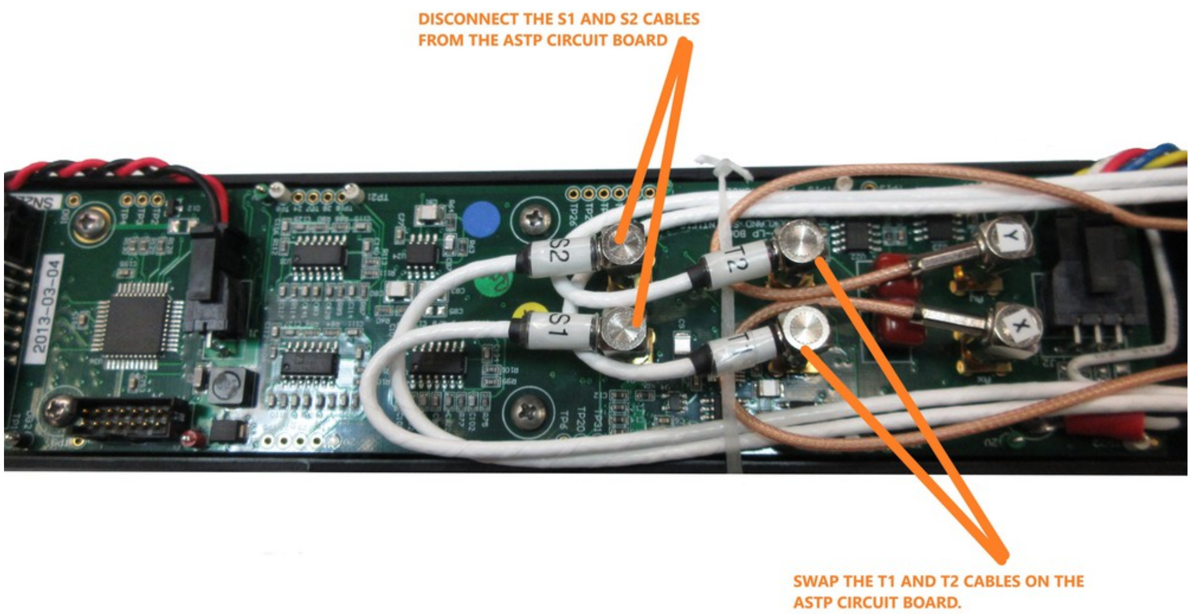


Figure 41: Modifying SMC connections on the ASTP board to identify the cause of noisy data.

6.5 Broken probes and sensors

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

6.6 There are large vibrations in the spectra data

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

Appendices

A.1 Bench Test Checklist

The bench test checklist included on the following pages provides guidance on the expected signals from an electronics bench test (Section 4.4). If the signals deviate from the expected values, please forward the checklist and the data file to support@rocklandscientific.com.

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

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

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

Bench Test Review Checklist
Please note that the document format has been optimized for Adobe Acrobat Reader

Conducted by: ______________________________ Date: _____________________

Reviewed by: _______________________________ Date: _____________________

Instrument Type: ___________________________ SN: _______________ Data File: _________________

Notes: ____

Bench Test Instructions:

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

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

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

Time Series Figure

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

Notes:

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

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

Spectra Figure

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

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

Notes:

* Refer to the ASTP Calibration Report for reference.

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

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

(If applicable) CT/CLTU Time Series Figure

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

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

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

Notes:

(If applicable) EM Current Meter Figure

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

Notes:

(If applicable) U_EM Sensor Figure

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

Notes:

A.2 Pre-Deployment Checklist

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

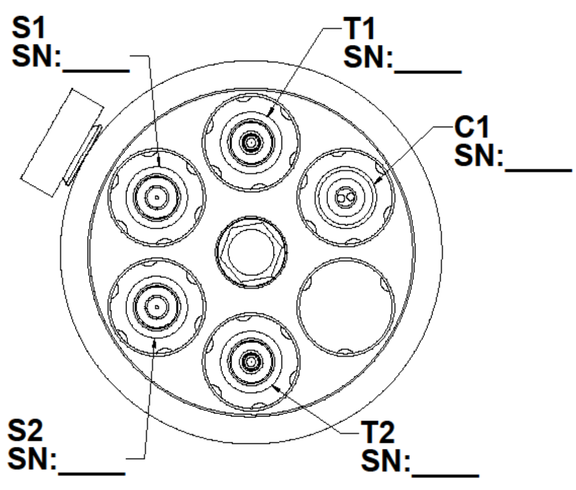
PRE-DEPLOYMENT CHECKLIST

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

This checklist summarizes essential pre-deployment steps.

MicroRider-1000

- [ ] 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
- [ ] Format compact flash card - consult manual
- [ ] Install new CR123 battery, reset instrument clock
- [ ] Ensure all probe ports have a greased o-ring and a white ferrule
- [ ] Ensure o-ring and ferrule are in correct order - consult manual for diagram
- [ ] Ensure that all bolts & connectors are secure (consult manual for safe torque rating)
- [ ] Ensure probes are fully inserted
- [ ] Confirm shear probes are oriented correctly
- [ ] Ensure probe holders are tightened correctly - consult manual
- [ ] Confirm power supply and ancillary sensors (if applicable) are connected & functional
- [ ] Consult platform manufacturer for correct/safe integration instructions (if applicable)
- [ ] Turn on instrument and confirm communication via deck cable or platform interface



A.3 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.

2019-05-17

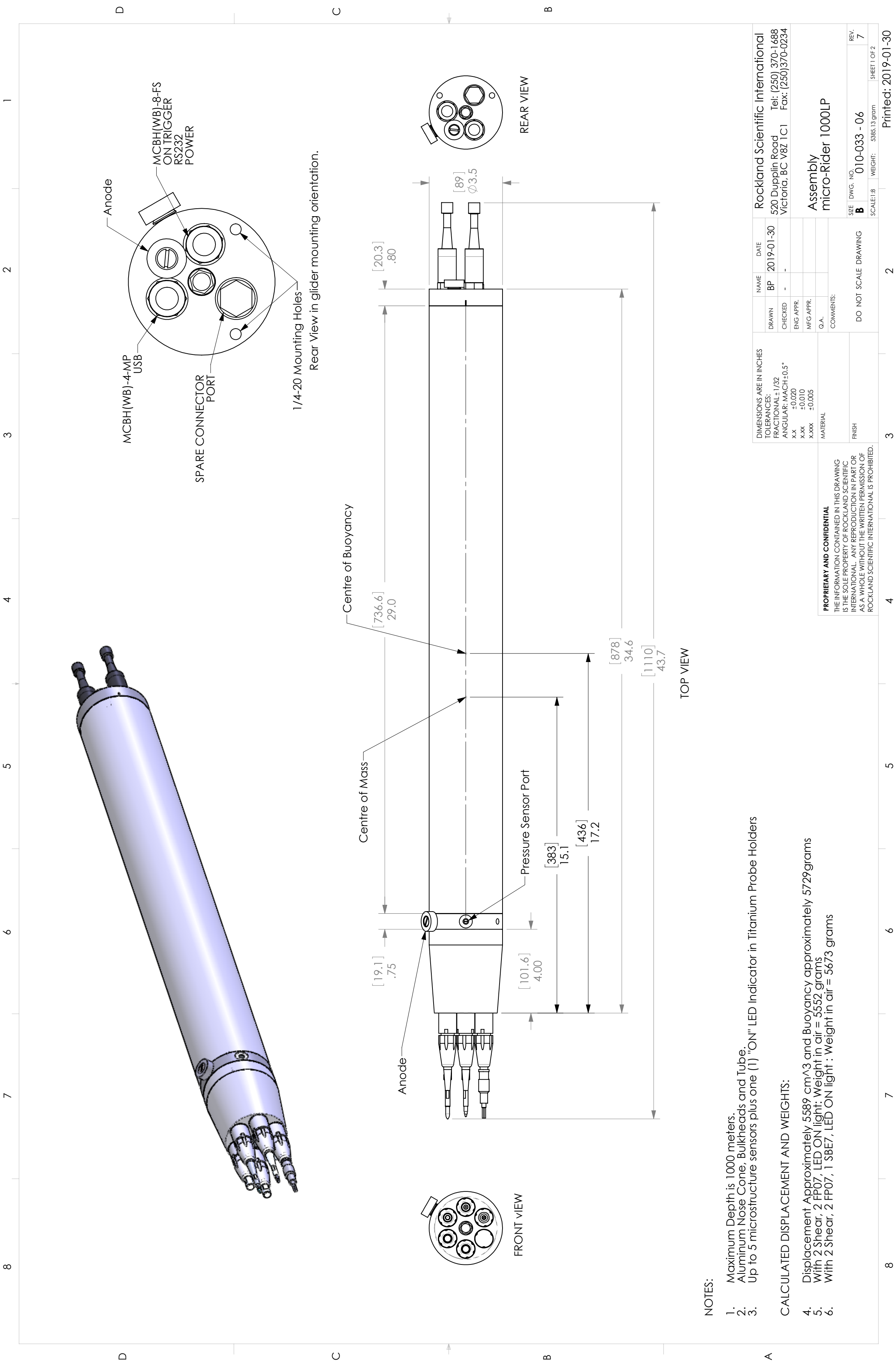
BOM
037-038-20 REV 5
Spares Kit, MR1000

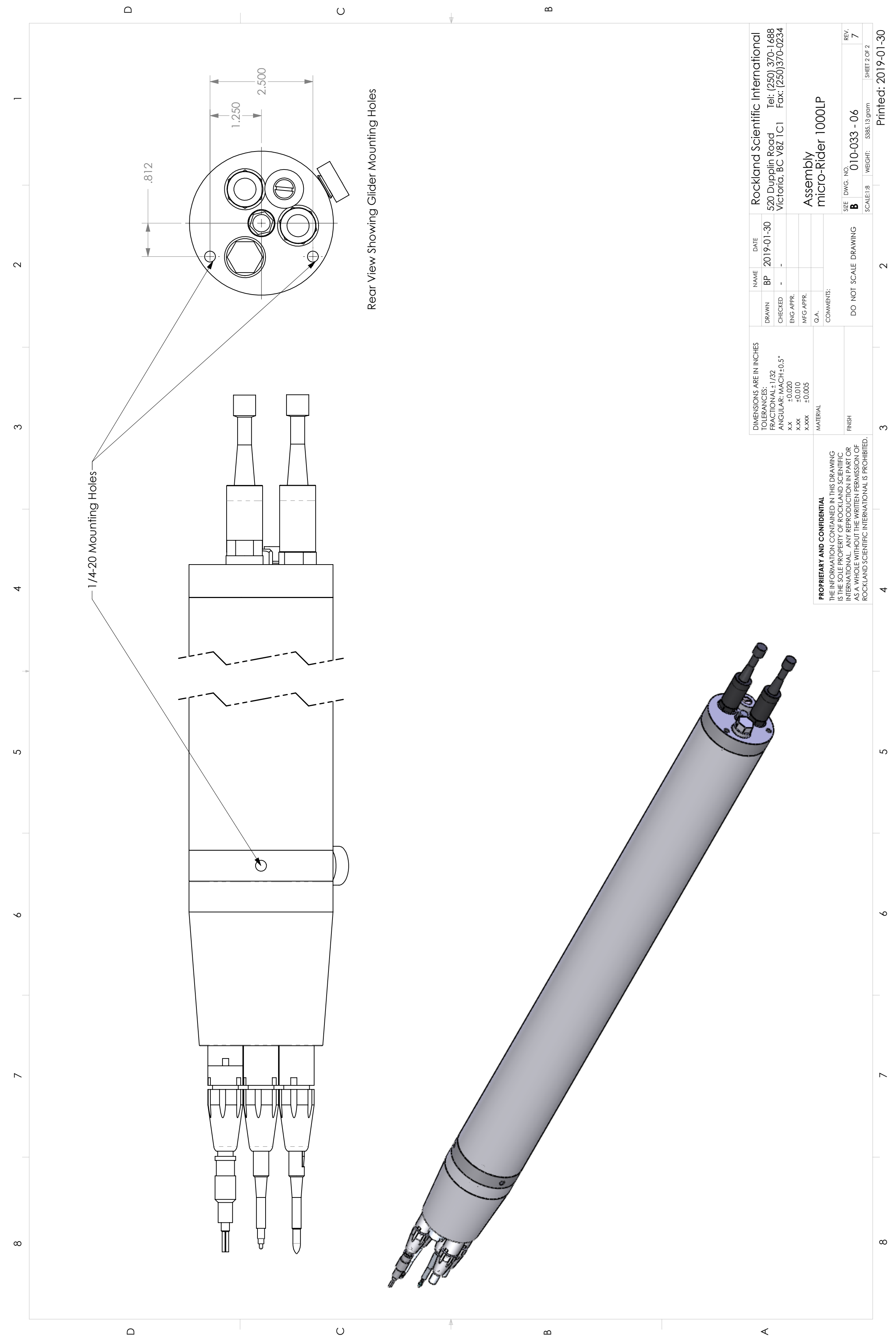
Item No.	Part Number	Revision	Description	Use	Qty
1	591-011-10	-	O-Ring, 2-012 Buna-N, 70A	Probe Holder Sensor Seals	10
2	591-099-10	-	O-Ring, 2-151 Buna-N, 70A	Main Bulkhead Face Seals	3
3	591-013-10	-	O-Ring, 2-014 Buna-N, 70A	Sealing Nut, MCBH Bulkheads, Plug	10
4	591-014-10	-	O-Ring, 2-015 Buna-N, 70A	Probe Holder Face Seals	6
5	592-013-10	-	Backup-Ring, 8-014 Buna-N, 90A	Sealing Nut	4
6	634-004-10	-	Nut, Hex, 1/4-20, SS316	Bulkhead Insertion Plate	2
7	185-002-10	-	CR123 Lithium battery	LP-Power Circuit Board	1
8	240-001-10	-	250 mA, 125 V, fast blow SMF fuse	LP-Power Circuit Board ("F1" lower side)	2
9	240-002-10	-	1 A, 125 V, fast blow SMF fuse	LP-Power Circuit Board ("R1" upper side)	2
10	501-052-10	0	1/4 inch diameter clear heat shrink tubing x 8 mm length	Probe SMC cable connector insulation	4
11	500-027-10	3	Probe Holder Ferrules	Probe Holders	4
12	013-125-20	0	Assembly, Anode, Aluminum	Replacement Anode Assembly	2
13	037-060-20	-	USB Stick, MR1000	Data Files, Manuals, utilities, software	1
14	500-529-10	0	Instrument Assembly Plate, Micro-Rider	Assembling Instrument Pressure Case	1
15	975-000-10	-	O-Ring grease (1 oz container)	All O-Ring Seals	1
16	977-011-10	-	Container, Storage Box, 10 compartment, 8x4	Spares Kit Container	1
OPTION, AEM1-G SENSOR					
25	651-000-10		Cable Tie, 4 inch	AEM1-G wiring	4
26	651-001-10		Twine, Lacing, Flat, "wax string"	AEM1-G wiring	12 inch
24	976-027-10		Tape, Conductive Shield	AEM1-G wiring shield	1
18	593-016-10	-	O-Ring, JIS-2401, P16 Buna-N, 70A	AEM1-G sensor, face seal	1
19	593-212-10	-	O-Ring, JIS-2401, S10 Buna-N, 70A	AEM1-G sensor, piston seal	1
OPTION, MHDG/IE55 Connectors (old MR1000)					
20	591-015-10	-	O-Ring, 2-016 Buna-N, 70A	MHDG-BCR	1
21	591-016-10	-	O-Ring, 2-017 Buna-N, 70A	MHDG-CCP	1
22	591-351-10		O-Ring, Custom, 5-254 , for MHDG-BCR	MHDG-BCR	1
23	591-352-10		O-Ring, Custom, 5-712, for IE55-BCR	IE55-BCR	1

Rockland Scientific International Inc.

A.4 Outline Drawing

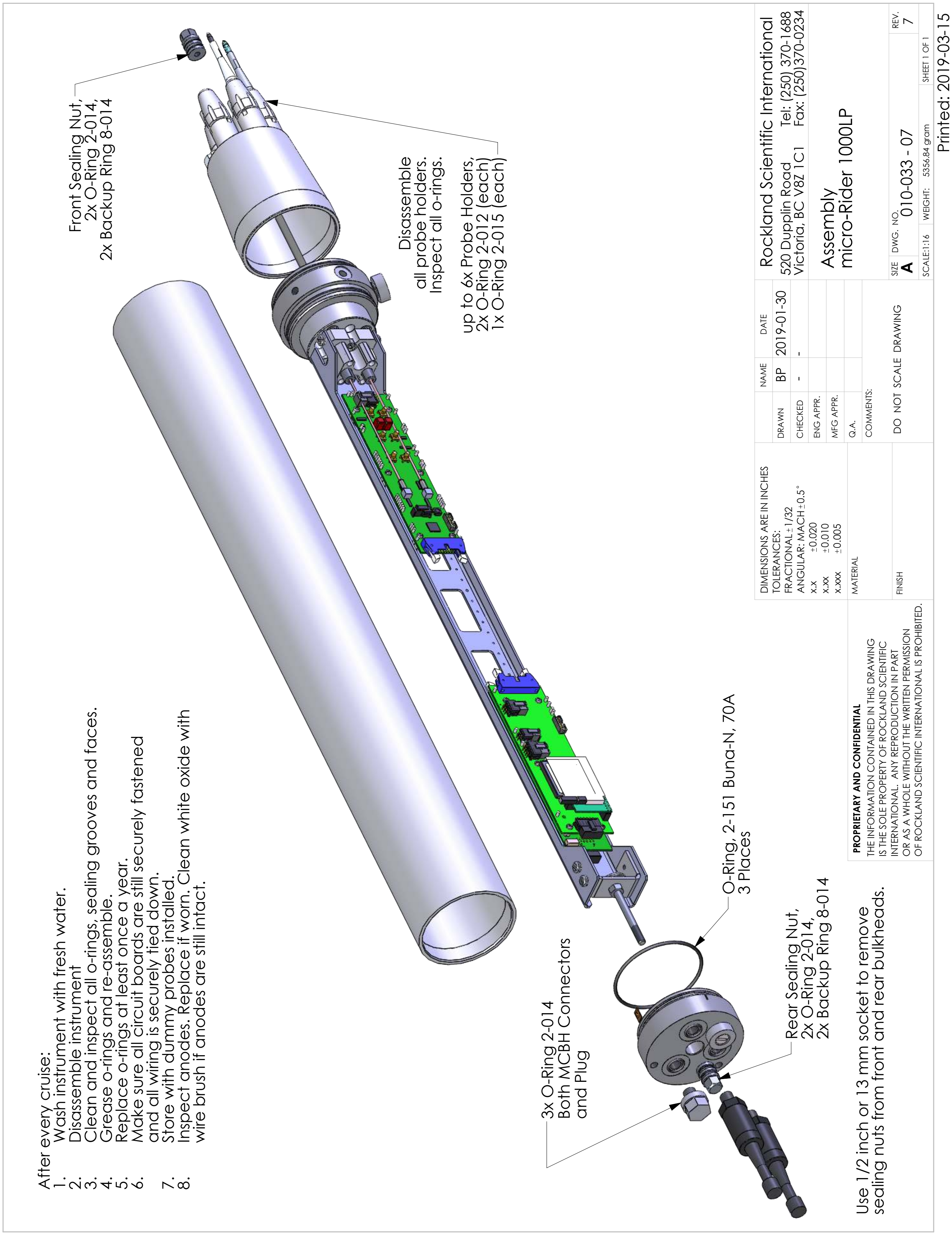
The outline drawing on the following page(s) shows the components of the MicroRider-1000 and its dimensions.


MCBH(WB)-8-FS
ON TRIGGER
RS232
POWER
Anode
MCBH(WB)-4-MP
USB
SPARE CONNECTOR
PORT
1/4-20 Mounting Holes
Rear View in glider mounting orientation.
REAR VIEW
FRONT VIEW
TOP VIEW
Centre of Buoyancy
Centre of Mass
Pressure Sensor Port
Anode
[89]
∅3.5
[20.3]
.80
[736.6]
29.0
[878]
34.6
[1110]
43.7
[383]
15.1
[436]
17.2
[19.1]
.75
[101.6]
4.00
NOTES:
1. Maximum Depth is 1000 meters.
2. Aluminum Nose Cone, Bulkheads and Tube.
3. Up to 5 microstructure sensors plus one (1) "ON" LED Indicator in Titanium Probe Holders
CALCULATED DISPLACEMENT AND WEIGHTS:
4. Displacement Approximately 5589 cm^3 and Buoyancy approximately 5729grams
5. With 2 Shear, 2 FP07, LED ON light: Weight in air = 5552 grams
6. With 2 Shear, 2 FP07, 1 SBE7, LED ON light : Weight in air = 5673 grams
Rockland Scientific International
520 Dupplin Road
Victoria, BC V8Z 1C1
Tel: (250) 370-1688
Fax: (250)370-0234
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/32
ANGULAR: MACH ± 0.5°
X.X ±0.020
X.XX ±0.010
X.XXX ±0.005
MATERIAL
FINISH
DRAWN BP 2019-01-30
CHECKED
ENG APPR.
MFG APPR.
Q.A.
COMMENTS:
DO NOT SCALE DRAWING
Assembly
micro-Rider 1000LP
SIZE B
DWG. NO. 010-033 - 06
REV. 7
SCALE:1:8
WEIGHT: 5385.13 gram
SHEET 1 OF 2
Printed: 2019-01-30
PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF ROCKLAND SCIENTIFIC INTERNATIONAL. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF ROCKLAND SCIENTIFIC INTERNATIONAL IS PROHIBITED.


Rear View Showing Glider Mounting Holes
1/4-20 Mounting Holes
2.500
1.250
.812
Rockland Scientific International
520 Dupplin Road
Victoria, BC V8Z 1C1
Tel: (250) 370-1688
Fax: (250)370-0234
Assembly
micro-Rider 1000LP
DRAWN BP 2019-01-30
DO NOT SCALE DRAWING
010-033 - 06
REV. 7
Printed: 2019-01-30
PROPRIETARY AND CONFIDENTIAL

A.5 Maintenance Drawing

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



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

A.6 Impulse Connector Technical Bulletin

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

TELEDYNE IMPULSE

MICRO MINI WET PLUGGABLE

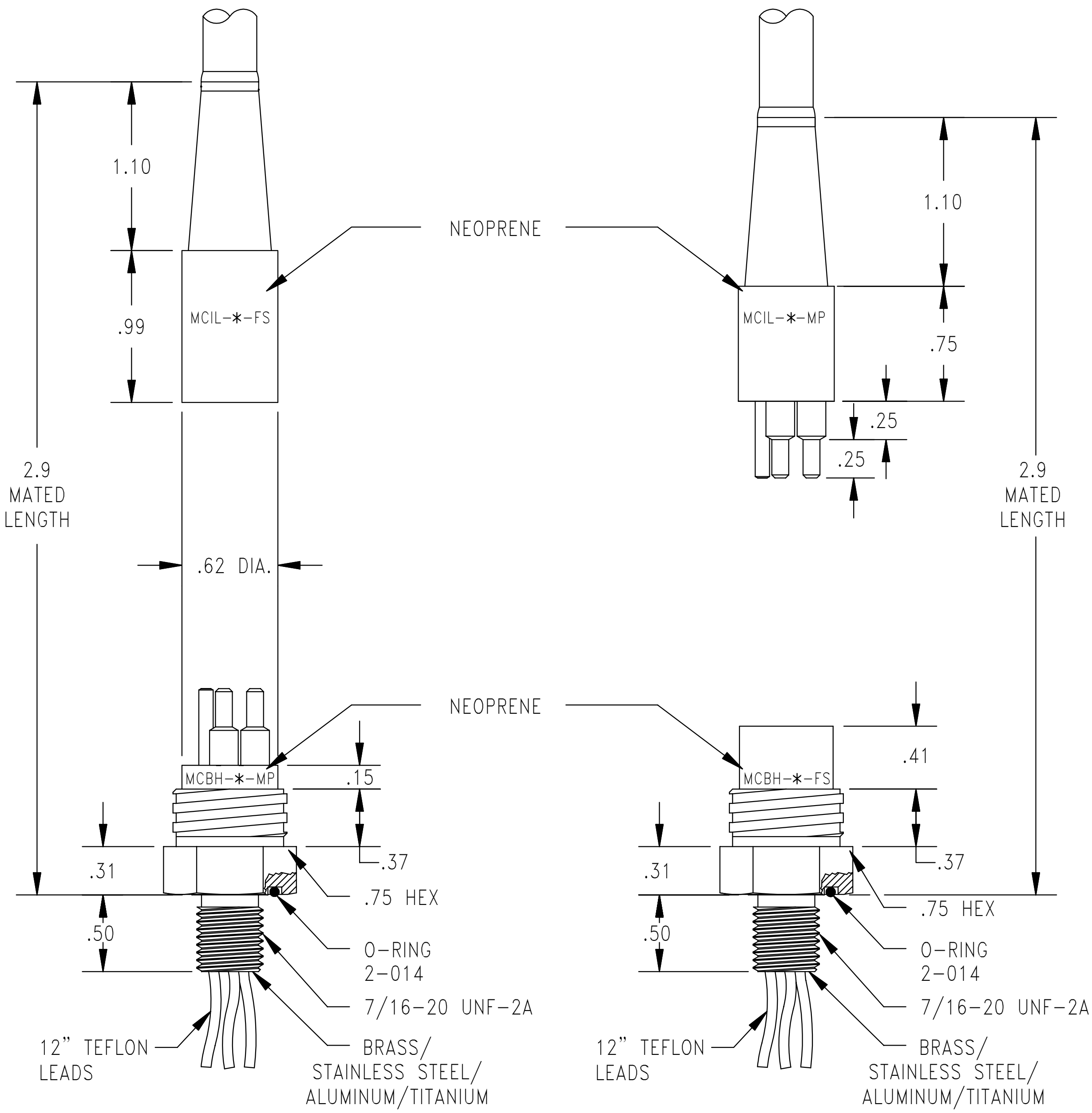
DESCRIPTION AND MATERIAL	• Molded neoprene or polyurethane. • Two to eight contacts. • Up to 750 VDC. • Up to 10,000 PSI, mated. • Bulkhead connector design open face pressure rated to 5000 PSI. • Contacts gold plated per MIL-G-45204.
CABLE	• Inline connectors in this series are molded on a standard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

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

MCIL/BH-2/3/4

MICRO MINI WET
PLUGGABLE

TELEDYNE IMPULSE

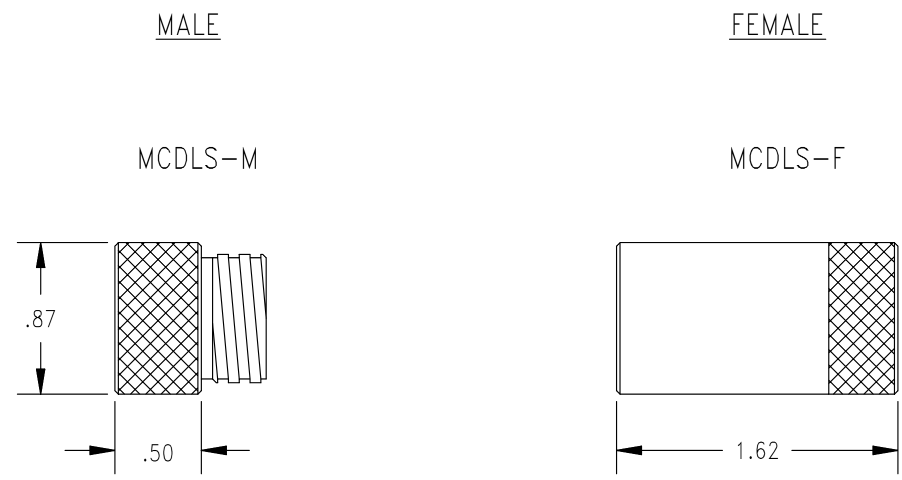


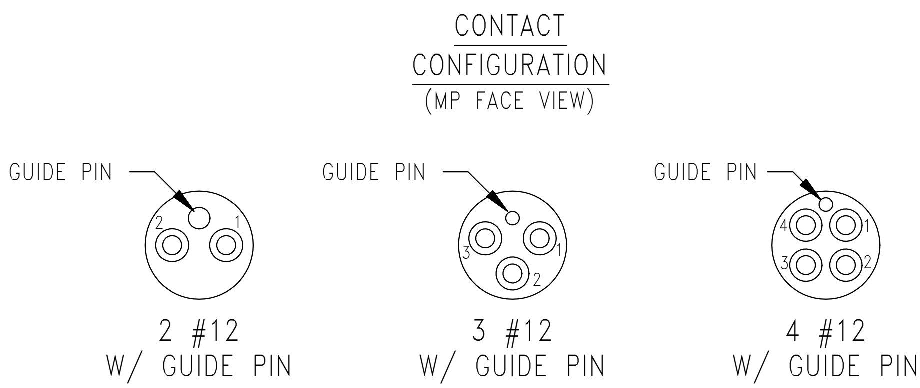
Technical Bulletin 65 110 1-800-327-0971 rev 0109

MCIL/BH-2/3/4

MICRO MINI WET
PLUGGABLE

TELEDYNE
IMPULSE





MOUNTING TORQUE FOR MCIL/BH-FS/MP	not to exceed 100 in lbs
MATED PRESSURE RATING (psi)	10,000
DUMMY PLUG FOR MCIL/BH-FS	MCDC- * -MP
DUMMY PLUG FOR MCIL/BH-MP	MCDC- * -FS

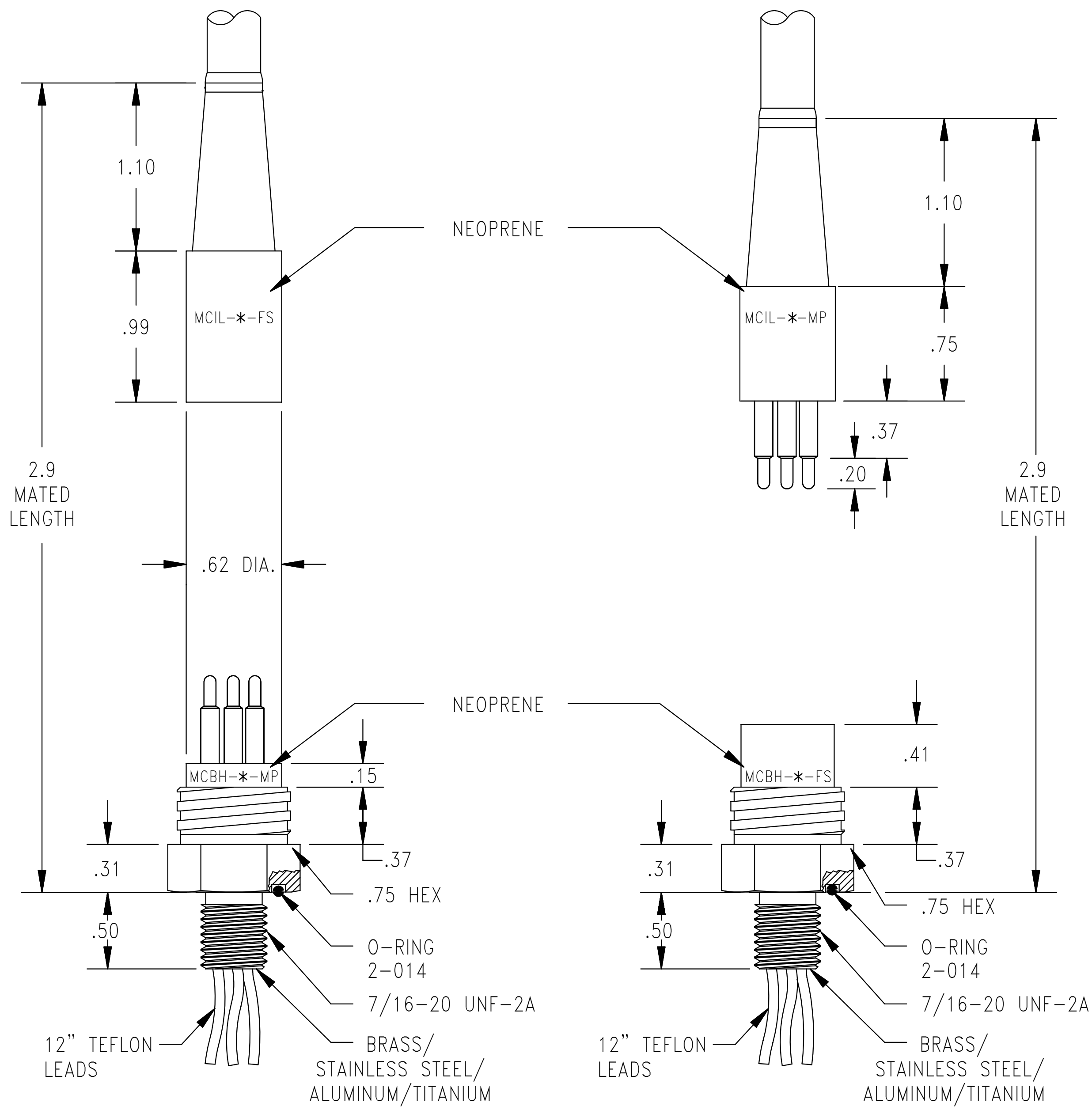
* Specify number of contacts.
* Dummy plugs found on page 65 125.

NOTE: Bulkhead body available in Titanium.
Standard 3/4" thread length.

MCIL/BH-5/6/8

MICRO MINI WET
PLUGGABLE

TELEDYNE
IMPULSE

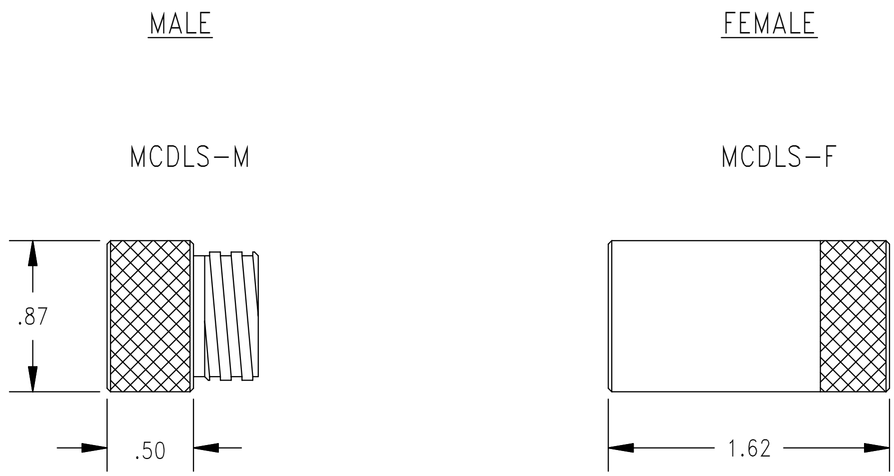


Technical Bulletin 65 120 1-800-327-0971 rev 0109

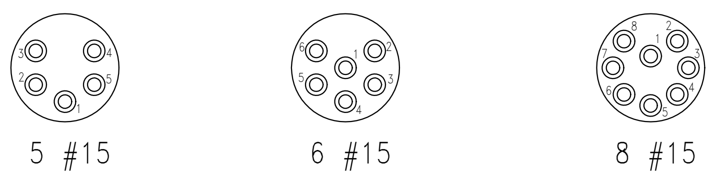
MCIL/BH-5/6/8

MICRO MINI WET
PLUGGABE

TELEDYNE IMPULSE



CONTACT CONFIGURATION
(MP FACE VIEW)

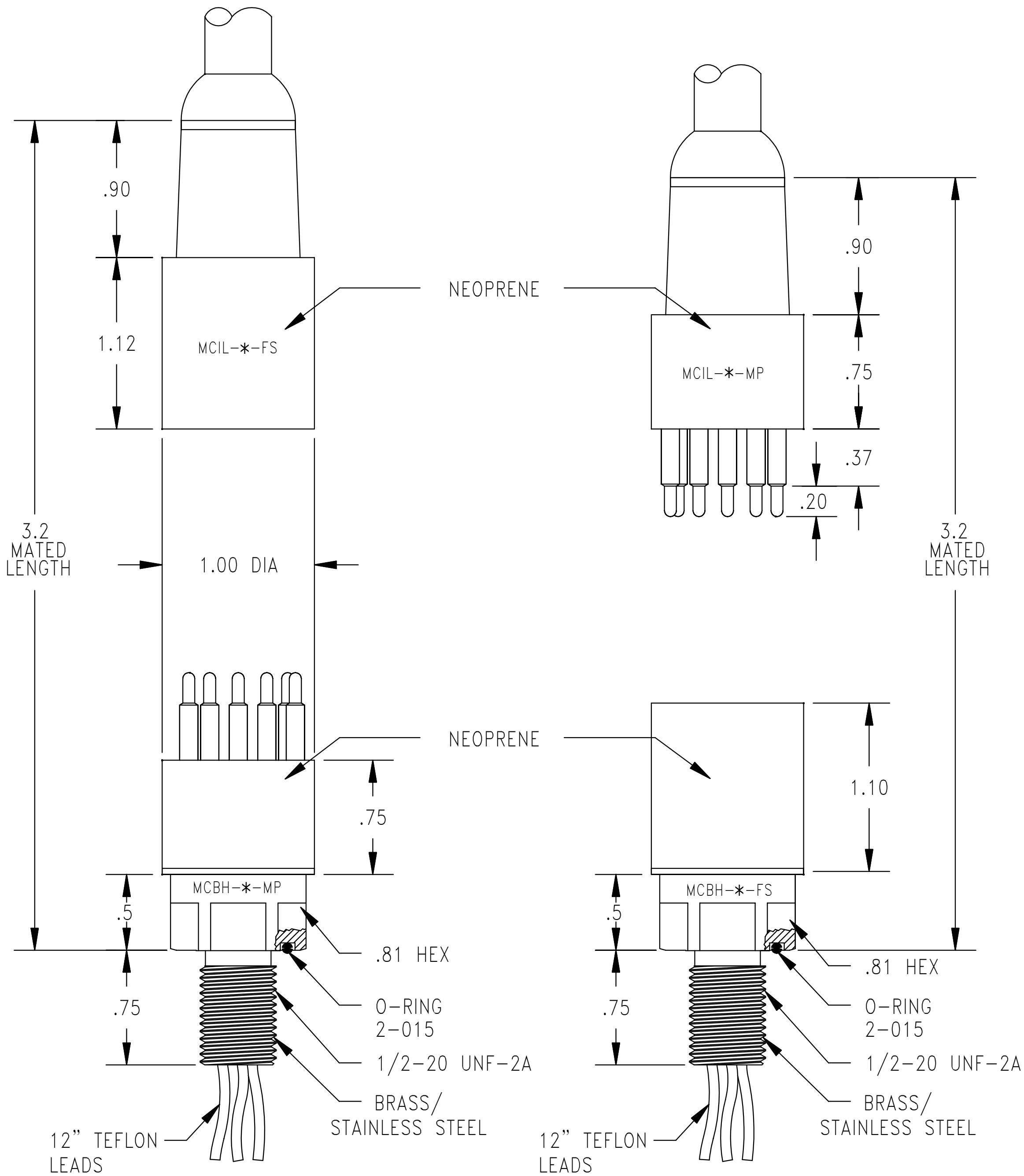


MOUNTING TORQUE FOR MCIL/BH-FS/MP	not to exceed 100 in lbs
MATED PRESSURE RATING (psi)	10,000
DUMMY PLUG FOR MCIL/BH-FS	MCDC- * -MP
DUMMY PLUG FOR MCIL/BH-MP	MCDC- * -FS
* Specify number of contacts. * Dummy plugs found on page 65 125.	
NOTE: Bulkhead body available in Titanium. Standard 3/4" thread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

MCIL/BH-10/12/16/18

MICRO MINI WET PLUGGABLE

TELEDYNE IMPULSE

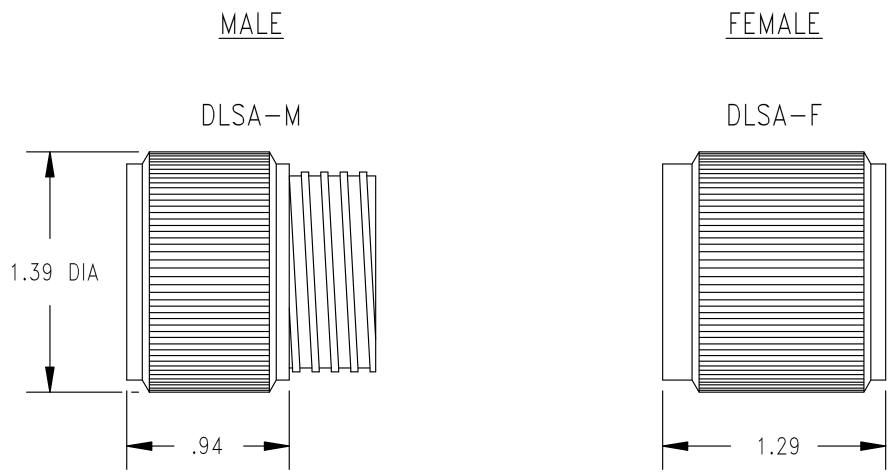


Technical Bulletin 65 122 1-800-327-0971 rev 0109

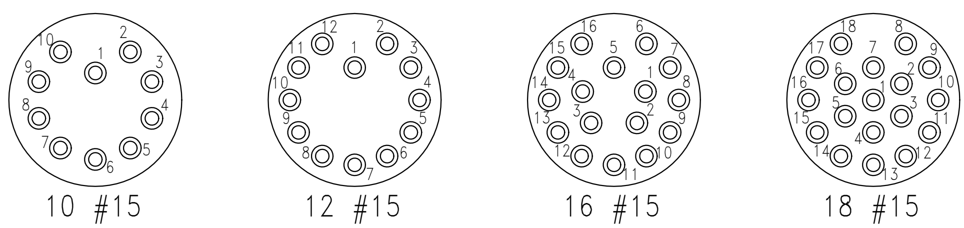
MCIL/BH-10/12/16/18

MICRO MINI WET
PLUGGABLE

TELEDYNE
IMPULSE



CONTACT
CONFIGURATION
(MP FACE VIEW)



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

Technical Bulletin 65 123 1-800-327-0971 rev 0109

Index