Instrument Manual

VMP-200

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Revision 3

2012-12-06

Revision History

Revision	Date	Description
0	2010-08-09	First Release.
1	2010-12-15	Changed to include telemetering (real time) version. Added micro-conductivity board.
2	2012-08-13	Added note regarding leaving the instrument on while charging.
3	2012-12-06	Added note regarding heat shrink tubing around the SMC connector, updated procedures for changing probes, instrument and sensor maintenance.

TABLE OF CONTENTS

1. Introduction

This document describes the operation and maintenance of the Rockland Scientific International (RSI) VMP-200, micro-structure instrument.

The VMP-200 is a coastal-zone, vertical, profiler for the measurement of micro-scale turbulence. The profiler was designed for operation from small vessels with limited deck space (e.g., Zodiacs), or where electrical power facilities are limited or missing (e.g., ice camps). The VMP-200-IR (“internally recording”) records data internally on a Flash RAM card, eliminating the requirement for a deck-side power supply and data recording system (i.e. laptop). The VMP-200-RT (“real-time”) transmits data through an underwater cable to a data recording system consisting of a UTRANS (USB-transceiver) and a Notebook computer. Both types of VMP-200 instruments are powered by an internal polymer lithium-ion battery of nominally 14.8 V and 2.2 Ah capacity. The battery and internal memory (IR-version) allow for up to 25 hours of continuous operation. Power consumption is approximately 1.2W. It is possible to repeat profiles without having to recover the profiler between deployments. At the end of the profiling series, the recorded data can be downloaded (if using an internally recording version) and the battery charged (both versions, optional) using the supplied deck cable which connects to the instrument via an underwater connector located on the instrument’s rear bulkhead.

Both versions of VMP-200 instruments are turned on by attaching a magnet to the front bulkhead of the instrument and turned off by removing this magnet. Shortly after the VMP-200-IR is turned on, it starts data collection and places the information into a new file. Shortly after the instrument is signaled to turn off, by removing the magnet, it updates a log-file by recording the time and the reason for the termination of data acquisition, then closes all files, and shuts itself down. An LED on the rear bulkhead of the VMP-200-IR flashes once per second during data acquisition. When the magnet is removed from a VMP-200-RT, it simply turns off. Its on-stead can be confirmed by communicating with this instrument using its tether and its deck receiver.

Other documents and software that are useful for operating and understanding the VMP-200 are listed below. All of these are available from our Web site for registered users.

VMP-200		Document
IR	**RT**	
√		ODAS5-IR User Guide Oceanographic Data Acquisition System, for the data acquisition software.
	√	The ODAS-RT Oceanographic Data Acquisition System Software User Guide, for the data acquisition software.
√	√	The ODAS Matlab Library, for functions used in data processing.
√		ODAS5-IR Software installation using Motocross, which is used to update software in the Persistor processor in the VMP-200-IR.
√		CF2 Firmware update. Always check for updates. This one is required to permit using CompactFlash cards not made by Silicon Systems.
√		ODAS5-IR Utilities & Documentation, for VMP-200-IR.
√		FTDI VCP Driver, which is required USB communication and is usually installed automatically with the ODAS5-IR Utilities.
√	√	AN-003, Digital signal processing to enhance oceanographic observations, which explains the theory behind using signal pre-emphasis on critical channels to maximize the signal to noise ratio.
√	√	AN-005, Converting Shear Probe, Thermistor and Micro-conductivity signals in to physical units, which gives a detailed explanation of this process.

VMP-200 IR	VMP-200 RT	Document
√	√	AN-010, Design and Optimization of Anti-Aliasing Filters for Ocean Turbulence Measurements, which gives a detailed explanation of the filtering required to produce sampled data that is free from aliased components.
√	√	AN-011, Serial Instrument Bus, which explains how digital data is transferred within the VMP-200-IR. Useful only to those wanting deeper knowledge of the workings inside of the VMP-200.
√	√	AN-015, Modeling the spatial response of the air foil shear probe using different size probes, which is a paper describing the wavenumber response of the shear probe.
√	√	AN-019, Determination of pressure coefficients from the Keller Factory calibration sheets.
√	√	AN-020, Using the µC-Board, P053R01.

2. Receipt of Goods

Promptly after you receive your VMP-200 you should:

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

2.1. Inspect the Instrument

- The VMP-200 is typically shipped in two to three cases: One case for the instrument and sensors, one case for the brushes and another case for any ancillary equipment.
- Remove the instrument from its shipping case.
- Inspect the instrument and all ancillary equipment/packages; check to be sure that no damage has occurred during shipment. If damage is found contact the shipper immediately to start the claims process. Most shippers have a time limit on claims, so start the process promptly.

2.2. Confirm Packing List

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

2.3. Tool List

Assembling and maintaining the VMP-200 requires the following tools:

- 1 x 7/16 inch wrench or socket/ratchet (for sensor guard, magnetic "ON/OFF" and pressure case sealing nut)
- 1 x 15/16 inch box wrench (for MHDG bulkhead connector)
- 1 x 3/4 inch wrench (for LED "ON" Indicator bolt)
- 1 x 9/16 inch wrench (for securing the strain relief/tether termination on back of instrument)
- 1 x Inch Hex Key set (for internal Socket Head Cap Screws)
- 1 x Hammer (for securing drag brushes tightly to rear rubber reducing coupler)
- 1 x Phillips Screwdriver, #1 size (for internal machine screws)
- 1 x 5/16 Nut Driver (hose clamps and internal stand-offs)
- 1 x Custom Probe Holder Wrench (included in "Spares Kit")

2.4. Confirm Instrument Communication

Proceed to section 3 to install the software on your host computer (which is usually a Notebook computer) and then on to section 4 to confirm that you can communicate with your VMP-200.

3. Software Installation

3.1. Software Installation — VMP-200-IR

Your VMP-200-IR acquires data with a Persistor CF2 processor using the ODAS5-IR software. User communication with the VMP-200-IR is accomplished using Motocross terminal software. Files are up- and down-loaded via a USB connection using the USB-Link.

The ODAS5-IR User Guide Oceanographic Data Acquisition System provides a full description of communication, file transfer and gives all details regarding the data acquisition software, including user configuration files. The latest software manual can be downloaded from the Rockland Scientific web site by all registered users. To register, go to www.rocklandscientific.com, click on “Downloads” and fill out the required information under “New User Registration”. Effective use of the VMP-200-IR requires a full understanding of the ODAS5-IR software.

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

3.2. Software Installation — VMP-200-RT

There is no software to install on the VMP-200-RT. However, the ODAS4-RT package must be installed on your Notebook computer, or whatever Windows OS device that is used for data acquisition. The ODAS4-RT Oceanographic Data Acquisition System Software User Guide provides a full description of the installation and usage of the software. The latest software and manual can be downloaded from the Rockland Scientific web site by all registered users. To register, go to www.rocklandscientific.com, click on “Downloads” and fill out the required information under “New User Registration”. Effective use of the VMP-200-RT requires a full understanding of the ODAS4-RT software.

4. Instrument Communication

4.1. Instrument Communication — VMP-200-IR

Items Required:

- Microstructure Instrument
- Computer (with a USB and a 9-pin RS-232 D-sub serial port)
- Instrument Deck Cable with Deck Unit (power supply and On switch)

After removing the instrument from the case, confirm the instruments ability to communicate with the computer. Do so by performing the following:

1. Turn on your host computer (if it isn't on already) and start the Motocross terminal emulation software (refer to the ODAS5-IR User Guide Oceanographic Data Acquisition System for details).
2. Connect the Deck Cable 9-pin D-sub connector to the RS-232 Serial port on your computer. Connect the USB connector to a USB port on your computer (Figure 1). Note that you can use a Serial-to-USB adaptor to connect the RS-232 D-sub to a USB port on your computer. However, we cannot guarantee that your particular USB-based serial connector will function properly. May do, but some do not function properly.

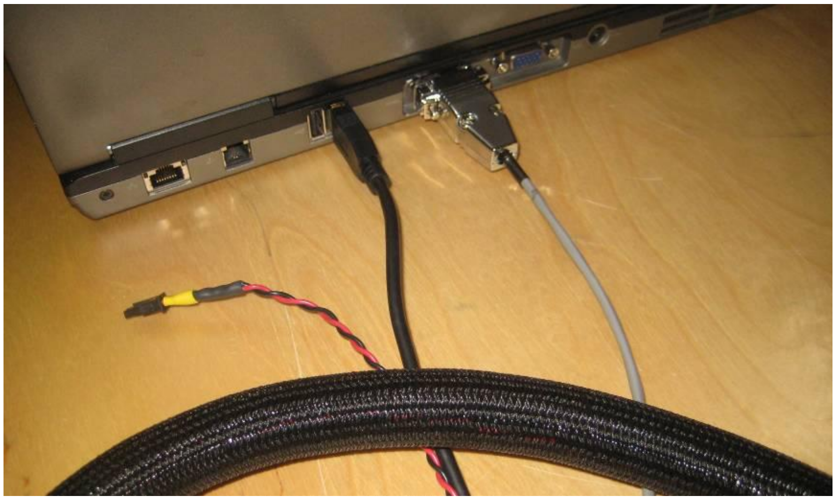

Figure 1: Connecting the deck cable to the computer.

3. Remove the Cap from the 9-pin MHDG bulkhead connector on the VMP-200 Rear Bulkhead. CAUTION: Ensure that the O-ring stays in the Cap (Figure 2, Figure 7).
4. Plug MHDG end of Deck Cable to the 9-pin MHDG on the VMP Rear Bulkhead (Figure 3).

Figure 2: Removing the MHDG cap from the MHDG bulkhead connector on the VMP-200-IR rear bulkhead. This connector pair has two o-rings; the female cap (in left hand) has an o-ring that falls out easily during handling.

Figure 3: Connecting the deck cable to the VMP-200-IR rear bulkhead.

5. Turn the instrument ON by attaching the magnets to the front bulkhead of the VMP-200 (Figure 4). Please, note that the "turn-on" signal sensed by your instrument is not whether or not the magnet is installed. Rather, it is the transition (or change of state) from "magnet removed" to "magnet installed". A smooth and continuous insertion of the magnet is required for a reliable turning on of the instrument. Multiple transitions due to a hesitant insertion of the magnet might turn it off shortly after it was turned on. If your instrument does not turn on, repeat the attempts several times. The "turn-off" signal is the change of state from "magnet installed" to "magnet removed".

Figure 4: Attaching magnet to front bulkhead to turn on instrument.

6. Wait for the prompt in Motocross. Press any key to stop the ten second countdown for data acquisition.
7. You should see a command prompt and PicoDOS is active and will accept most DOS commands such as “dir”, etc.
8. To check the data acquisition software in the instrument, type the command:

   “odas5ir –f setup.txt –c all”

   to start the calibration of each channel. The output will show the statistics of each channel, giving the minimum, maximum, mean, and standard deviation, in raw units of counts.
9. To check that the data acquisition is functioning correctly, type in the command:

   “odas5ir –f setup.txt”

   This should start a data file and the console will display the record number and average pressure reading per record.
10. Type shift+Q to stop data acquisition software and then type “dir” to see if a new data file is created.
11. Turn the instrument off by removing the magnet from the front bulkhead of the instrument. After a few seconds, reconnect the magnet to turn the instrument back on.
12. Do not interrupt the countdown process and check that the instrument starts data acquisition automatically. The LED in the rear bulkhead should flash every second, which indicates that a data record has been recorded. In addition, the console connection will show the completion of each record and display the record-average pressure.
13. Stop data acquisition by removing the magnet from the front bulkhead. This is the method that will be used in the field to stop data acquisition since the instrument will not be attached to the computer.

14. Turn the instrument back on and interrupt the ten second countdown for data acquisition. Then confirm that a new data file has been created. You can also list the contents of the log-file by using the command “type name-of-file”. The log-file has extension “txt” and the base name of the data files (the base name in which the user entered in the setup file).

15. Optionally, refer to the ODAS5-IR User Guide Oceanographic Data Acquisition System for transferring files from the instrument to the computer for data analysis using the Matlab ODAS Library of functions.

16. For deployment, continue with assembly of the unit under the “Operations” section 7 of this manual. NOTE: When replacing the MHDG cap, remember to check O-rings in the MHDG-9 connector to ensure the o-ring stays in the cap.

4.2. Instrument Communication — VMP-200-RT

Items Required:

- Microstructure Instrument
- Computer with a USB port
- Instrument Deck Cable
- UTRANS (USB Transceiver)

After removing the instrument from the case, confirm the instruments ability to communicate with the computer. Do so by performing the following:

17. Turn on your host computer (if it isn’t on already) and start ODAS4-RT (refer to the ODAS4-RT Oceanographic Data Acquisition System Software User Guide for details).

18. Load the setup file for your instrument, which will have been sent to you.

19. Connect the Deck Cable 9-pin D-sub connector to the UTRANS. (Figure 5)

Figure 5: Connecting Deck Cable 9-pin D-sub connector to the UTRANS. Note that this is a proprietary high-speed link and not a standard RS-232 COM connector.

20. Connect the UTRANS to your data acquisition computer with a USB cable (Figure 6, black cable). If the software is properly installed, you will hear three (3) short tones that indicate that the computer has recognized the USB (UTRANS) device.

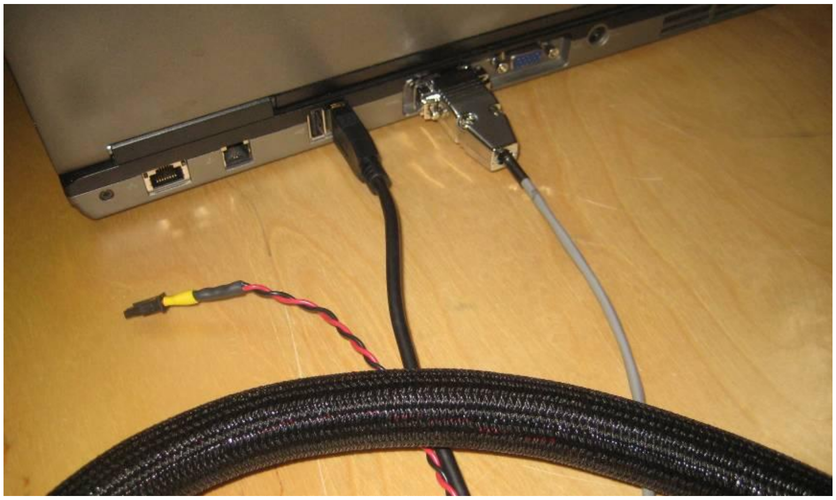

Figure 6: Connecting the USB cable from the UTRANS to your computer. The COM port (gray cable) is not normally used with a VMP-200-RT.

21. Remove the Cap from the 9-pin MHDG on the VMP-200-RT Rear Bulkhead. CAUTION: Ensure that the O-ring stays in the Cap and the Bulkhead Connector (Figure 7).

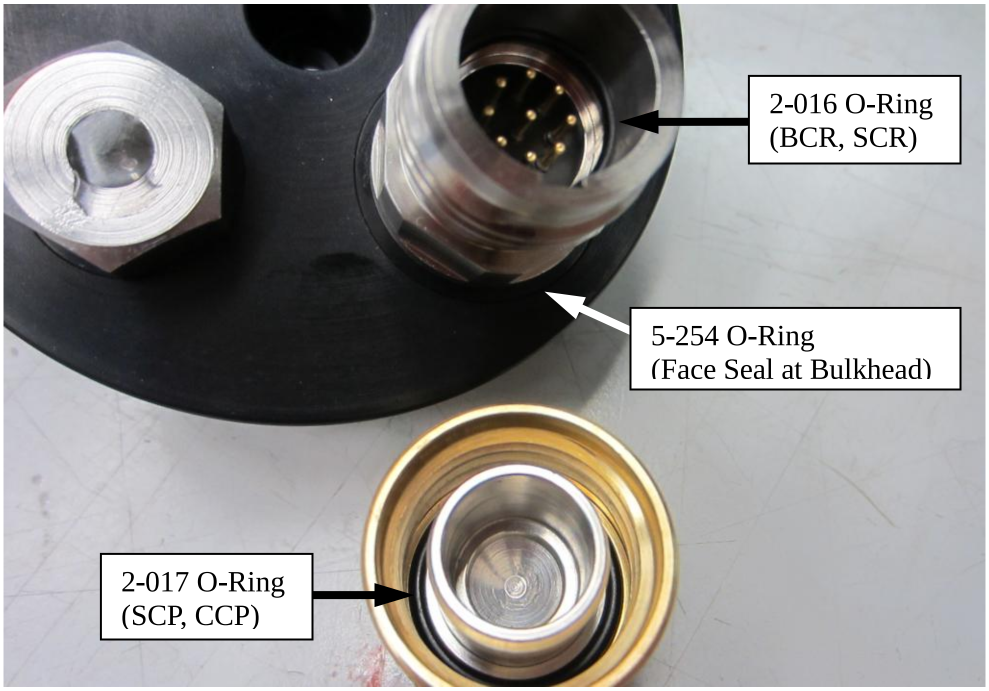

Figure 7: MHDG O-Rings

22. Plug MHDG end of Deck Cable to the 9-pin MHDG on the VMP Rear Bulkhead (Figure 8).

Figure 8: Connecting the MHDG cable (tether cable shown) on the VMP-200-RT rear bulkhead.

23. Turn the instrument ON by attaching the magnet to the front bulkhead of the VMP-200 (Figure 9). The magnet should be tightened by hand and torque on the bolt head of the magnet assembly should

be sufficient to slightly depress the rubber washer. Please, note that the “turn-on” signal sensed by your instrument is not whether or not the magnet is installed. Rather, it is the transition (or change of state) from “magnet removed” to “magnet installed”. A smooth and continuous insertion of the magnet is required for a reliable turning on of the instrument. Multiple transitions due to a hesitant insertion of the magnet might turn it off shortly after it was turned on. If your instrument does not turn on, repeat the attempts several times. The “turn-off” signal is the change of state from “magnet installed” to “magnet removed”.

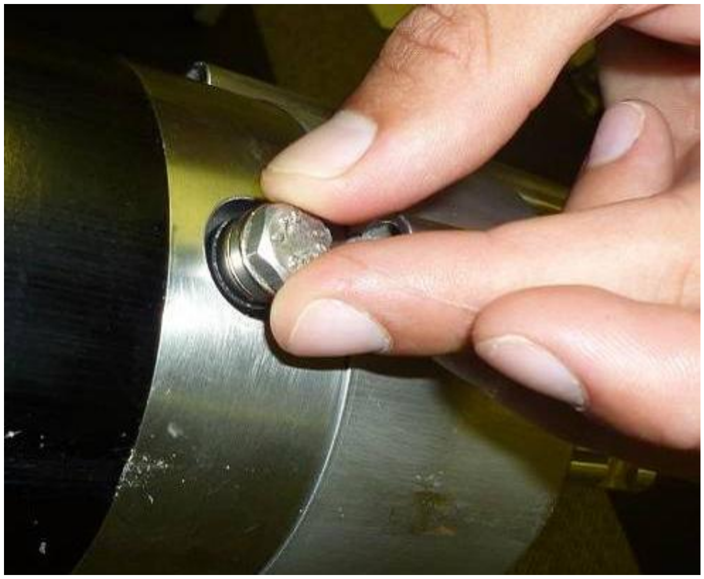

Figure 9: Attaching magnet to front bulkhead to turn on instrument.

24. Go to the “calibration” sub-menu of ODAS4-RT, and “calibrate” channel 0. The mean value should be small (±10 counts) and the standard deviation should also be small (~0.5 counts).
25. “Calibrate All” channels. Each channel should have a “green” response.
26. Return to the main menu and press “Connect”. Certain channels, such as pressure and ground should be displaying small but non-zero values that change slightly every second. This completes the check for instrument communication.
27. For deployment, continue with assembly of the unit under the “Operations” section 7 of this manual. NOTE: When replacing the MHDG cap, remember to check O-rings in the MHDG-9 connector to ensure the o-ring stays in the cap.

5. Matlab Software Installation

Data viewing and processing requires the Matlab ODAS Library of functions. The software and its User Guide can be downloaded from the Rockland Scientific Web Site by all registered users (see instructions on how to register in section 3 of this manual.

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

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

6. VMP-200 Overview

The VMP-200 is a 250 meter rated microstructure instrument, upgradable to a 1000m depth rating. There is a small difference between the internally recording version (VMP-200-IR) and the real-time transmitting version (VMP-200-RT), and these differences are discussed at the end of this section.

On both versions, up to four microstructure sensors can be installed. Typically the installed sensors are two shear probes and one FP07 thermistors with one spare sensor port; however, one additional FP07 thermistor or one micro-conductivity sensor can be added. Note: When a sensor is not installed, a "Dummy" probe is installed in its sensor port. In addition, the T and C dummy probes have internal termination resistors so that the signals produced by these dummy probes are approximately at mid-scale of its sensor. The S dummy probes are un-terminated and this simulates the signal from a shear probe when it is unperturbed by turbulence.

Located on the rear bulkhead of the instrument are one underwater connector (Impulse MHDG-9), a lifting ring for securing a line/underwater cable to the instrument (depending on the version), a sealing nut (located along the centre-axis of the bulkhead), and a Zinc anode. If you have an internally recording version you will also see an LED indicator, which will flash while the instrument is recording data.

Attached to the rear bulkhead is a plastic tail section with drag brushes. The tail section provides extra length to the instrument while also providing a mounting point for the drag brushes. The drag brushes control the descending speed of the VMP-200 and increases the pitch stability of the instrument. A rubber coupler connects the tail section to the pressure case and assists in damping vibrations created by the drag brushes and tail section.

There is one underwater connector on the rear bulkhead (Figure 10). The 9-pin MHDG connector handles the communication and provides a connection for charging the internal battery. Communication is discussed at the end of this section. For instructions on how to charge the battery, please refer to section 8.4.

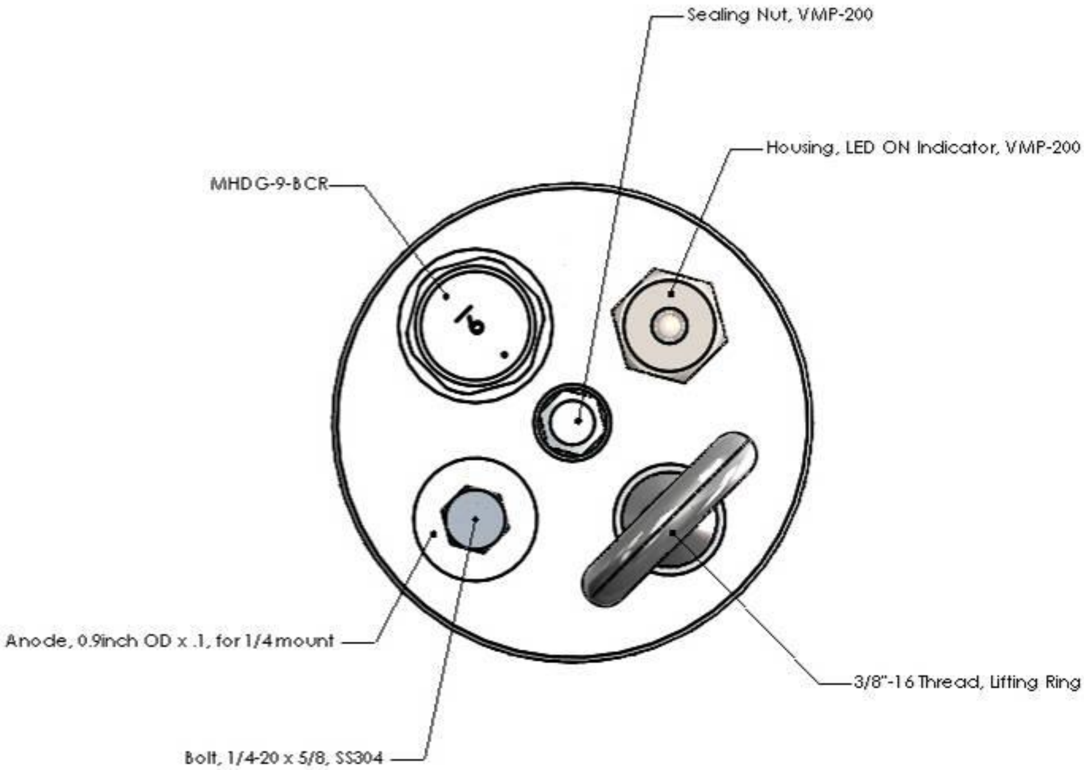

Figure 10: VMP-200-IR rear bulkhead. The VMP-200-IR has a LED ON indicator and a lifting ring, the VMP-200-RT does not have this LED and substitutes a cable strain-relief assembly for the lifting ring.

The electrical system in the VMP-200 consists of the following items.

- An analog signal conditioning board that handles two shear probes, two thermistors, a pressure transducer and two piezo-accelerometers. It also, provides anti-aliasing filters on all channels, and has an ultra-linear, extremely low-noise 16-bit analog-to-digital converter.
- A power supply board that has DC-to-DC converters to provide a +5VDC power rail to all analog components, a 3.3VDC rail for all digital components, and raw power equal to the battery voltage less 1V for optional equipment. This board monitors the magnetic ON-OFF switch and also measures the battery voltage and makes it available to the data acquisition system. There are 4 spare analog input channels for optional equipment that has an output in the 0-to-5V range. A precision 2-axis inclinometer measures the pitch and roll of the instrument, and this too is available to the data acquisition system.
- Either one of two interface boards.
    - For VMP-200-IR, only, the CF2-Interface board which holds the Persistor CF2 computer, communicates with the other boards in the system and provides an input for signals from an optional Sea-Bird SBE3F thermometer and a SBE4C conductivity cell. It also, provides the serial and the USB link to the instrument.
    - For VMP-200-RT, only, the RSTRANS (Remote Serial TRANSceiver) that communicates in real-time with the deck unit, communicates with the other boards in the system and provides an input for signals from an optional Sea-Bird SBE3F thermometer and a SBE4C conductivity cell.
- An optional board for a µconductivity sensor.

6.1. Power-Supply Board (P050)

The instrument runs on DC power supplied by an internal Lithium-ion polymer 4-cell battery with a capacity of 2.5 A-Hr. The nominal voltage of this battery is 14.8V. The operating voltage range of the VMP-200-IR is 9.5V to 17V. Typical current consumption is 70 mA at 15V.

A fully charged battery has a voltage of 16.8V. The voltage decreases with use and a switch internal to the battery itself will disconnect the battery from its load when the voltage drops below 11V – a threshold set by the manufacturer of the battery to protect it against under-charge damage. The power supply board monitors the voltage and will turn the instrument off when the battery voltage falls below 13V. At 13V, the battery has only a few minutes of life left in it before it turns itself off internally. The power supply board will refuse to start the instrument if the battery voltage is below 14V. If the instrument refuses to turn on, the user must connect the deck cable and use a voltmeter to check the voltage on the battery. The battery *must* always be charged with the charger provided. Excessive charging will destroy or shorten the service life of the battery.

A 0.25A fuse is mounted on the board at its power input. It is sufficient for handling the normal load of the instrument. If the user wishes to use the switched and raw output port of the board, then the fuse capacity has to be taken into account. Please, consult RSI for such applications. The battery has an internal resettable fuse of much large value, which is not user serviceable.

The instrument is instructed to turned on (off) by attaching (detaching) the magnet to the front bulkhead. Shortly after the instrument is turned on, it will start recording a new data file. Shortly after the instrument is instructed to turn off, by removing the magnet, it will terminate data acquisition, close all files and signal the power supply board that it is safe to turn the instrument off. While the instrument is off it draws no power from the internal battery.

DC-to-DC converters provide the power rails of +5V for all analog circuits and 3.3V for all digital circuits. These converters are turned on in sequence (3.3V, then 5V, and then raw output). If the power supply voltage is above 14V, the start-up sequence will start and, if it remains above 13V throughout the sequence, then the power will remain on until the magnet is removed. In a VMP-200-IR, the power supply board will signal the data acquisition software that power is good and that it is safe to proceed with the data acquisition process. The software sends a return signal that indicates that the data acquisition is in progress. In a VMP-200-RT, the instrument simply remains on.

The power supply board also manages the shutdown process. If the user removes the turn-on magnet, or if the internal battery voltage falls below 13V, then the board signals the data acquisition software about these two conditions and it then waits for a signal from the software that it is safe to turn off the power. Upon receiving the signal that data acquisition has ended, the power supply turns off al DC-DC converters and waits for a turn-on signal from the magnet. While waiting the power draw by the instrument is zero.

A 2-axis inclinometer is mounted on the power supply board. It has an accuracy of ±0.1º over the oceanic temperature range. One inclinometer is sensitive to tilting of the *y*-axis (see Figure 11). The other unit is sensitive to tilting of the *z*-axis. On a vertically profiling instrument, such as the VMP-200, this axis is vertical, nominally at 90º, and it is not very sensitive to tiling in the x-direction. This inclinometer is primarily intended for quasi-horizontal profilers, where the axis of the instrument is conventionally the *x*-axis, in which case it gives a very good measure of the pitch of such a profiler. The standard channels are 40-42 for the *x*- and the *y*-inclinometers and the inclinometer temperature, respectively.

The power supply board has 4 channels of analog input for optional signals. The input must be in the range of 0-to-5V. There are no anti-aliasing filters on these inputs other than a simple RC network with a cut-off of 40Hz. The input-to-output relation of these channels is

$$V_{in} = 2.560 + \frac{N}{12800} \tag{1}$$

where V_{in} is the input voltage and N is the signed 16-bit number produced by the analog-to-digital converter. The standard channel addresses are 33 through 36.

In addition to monitoring the input voltage from the battery, the power supply board also measures this voltage, and its input-to-output relation is

$$V_{Bat} = \frac{N}{1600} \tag{2}$$

where N is the signed 16-bit number produced by the analog-to-digital converter. The standard address is 32 for the battery measurement.

6.2. Back-up Battery in the VMP-200

A lithium CR123 battery is mounted on the power supply board. It maintains the logic function of the power supply board, and the time-of-day clock in the data logger, and it has enough capacity to last about 6 months. When this battery is depleted, the VMP-200 cannot be turned on. Therefore, the user should always insert a fresh new battery before every major deployment and certainly after the instrument has been in storage for more than a few months. When the instrument is turned on, no current is drawn from the CR123 battery. After a battery replacement, the time and date of the clock in the Persistor computer must be reset to its proper value.

6.3. Analog Signal conditioning board, µASTP-LP (P049)

The analog signal conditioning board supports 2 shear probes, 2 FP-07 thermistors, a pressure transducer and two 1-axis piezo-accelerometers. 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. This report is also required to convert the data from certain channels into physical units. The piezo-accelerometers have no DC response and are treated like a shear probe channel. Their primary purpose is to sense the vibrations of the instrument in the *x*- and *y*-directions. The DC- and low-frequency response to tilting is measured by the inclinometers on the power supply board.

The µASTP-LP board also provides anti-aliasing filtering at 98Hz, using 8-pole Butterworth low-pass filters, for all microstructure signals, including the piezo-accelerometers and filtering at 5Hz for the pressure signal channels. The data are sampled at 512 per second for the “fast” micro-structure signals and at 64 per second for the other “slow” channels. This is user configurable in the setup file of the data acquisition software.

The coordinate system of the VMP-200 is as follows (Figure 11):

> *x*-axis: It is directed through the threaded hole which is used for the “ON” magnet. Nominally, horizontal on a vertical profiler.
>
> y-axis: Orthogonal to the *x*-axis and nominally horizontal on a vertical profiler.
>
> *z*-axis: Parallel with the axis of the instrument running from the front bulkhead to the rear bulkhead. Nominally vertical and directed upwards on a vertical profiler.

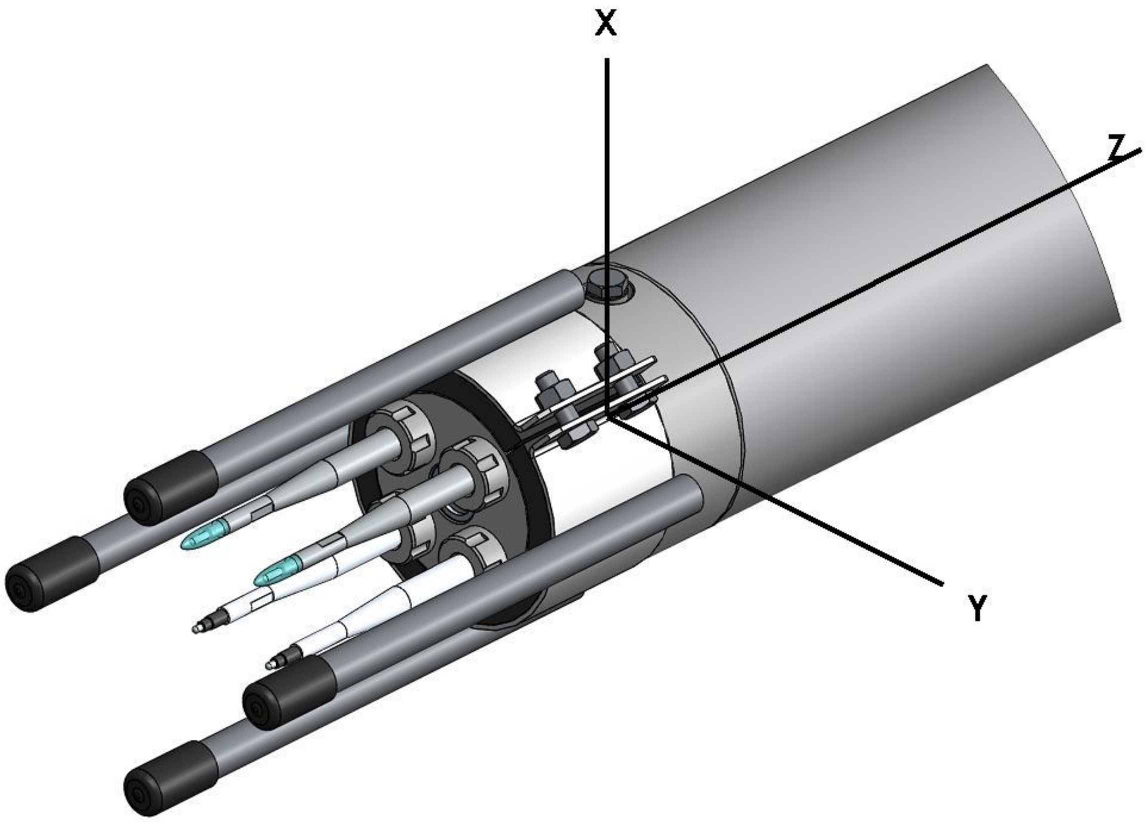

Figure 11: VMP-200 coordinate system.

The numeric assignment of the signal channels follows standard values used by most RSI instruments and this is summarized in Table 1. Further details are in the ODAS5-IR User Guide Oceanographic Data Acquisition System.

Ch #	Name	Signal
0	gnd	Analog ground.
1	Ax	*x*-axis piezo-accelerometer.
2	Ay	*y*-axis piezo-accelerometer.
4	T1	Thermistor 1.
5	T1_dT1	Thermistor 1 with pre-emphasis.
6	T2 or NA	Thermistor #2. Not used if a µ-conductivity sensor is installed.
7	T2_dT2, or C1_dC1	Thermistor 2 with pre-emphasis, or µ-conductivity sensor 1 with pre-emphasis.
8	Sh1	Shear probe 1.
9	Sh2	Shear probe 2.
10	P	Pressure.
11	P_dP	Pressure with pre-emphasis.
12	PV	Voltage on high-side of pressure transducer.
16	sbte	SBE3F, LS 16 bits, optional.
17	sbto	SBE3F, MS 16 bits, optional.
18	sbce	SBE4C, LS 16 bits, optional.
19	sbco	SBE4C, MS 16 bits, optional.
32	V_Bat	Battery voltage divided by 10.
33-36		Spare analog inputs
40	Incl_x	*x* –inclinometer.
41	Incl_y	*y* –inclinometer.
42	Incl_T	Inclinometer temperature
256	Sp_char	Special Character, 7FF0H

Table 1. Numeric assignment of signal channels in a VMP-200.

6.4. CF2-Interface, Persistor (P040), VMP-200-IR only

The CF2-Interface board holds the Persistor computer which runs the PicoDOS operating system and handles the data acquisition. The data are logged on to a Compact Flash card. The computer setup is done through the RS-232 serial connection and the data download is done over USB; see the ODAS5-IR User Guide Oceanographic Data Acquisition System for details. The user communicates with the instrument using its deck cable.

The CF2-Interface board handles all communication of data samples from the µASTP-LP analog signal conditioning board and from the power supply board. 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 by removing the magnet from the front bulkhead. The board also supports two frequency input channels that are used with the optional Sea-Bird SBE3F thermometer and SBE4C conductivity cell. A 14-line Serial Instrument Bus is used to transfer address- and data-words between the CF2 Interface and the µASTP-LP and power supply boards (see application note AN-011).

6.5. RSTRANS (P004) Real-Time Communication Board, VMP-200-RT only

In a real-time transmitting instrument, all communication with the instrument is handled by the RSTRANS board. The RSTRANS board accepts addresses sent by the companion UTRANS via the instruments tether and transmits a data word, for every address received, back to the UTRANS. It is designed for long-line communication and uses RS485 drivers and Manchester II encoding. A 14-line Serial Instrument Bus is used to transfer address- and data-words internally between the RSTRANS and the µASTP-LP and power supply boards (see application note AN-011). The board also supports two frequency input channels that are used with the optional Sea-Bird SBE3F thermometer and SBE4C conductivity cell.

6.6. Battery Charging

1. Connect the deck cable to the MHDG-9 connector.
2. Measure the main battery voltage by connecting a multi-meter to the 2-pin Molex connector on the deck cable. If the voltage is below 14V, the battery must be charged. If the voltage is less than 15V, it should be charged. The battery is fully charged if the voltage is above 16.7V.
3. Plug in the charger power cord into an AC 100-240V, 50-60Hz source. The LED on the charger will flash red and green twice to indicate it is functioning correctly after AC power is connected.
4. Connect the two-pin Molex connector on the deck cable to the mating connector on the charger. The LED on the charger will turn red to indicate charging.
5. Once the battery is fully charged, the LED will turn green.

Note: It is not necessary to switch off the VMP-200 while charging. However, it will take longer (~30%) to charge the battery because some of the current is used to operate the instrument and only the remainder enters the battery.

6.7. Differences between –IR and –RT Versions

The IR and RT versions of the VMP-200 differ from each other, but only slightly. The IR version records data using the CF-2 Interface and Persistor boards (P040) whereas the RT transmits data from the instrument via the RSTTANS Board (P004) to the UTRANS. Externally, the differences between the two versions are how they are tethered and how they show that they are recording. The RT version uses the underwater cable to tether the instrument. The instrument is mechanically supported by a strain-relief assembly which is attached to the cable. The IR version does not require an underwater cable since data are stored internally. Therefore, a rope line and eye-bolt are used to tether the VMP-200-IR. Another difference between the two versions is the LED "ON" indication light. The indication light is only present on the IR version. The LED flashes once per record (second) and gives a visual indication that the data acquisition process is underway. The RT version does not have the indication light, and a plug is installed in the hole in the rear end-cap. The user verifies that the instrument is on by communicated with it directly.

7. Operations

1. Before attaching the tail section to the VMP-200 for deployment, **ensure that all o-rings are intact and all seals are properly secured**. Refer to the next section for disassembly/assembly procedures, if necessary. The pressure tube and nose use piston seal o-rings (o-ring size 2-150). **CRITICAL: make sure there is no visible gap between the pressure tube and the bulkheads and between the nose and the front bulkhead.** Replace the zinc anodes if necessary.

2. Connect the deck cable to the MHDG-9 connector.

3. If using the IR version, follow the instructions in Section 4.1 to connect and communicate with the instrument. For the RT version, follow the instructions in Section 4.2.

4. After confirming communication with the instrument, turn the instrument off by removing the magnet.

5. Disconnect the deck cable and put the cap on the MHDG-9 connector.

6. Select the number of brushes required to achieve the desired fall rate for your profile (using a combination of 1 - 4 brushes should allow you to achieve fall rates between 0.4-0.9 m/s). NOTE: The brushes should be stored flat when not in use for prolonged periods of time to keep the filaments from bending. Bent filaments will cause the brush to produce uneven drag around its circumference. If the brush filaments become bent, place them on a flat surface in a warm environment to allow them to spring back to a straight form.

7. Taking the detached tail section, slide the drag brush(es) onto the tail section and attach the rubber reducer coupler over the end of the tail, clamping the brushes between the plastic stop on the tail and the rubber coupler (Figure 12).

   It is important to ensure that the metal brush rings are tight together and cannot rattle. Any vibrations from the brush ring will be sensed by the shear probes and accelerometers. You may need to adjust the location of the plastic stop by loosening the stop's hose clamp and sliding the stop along the tail. Remember to retighten the hose clamp on the stop ring and the rubber coupler.

   Increase the clamping force between the brushes, the coupler and the plastic stop on the tail, using a hammer (Figure 13). This will ensure the brushes do not rattle in place during instrument deployment and data recording.

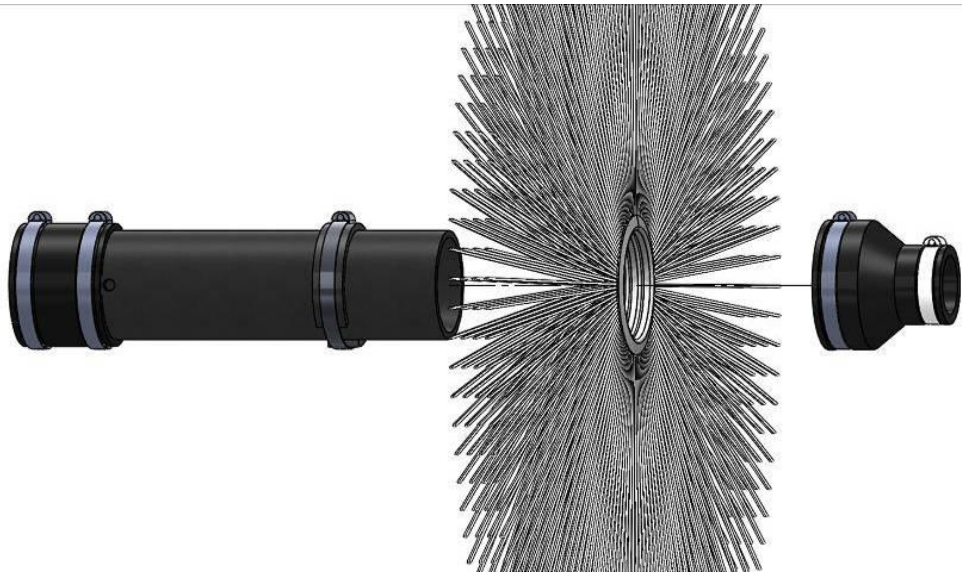

Figure 12: Exploded view of tail section, brushes and rubber coupler.

Figure 13: Tightening brushes to tail section.

8. Attach the tether to the rear bulkhead of the instrument. For the IR version, see Figure 14. For the RT version, see Figure 15. Note: Guide the tether through the tail section before attaching the tether to the rear bulkhead.

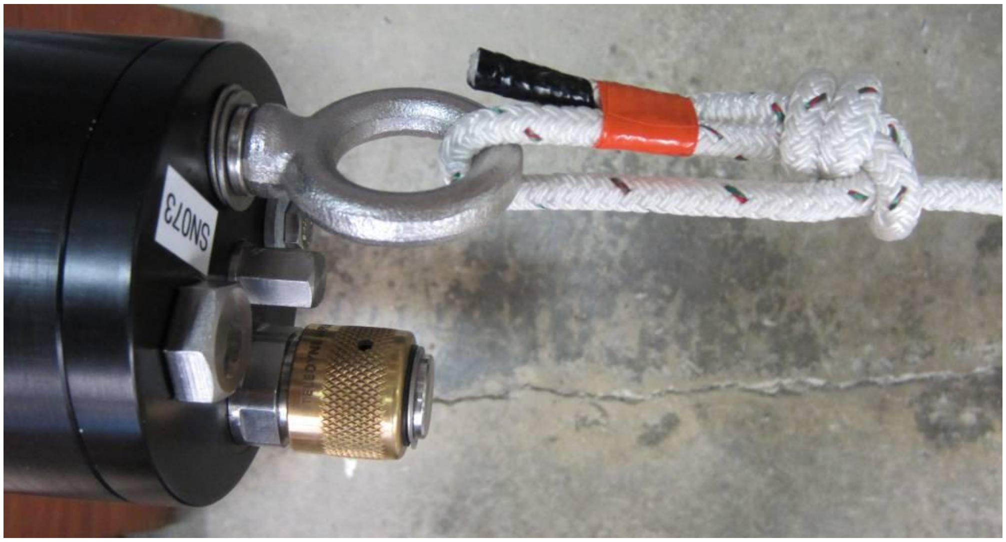

Figure 14: Attaching rope tether to VMP-200-IR.

Figure 15: Attaching underwater cable tether to VMP-200-RT.

9. Attach the tail section to the pressure case using the straight rubber coupler, leaving approximately an inch of space between the pressure case and the tail (Figure 16).

   CAUTION: Do not allow the tail section to come in direct contact with the rear bulkhead. The straight rubber coupler is designed to remove vibration noise caused by the tail section and drag brushes from being picked up by the shear probes and accelerometers.

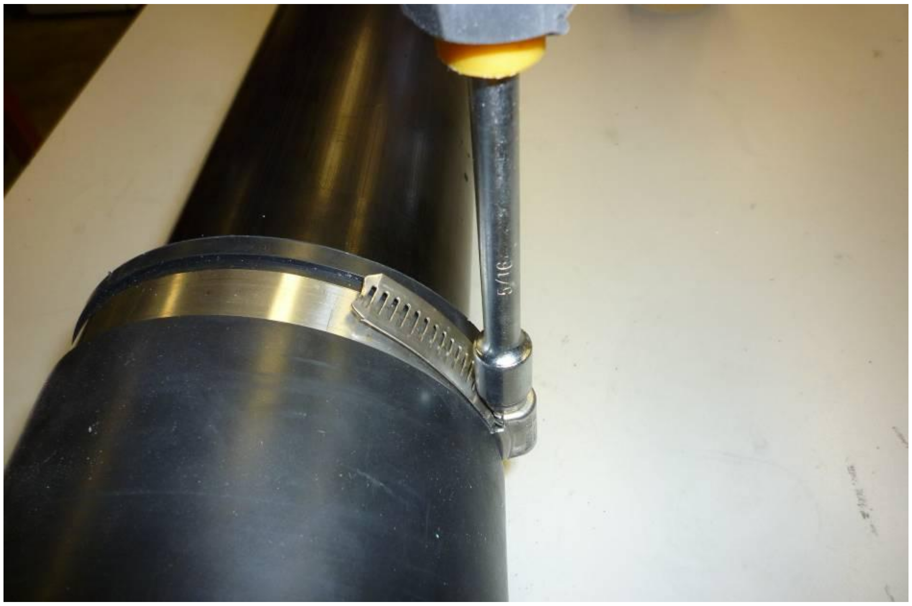

Figure 16: Attaching tail section to pressure case using straight rubber coupler.

10. Ensure that the axis of the tail section is in line with the axis of the pressure case and tighten the hose clamps on the straight rubber coupler.

11. Install microstructure sensors as follows (Note: if replacing a sensor or installing a dummy probe, follow these instructions):

    i. Loosen the holder cap of the dummy probe. Usually a half to three-quarter turn is enough (Figure 17). CAUTION: When tightening or loosening an SMC connector, rotate either the probe or the end of the connector while preventing the cable from rotating. Allowing the cable to twist will damage the cable and connector over time.

    ii. Gently pull out the dummy probe. Disconnect the SMC cable and leave it hanging out of the probe holder (Figure 18). Please note that the dummy probes are labeled (T1, T2, S1, S2, C1, for temperature, shear and conductivity, respectively) and these identifications must match the tags on the SMC cables attached to these dummy probes.

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

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

v. Orient the shear probes to their proper axes and tighten the probe holders. Figure 11 shows the instrument coordinate system. Typically, one shear probe is aligned with the instrument's x-axis, and the other with its y-axis. The sensitivity on a shear probe is in the direction normal to the flat section of the sensor's serial number. Figure 19 shows all the sensors installed in the probe holders. Figure 11 shows the typical orientation of the shear probes.

vi. Note: In some cases, while tightening the probe holder cap, the shear probes will want to rotate with the cap. This is because of the friction from the o-ring inside the probe holder hole. If this occurs, make sure that the o-ring is properly lubricated. In some cases this does not fix the problem and the probes will need to be rotated before tightening so that after they are secured, they have the proper alignment. **CRITICAL: The probe holders should not be over-tightened – tighten to the point where the probe holder caps can no longer be rotated by hand, then use the probe wrench to tighten the caps an additional 1/4 or 1/2 turn.** At the proper tightness, it should be difficult to rotate the probes by hand. Over-tightening the probes will deform the plastic ferrule and affect the integrity of the o-ring seal. The sensor port is shown in detail in Figure 22.

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

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

Figure 17: Loosening the probe holder using custom probe wrench.

Figure 18: Removing Dummy Probe. Note the clear heat shrink tubing around the SMC connector.

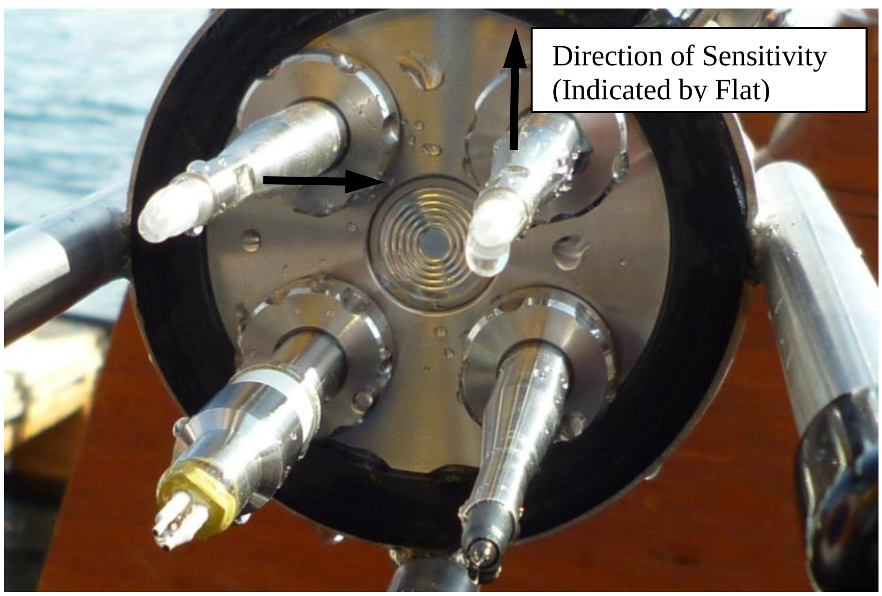

Figure 19: VMP-200 with probes installed. Note the orientation of the shear probes before deployment. (The magnet hole is in line with the x-axis.)

12. Turn the instrument on by attaching the magnet to the front bulkhead of the instrument. If using the IR version, look through the end of the tail section for the LED “ON” indicator light and wait at least 10 seconds for confirmation that the instrument has turned on properly and is recording data (the light will blink if data is being recorded). For the RT version, open ODAS4-RT and follow the instructions for data acquisition found in the ODAS4-RT Oceanographic Data Acquisition System Software User Guide.
13. Deploy the instrument.
14. Recover the instrument.
15. Turn the instrument off.
16. Follow Steps 18-21 if using the IR version to obtain data stored on the instrument. If using the RT version, proceed to Step 22.
17. Remove the tail section from the pressure case section of the instrument.
18. Connect the deck cable to the MHDG-9 connector.
19. Turn the instrument on. and follow the instructions in the ODAS5-IR User Guide Oceanographic Data Acquisition System for logging into the computer and downloading the data.
20. At the end of the cruise, or at any time for safety reasons, remove the microstructure sensors and replace them with dummy probes.
21. Any time the instrument experiences a prolonged time period between profiles, rinse the exterior of the instrument with fresh water. This will help decrease corrosion of the metallic components on the instrument and prolong the instruments life.
22. Upon your return to your base of operations, follow the maintenance instructions for cleaning and preparation for storage.

8. Maintenance

After every cruise, fully disassemble the instrument using the instructions in this section. **CRITICAL: Inspect all o-rings and sealing faces for damage**. Inspect all components for wear and damage.

8.1. Disassembly and Maintenance

1. Remove the rear bulkhead Sealing Nut using a 7/16-inch Socket & Ratchet on a 6-inch extension.
2. Hold on to the pressure tube and gently wiggle the rear bulkhead out of the tube.
3. Slowly slide the rear bulkhead out over the threaded rod.

CAUTION: Remove the bulkhead slowly as the Molex Connectors are plugged into the inner electronics (Figure 20).

Figure 20: Rear bulkhead removed showing Molex Connectors.

4. Disconnect the three Molex Connectors between the rear bulkhead and the internal electronics.
5. Set the rear bulkhead aside, being careful not to damage cables, connectors and the o-rings.
6. Holding on to the pressure tube, gently wiggle the front bulkhead until the front bulkhead is free of the tube. Slide the internal electronics assembly out of the pressure tube (Figure 21). This step is best completed with two people. Note: when removing the pressure tube, ensure that you and the instrument are electrically grounded so as to prevent any buildup of static charge from being dissipated through the electronics.
   CRITICAL: Be VERY careful not to damage the internal faces on the Pressure Tube. These are sealing surfaces and must remain smooth and clean.

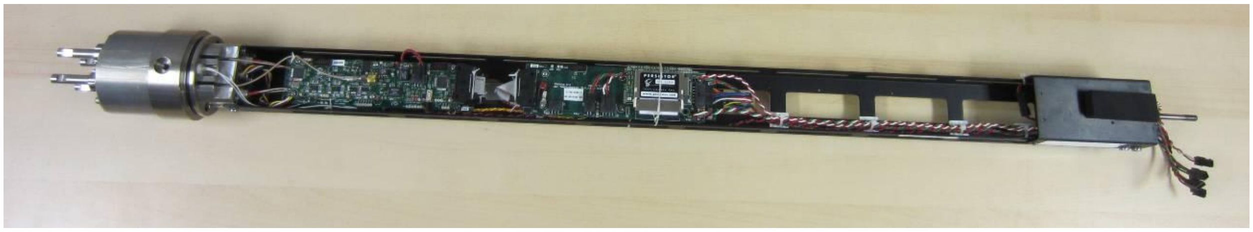

Figure 21: Front bulkhead/electronics Assembly.

7. Remove the dummy probes from the front bulkhead.
8. Disassemble the probe holders and remove them from the nose cone.
9. Remove all components from the rear bulkhead (LED “ON” indicator, lifting ring, Zinc anode, MHDG connector). Replace the Zinc anode if necessary.
10. Remove the sensor guard and rubber liner from the front bulkhead.
11. Remove and inspect all o-rings. Replace any that are worn or damaged or older than one year.
12. Clean all sealing faces on the front and rear bulkheads with a damp cloth/paper towel (using fresh water) to remove any residual salt. Re-wipe these surfaces with isopropyl alcohol (to remove oils). Inspect all sealing surfaces for debris and damage. If any sealing surfaces are scratched or damaged contact Rockland Scientific.
13. Clean the lifting ring, zinc anode, “ON” magnets, sensor guard, sensor guard rubber liner and any external fasteners with fresh water and leave to dry.
14. Carefully wipe the sensor port threads on the front bulkhead with a clean damp cloth/paper towel (using fresh water) to remove any residual salt.
15. Clean the drag brushes and tail section components with fresh water and leave to dry.

8.2. Assembly

1. These steps assume that all o-rings have been cleaned (or replaced if worn, cut or damaged in any way) and re-greased.
2. Re-install all components on the rear bulkhead (see Figure 10). If while reinstalling the lifting ring on the IR version, the ring’s final orientation after tightening doesn’t allow the tail section to be able to be mounted properly, add washers to shim the lifting ring until proper orientation is achieved. Additional washers can be found in the VMP-200-IR spares kit. Proper orientation of the lifting ring can be seen in Figure 10.
3. Install the sensor guard and rubber liner.
4. Apply a “no-seize” compound to the threads on the probe holders and install the probe holders and dummy probes. Make sure the o-rings and ferrules are properly oriented and seated (refer to Figure 22). The no-seize will greatly reduce any tendency for the probe holders and the front bulkhead to gall.

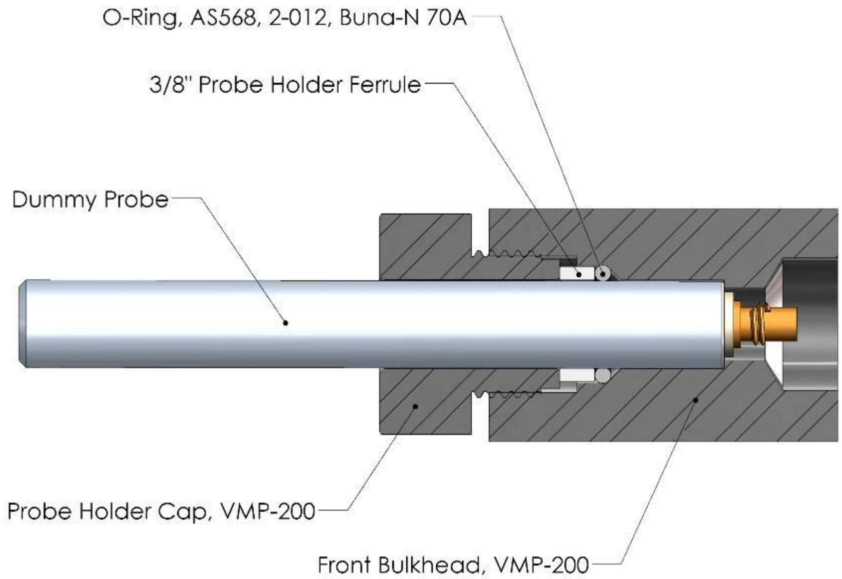

Figure 22: Probe holder assembly (shown from a section view of the front bulkhead).

5. Slide the front bulkhead and electronics assembly into the pressure tube up to the o-ring on the front bulkhead, **CRITICAL: Ensure the inside surfaces of the pressure tube are not scratched by the electronics assembly or the threaded rod**.
6. Plug the rear bulkhead internal Molex connectors into the instrument connectors.
7. Insert the rear sealing nut into the centre bore on the rear bulkhead as shown in Figure 23 (this will ensure that the sealing nut will engage the threaded rod) and push the rear bulkhead into the pressure tube until the nut hits the threaded rod (about where the o-ring touches the pressure tube). Make sure the internal wires are not pinched.

Figure 23: Rear bulkhead inserted onto end of tube with threaded rod extending through the bore.

8. Tighten the rear sealing nut to seat the rear bulkhead into the tube (Figure 24).
   CRITICAL: When tightening the sealing nut, pay close attention to the o-rings on the nut and ensure that they are not pinched as they enter the sealing bore. It is recommended to slowly tighten the nut when the o-rings are being inserted. If the o-rings start to get pinched, back off the nut slightly and then re-tighten. Ensure the o-rings and sealing bore are properly greased before installation.
   CRITICAL: make sure there is no visible gap between the pressure tube and the bulkheads and between the nose and the front bulkhead.

Figure 24: Tightening the sealing nut.

9. Install Dummy probes according to Step 11 in Section 7 "Operations".

8.3. Sensors

Any time the instrument experiences a prolonged time period between profiles and after every cruise, wipe the shaft of the sensors with a damp cloth/paper towel (using fresh water) to remove any residual salt. Re-wipe these surfaces with isopropyl alcohol (to remove oils). **Caution: Avoid getting water on the connector of a sensor as it may cause damage to the connector**. Inspect the shaft of the sensor for scratches in the direction parallel to the axis of the sensor. If there are any large scratches, contact RSI.

8.3.1. Shear Probe

First do a visual inspection to check if the white centre beam of the probe tip is straight in line with the main axis of the probe. A bent beam almost certainly means the probe is broken. The integrity of the piezo ceramic can be checked by measuring the capacitance and the resistance of the probe. Nominal values are C ~ 0.7-0.9 nF; R ~ 200 MOhm to 1 GOhm (use a Gigaohm meter with an input voltage of no more than 50 V). If the capacitance is 0.5 nF or less, then this means the probe beam is almost certainly broken.

8.3.2. FP07 thermistor

Confirm by visual inspection (using a microscope or magnifying) that the glass tip is free of cracks or fissures. Also, the small sensing tip on top of the glass beam should be visible and intact. Use a multi-meter (Fluke) to measure the resistance of the probe (in air). At room temperature R ~ 2KOhm (+/-25%). Open circuit or short circuit means the probe is broken.

8.3.3. SBE7 Micro-Conductivity Sensor

Do a visual inspection. Bent or broken probe tips are a clear sign of damage. Also check (with a magnifying glass or microscope) for any deposits on the black contact surfaces of the tip.

Sea-Bird has revised their recommendations for preparing and storing their conductivity sensors (Application Note No. 2D, revised September 2008). This note applies to the SBE7 micro-conductivity sensor.

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:

- Soak the sensors in 1% Triton X-100 for 10 minutes;
- Rinse the sensors with distilled water and let them dry.
- Conduct a visual inspection with magnifying glass and confirm that the electrodes return to a “jet black” appearance.
- Soak the sensors in 0.1% Triton X-100 for 16 hours.
- Rinse with distilled water.
- Air dry for 1 hour.
- The micro-conductivity sensors should be stored with their “syringe” style protectors and kept dry.

CRITICAL: 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. Triton X-100 is a powerful wetting agent that quickly removes particulate stains and some oils and greases. Pre-soaking the probe tips is essential for retaining the sensitivity of the probe.

Note: 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. (If you are located at a university, your chemistry shop on campus may even have it.)

9. Preparation for Storage

1. Do the post-cruise maintenance (Section 8).
2. Store the instrument in its shipping case in a clean dry environment.

10. Appendix

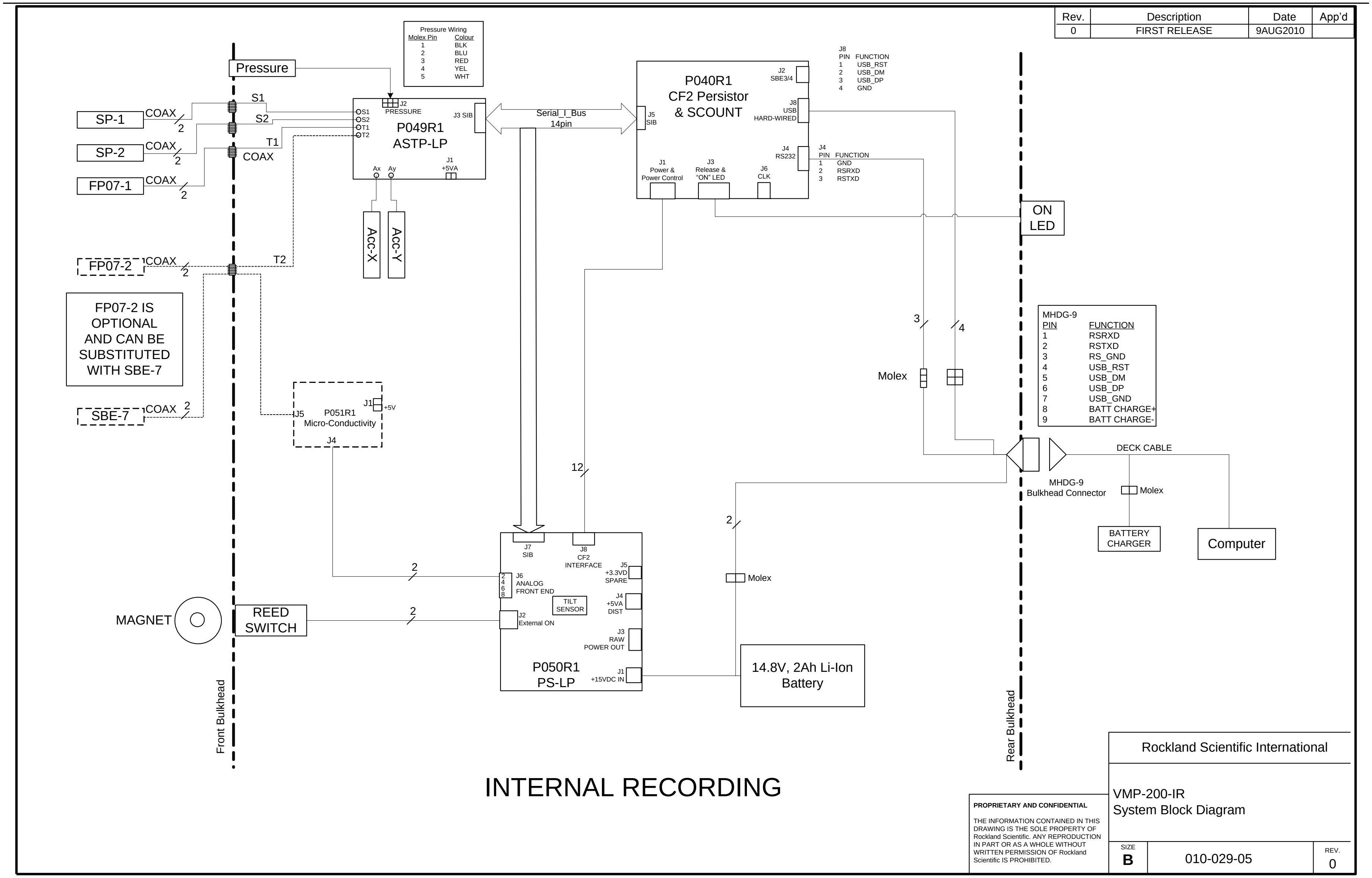

Figure 25: VMP-200-IR Electrical Block Diagram.

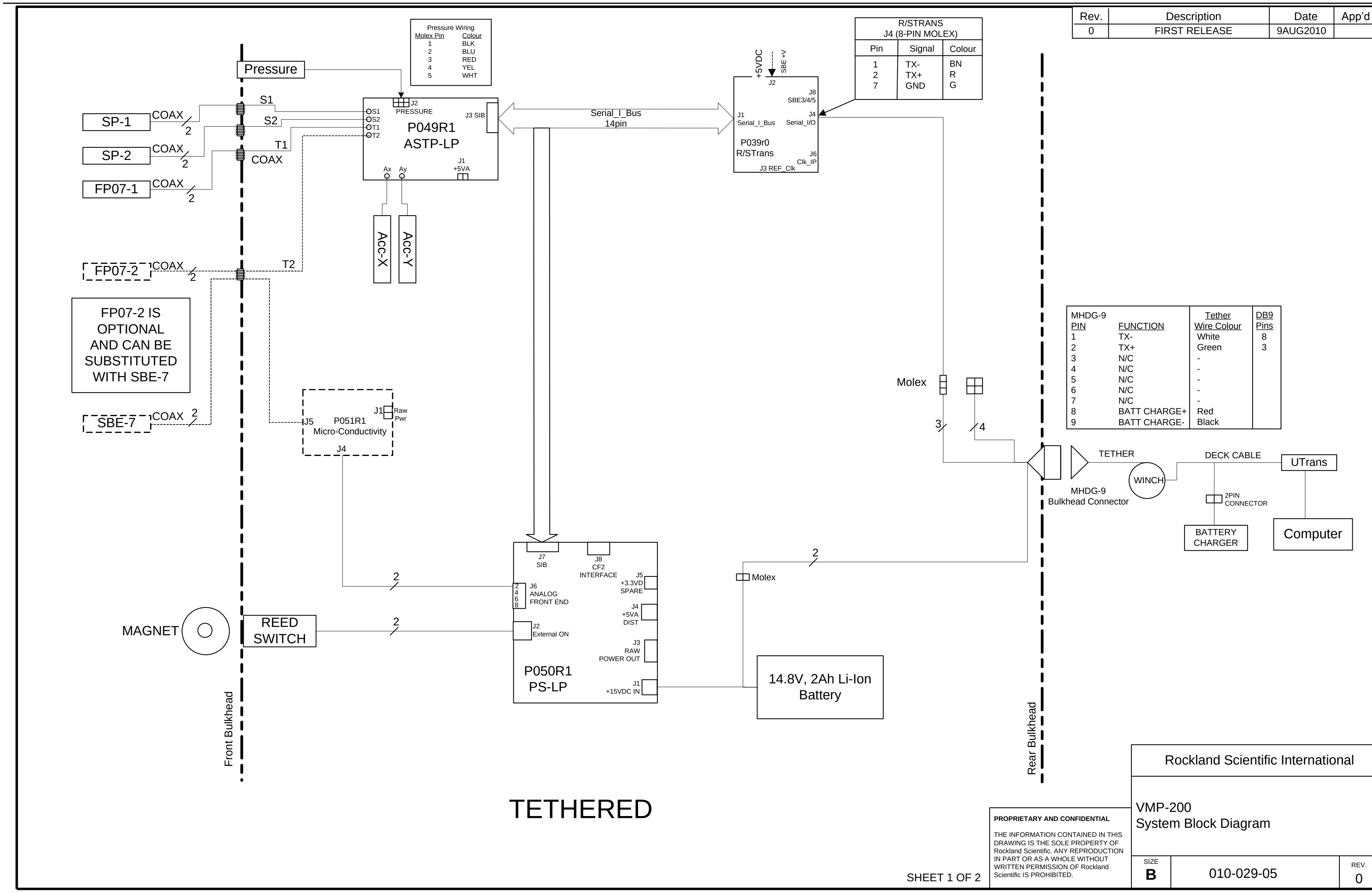

Figure 26: VMP-200-RT Electrical Block Diagram.

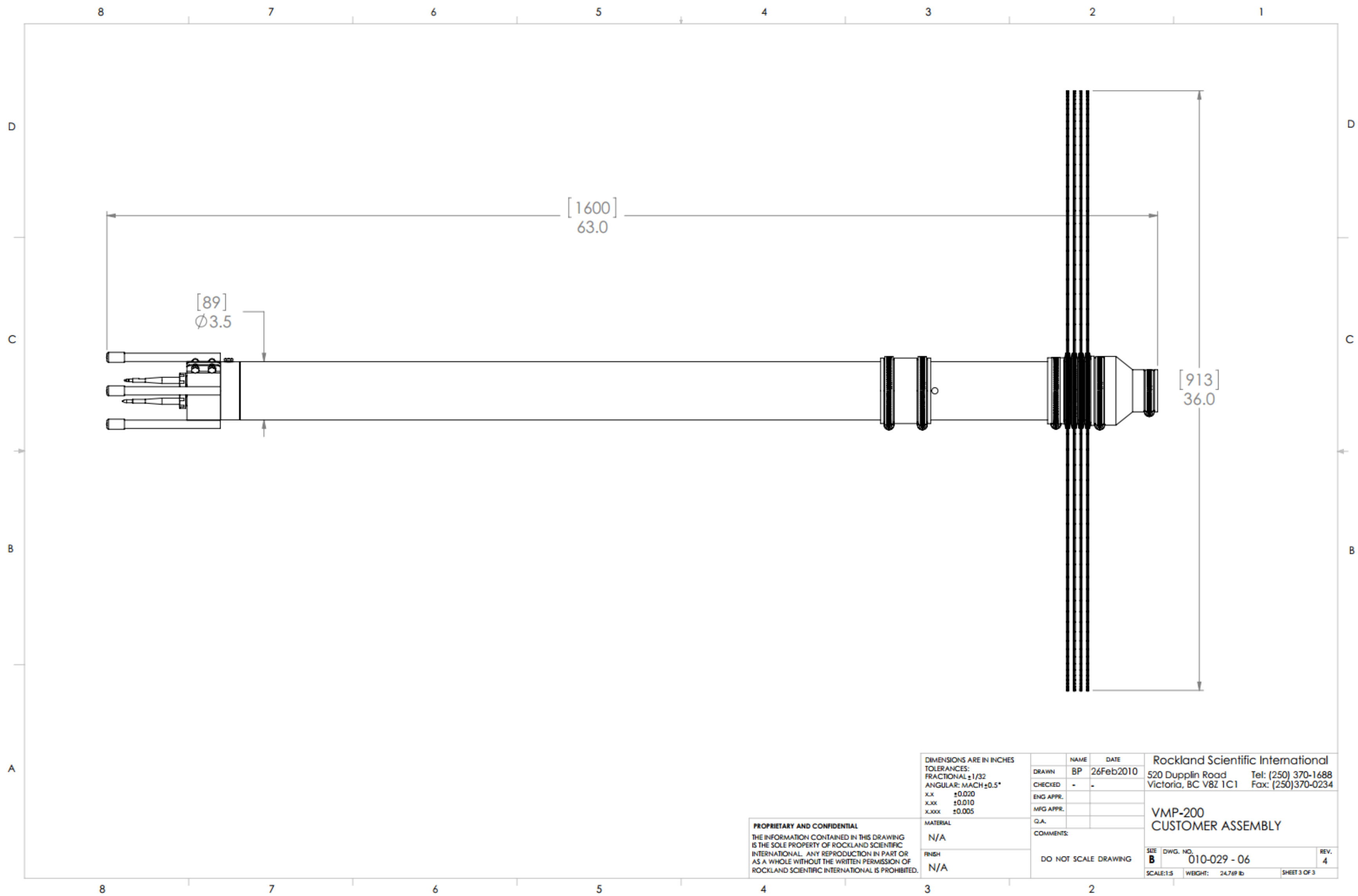

Figure 27: Dimensional information on the VMP-200.

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