SEA-BIRD SCIENTIFIC

User manual

WETStar

Chlorophyll-a and rhodamine fluorometer

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541-929-5650
seabird.com

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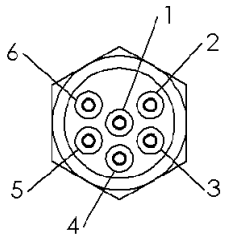
Section 1 Specifications

1.1 Mechanical

Diameter	6.98 cm
Length	17.1 cm; 25.7 cm with tubing
Depth rating	600 m
Temperature range	0–30 °C
Weight in air, water	0.8 kg, 0.1 kg

1.1.1 MCBH-6-MP bulkhead connector

Previous sensor models also used the bulkhead connector below for analog-only output.

Contact	Digital	Analog	MCBH-6-MP
1	Ground		
2	RS232 RX	Reserved	
3	Reserved		
4	Voltage in		
5	RS232 TX	Reserved	
6	Reserved	Analog out	

1.2 Electrical

Input	7–15 VDC
Current draw	< 40 mA (analog); < 80 mA (digital)
Linearity	99%

1.3 Communications

Maximum output, digital	~4095 counts
Maximum output, analog	5 V
Response time, digital	0.125 seconds
Response time, analog	0.17 seconds

1.4 Optical

Parameter	Wavelength EX/EM	Range, Sensitivity
Chlorophyll (Chl)	460/695 nm	0.03–75, 0.03 µg/L (standard) 0.06–150, 0.03 µg/L
Rhodamine (Rh)	470/590 nm	0–400, 0.05 ppb

Section 2 Operation and maintenance

2.1 Verify analog data output

1. Connect the optional test cable to the sensor. Refer to the section on the Test cable on page 8 for details about test cables.
2. Use a regulated power supply to supply 12 VDC to the sensor or connect a 9V battery to the connectors on the test cable.
   The sensor comes on.
3. Use the probes on a digital multimeter (DMM) to touch the RCA connector on the auxiliary leg(s) of the test cable.
4. Put the red (signal) probe in the RCA connector and the black (ground) on the outside.
   The DMM shows near 0 VDC.
5. Put the fluorescent stick (for fluorometers) or a solid object near the light source of the sensor.
   The DMM shows near 5 VDC.

2.2 Deployment

Deploy the sensor with or without a pump. The manufacturer recommends using a pump because it supplies a consistent flow of water through the sensor. The manufacturer supplies threaded tubing nipples for the flow tube ports to use with a pump or water trap.

Note: *Use an RS232 cable less than 5 m long unless a longer cable has been tested.*

The manufacturer recommends a flow rate of 25 ml/sec using a pump made by Sea-Bird Electronics. The SBE-05T has an adjustable motor speed so the user can control the flow rate into the sensor. Refer to the section on flow rate dependence for more information.

If the user deploys the sensor in a free-flow mode without a pump, make sure that the sensor has a clear water path during descent. Use a water trap if necessary: this is a funnel-type device attached to the sensor with the wide end pointed toward the direction of deployment. The manufacturer recommends a descent rate of 0.2–1.0 m/sec.

2.2.1 Data collection

Connect digital sensors to a PC or data logger that can receive an RS232 signal at 19200 baud. Connection to a PC or data logger also lets the user save the data collected by the sensor.

Connect analog sensors to a host such as a data logger, radiometer, or CTD (conductivity-temperature-depth) that can digitize the analog output of the sensor. A data logger will merge CTD and sensor data and correlate the sensor output with depth or time.

2.3 Clean the sensor

⚠ CAUTION

Clean the quartz flow tube carefully. It scratches and breaks easily.

1. After each cast or exposure to natural water, flush the sensor with clean fresh water.
2. Clean any grease or oil with soapy water.
   a. Solvents such as methanol can be used to clean the flow tube. Use a long cotton swab to reach the length of the flow tube.
   b. Rinse the sensor thoroughly inside and outside.
3. Let the sensor dry in air.

2.4 Maintain bulkhead connector

⚠CAUTION

Do not use WD-40® or petroleum-based lubricants on bulkhead connectors. It will cause damage to the rubber.
Damaged connectors can cause a loss of data and additional costs for service.

Damaged connectors can cause damage to the sensor and make it unserviceable.

Examine, clean, and lubricate bulkhead connectors at regular intervals. Connectors that are not lubricated increase the damage to the rubber that seals the connector contacts. The incorrect lubricant will cause the bulkhead connector to fail.

1. Apply isopropyl alcohol (IPA) as a spray or with a nylon brush or lint-free swab or wipes to clean the contacts.
2. Flush with additional IPA.
3. Shake the socket ends and wipe the pins of the connectors to remove the IPA.
4. Blow air into the sockets and on the pins to make sure they are dry.
5. Use a flashlight and a magnifying glass to look for:

Cracks, scratches, or other damage on the rubber pins or in the sockets.	
Any corrosion.	 
Separation of the rubber from the pins.	
Swelled or bulging rubber pins.	

6. Apply a small quantity of 3M™ Spray Silicone Lubricant (3M ID# 62-4678-4930-3) to the pin end of the connector. Make sure to let it dry.
7. Connect the connectors.
8. Use a lint-free wipe to clean any unwanted lubricant from the sides of the connectors.

Section 3 Reference

3.1 Delivered items

- The sensor
- dummy plug with lock collar
- 1 nozzle, 6.9 cm
- 1 nozzle, 3.8 cm
- fluorescent stick
- CD with user manual and characterization page

3.2 Characterization

The manufacturer uses a fluorescent material to characterize all fluorescence sensors to make sure that the data that is collected meets the specifications of the sensor. This information is on the sensor-specific characterization page that comes with the sensor.

3.2.1 Field characterization

The manufacturer recommends that the user perform a field characterization on fluorometers to make sure that the data output is as accurate as possible for the user's application. The scale factor and dark counts values can vary depending on the natural water, temperature, cable length, power supply, and other factors.

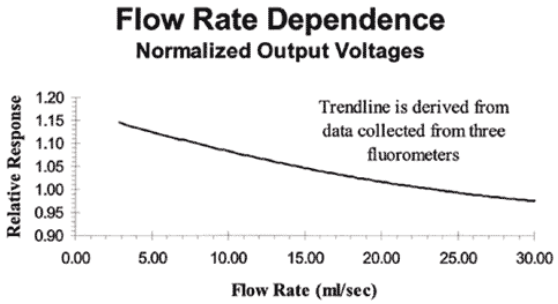
Do the steps below to field-characterize the sensor.

- ***x*** = the solution of a known concentration in volts or counts.
- **output** = the measured sample of interest in volts or counts.
- **clean water offset** = the measured signal output in volts or counts of the sensor with clean water in the flow tube.
- **scale factor** = the multiplier in µg/L/volt, ppb/L/volt, OR µg/L/count, ppb/L/count.

1. Connect the sensor to a 16-bit analog-to-digital converter (ADC).
   Look at the output of the sensor in counts in HyperTerminal or other terminal emulator software.
2. Get a solution of known concentration, ***x***.
3. Measure and record this solution using the sensor.
   This value is the **output** in volts or counts.
4. Measure and record the sensor's **clean water offset**.
5. Use this equation to determine the sensor's **scale factor:**
   Scale factor = x ÷ (output - dark counts).
6. Use the scale factor to determine the concentration of the sample of interest:
   (output - clean water offset) × scale factor = concentration of solution.
   For example, if the clean water offset is 60 counts and known concentration of 65 ppb gives an output of 3500 counts: 65 ppb ÷ (3500 - 60) counts = 0.018 scale factor.
7. Record the scale factor and offset to apply to the data collected by the sensor.

3.2.1.1 Flow rate dependence

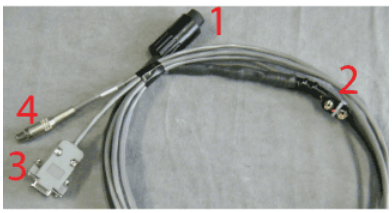
Fluorescent signals from phytoplankton have some dependence on the flow rate of the sample water through the flow tube. The manufacturer recommends the user use a small pump that has a known flow rate. The figure below shows that the output voltage of the sensor changes approximately 15–18% as flow rate changes from approximately 3 to 30 ml/sec. This data is based on samples with *Thalassiosira weissflogii*.



It is possible to use the sensor in a profiling mode without a pump. However, it is difficult to keep a constant flow rate through a sensor cage because of sea-states and ship motion.

3.3 Test cable

Use the optional test cable to set up and test the sensor before deployment.



1 six-contact connector	**3** db-9 serial port connector
2 9-volt battery connector	**4** RCA connector

1. Connect the six-contact connector to the sensor.
2. Connect the 9-volt connector to a 9-volt battery. As an alternative, it can be connected to a 12-volt regulated power supply.
3. Connect the db-9 connector to the host PC. Use a USB-to-RS232 adapter cable if necessary to see digital output.
4. Use the probes on a digital multimeter to see analog output. The inside of the RCA is power and the outside is ground.

3.4 Verify digital data output

1. Connect the test cable to the sensor.
   Refer to the section about the Test cable on page 8 for information on the test cable.
2. Connect the DB-9 connector on the test cable to a PC.
3. Connect the test cable to a regulated power supply or a 9 V battery.
4. Start a terminal communication program such as HyperTerminal® or Terra Term.
   Select:
   a. Bits per second: 9600
   b. Data bits: 8
   c. Parity: none
   d. Stop bits: 1
   e. Flow control: none.
5. Turn the power supply on if necessary.
   The digital output is a column of zeros.
6. Put the fluorescent stick in the flow tube of the sensor.
   The output increases to the maximum output (in counts) specified for the sensor.

Section 4 General information

Revised editions of this user manual are on the manufacturer's website.

4.1 Warranty

This sensor is warranted against defects in materials and workmanship for one year from the date of purchase. The warranty is void if the manufacturer finds the sensor was abused or neglected beyond the normal wear and tear of deployment. The manufacturer will replace or repair, as deemed necessary, any defective components. This warranty does not include shipping charges to and from the manufacturer's facility.

4.2 Service and support

The manufacturer recommends that sensors be sent back to the manufacturer annually to be cleaned, calibrated, and for standard maintenance.
Refer to the website for FAQs and technical notes, or contact the manufacturer for support at support@seabird.com.

Do the steps below to send a sensor back to the manufacturer.

1. Complete the online Return Merchandise Authorization (RMA) form or contact the manufacturer.
   Note: *The manufacturer is not responsible for damage to the sensor during return shipment.*
2. Remove all batteries from the sensor, if so equipped.
3. Remove all anti-fouling treatments and devices.
   Note: *The manufacturer will not accept sensors that have been treated with anti-fouling compounds for service or repair. This includes AF 24173 devices, tri-butyl tin, marine anti-fouling paint, ablative coatings, etc.*
4. Use the sensor's original ruggedized shipping case to send the sensor back to the manufacturer.
5. Write the RMA number on the outside of the shipping case and on the packing list.
6. Use 3rd-day air to ship the sensor back to the manufacturer. Do not use ground shipping.
7. The manufacturer will supply all replacement parts and labor and pay to send the sensor back to the user via 3rd-day air shipping.

4.3 Waste electrical and electronic equipment

Electrical equipment that is marked with this symbol may not be disposed of in European public disposal systems. In conformity with EU Directive 2002/96/EC, European electrical equipment users must return old or end-of-life equipment to the manufacturer for disposal at no charge to the user. To recycle, please contact the manufacturer for instructions on how to return end-of-life equipment, manufacturer-supplied electrical accessories, and auxiliary items for proper disposal.

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