Installation Manual
In-Situ® Aquaculture Buoy

March 2012

Please read entire manual prior to installing this product.

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0097002 rev. 003

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Chapter 1 Safety Information

Please read this manual before unpacking or installing any part of this system.

1.1 HAZARD SYMBOLS THAT MAY APPEAR IN THE MANUAL

DANGER  Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.

NOTE  Indicates a situation that is not related to potential injury.

1.2 PRECAUTIONARY LABELS THAT MAY APPEAR ON THE PRODUCT

 When noted on the instrument, this symbol references the user to the instrument manual.

 When noted on the instrument, this symbol indicates a risk of electrical shock.

 When noted on the instrument, this symbol indicates the location of Protective Earth (ground).

Chapter 2 Overview

The In-Situ Aquaculture System provides large or small fish farming operations with a reliable and easy-to-maintain water quality monitoring system. The system consists of:

- Any number of solar-powered wireless buoys capable of transmitting oxygen, temperature, and optional pH data to the host PC
- A host PC that processes the data transmitted by the buoy
- Wireless controllers that receive control messages from the PC and turns on/off aerators and pumps as needed

Additionally, the system can monitor hundreds of ponds spread out over large areas by using wireless repeaters and high-gain antennas (user-supplied).

2.1 UNPACKING

Remove the buoy from the shipping box. The transceiver mast is detached from the buoy. After removing the buoy from the box, place the mast in the buoy as shown in Figure 1. The battery is shipped outside the battery box.

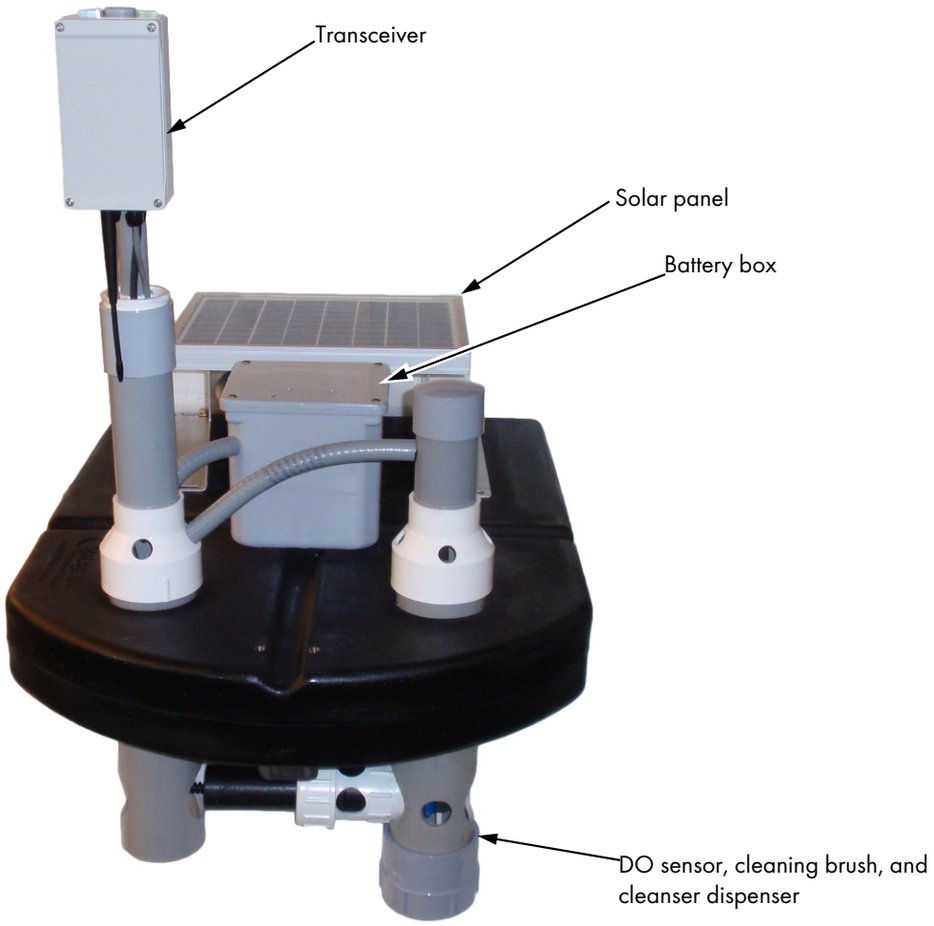
2.2 BUOY COMPONENTS

The primary components of the foam-filled, polyethylene buoy include:

- A wireless radio transceiver that transmits DO and temperature data to the host PC
- The In-Situ® RDO® PRO dissolved oxygen sensor
- A 12 VDC battery that powers the transceiver
- A 10 W solar panel with charge controller to recharge the battery
- A cleaning brush and chemical cleaning dispenser to minimize biofouling
- Desiccant pack (PN: 0063100)

Additionally, you may wish to purchase an anchor for the buoy. In-Situ recommends the Bass Pro Shops' Navy Anchor.

FIGURE 1. Main components of the buoy



2.3 DEPLOYMENT CONSIDERATIONS

- Ensure that the DO sensor and brush are adequately submerged in the pond (at least 2 feet deep), sufficiently away from the pond's edge or above the bottom of the pond.
- Do not carry the buoy by the conduit. Carry it by the float. Otherwise you may damage the wiring.
- Anchor the buoy.

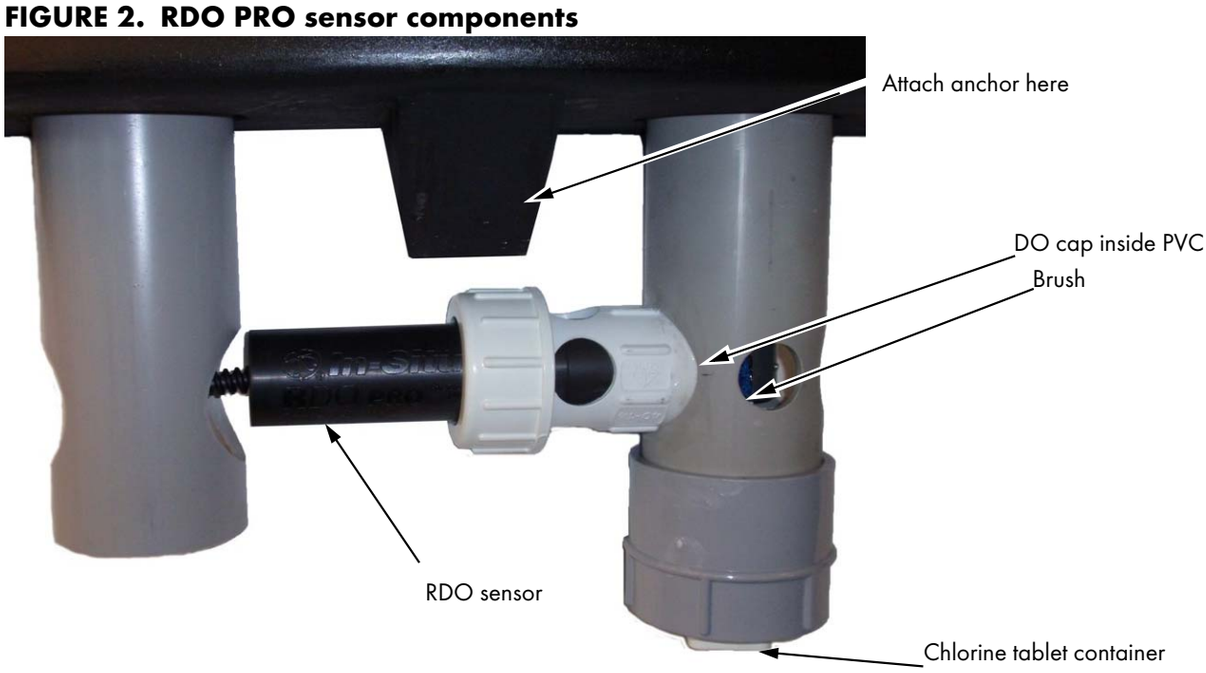
Chapter 3 Sensors

3.1 RDO® PRO DISSOLVED OXYGEN (DO) SENSOR

The RDO PRO DO sensor ships pre-installed on the buoy. The sensor is rugged, reliable, and designed to deliver accurate DO and temperature data across a wide measuring range while reducing maintenance costs. It features the latest optical technology for DO measurement. The main components of the sensor include:

- Black sensor body
- Removable nose cone
- Optical DO sensing cap
- Thermistor (for measuring temperature)

FIGURE 2. RDO PRO sensor components



3.1.1 RDO Sensor Cap Description and Installation

1. Loosen the white PVC fitting that holds the RDO sensor in place (Figure 3).
2. Slide the RDO sensor backward into the vertical PVC tube.
3. Remove the white PVC fitting that you loosened in step 1.
4. Pull the RDO sensor out so that you can access the nose cone.

FIGURE 3. Removing the RDO sensor from the buoy to attach the cap

Note: *Avoid allowing moisture, including atmospheric humidity, inside the cap. Keep the cap in its sealed packaging until you are ready to install it. Install promptly. Make sure that O-ring grooves are dry and the O-ring is not rolled or pinched inside the cap.*

5. Unscrew the nose cone from the sensor and remove the red protective dust cap from the sensor. Save the dust cap for use during storage, if applicable.
6. Remove the RDO sensor cap from its shipping/storage sleeve.
7. Align the arrow on the cap with the index mark on the sensor and firmly press the cap onto the sensor, without twisting, until it seals over the probe body.

FIGURE 4. Placing the cap on the sensor and replacing the nose cone

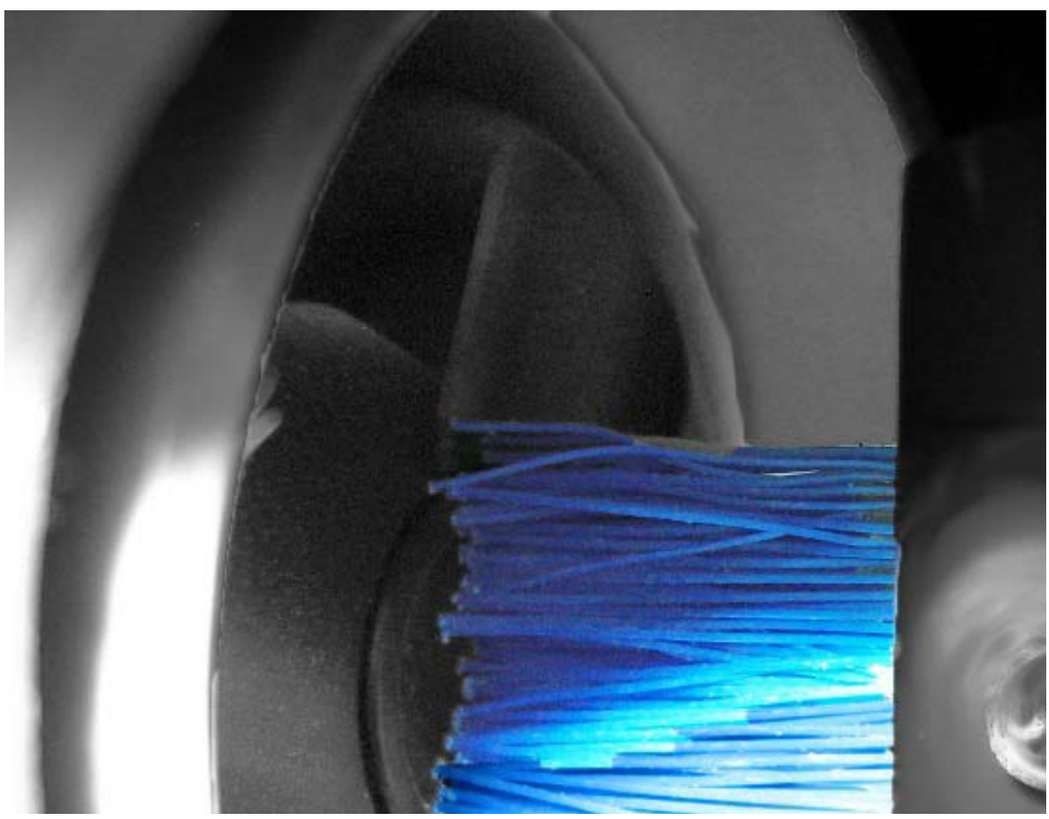
8. Reattach the nose cone.
9. Reattach the RDO sensor and white PVC fitting. Do not completely tighten the white fitting. You will need to adjust the sensor so that it touches the brush in the next section.

Note: *The cap's lifetime is 1 year after the first reading has been taken. Install by the date printed on the packaging.*

3.1.2 Adjusting the Wiper Brush

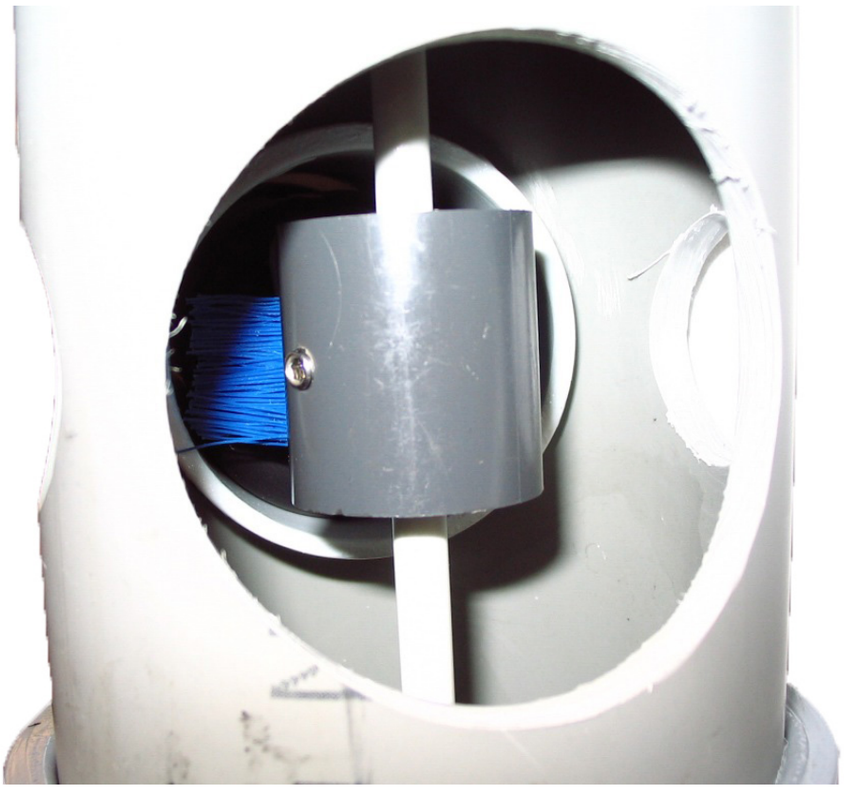
1. With the white PVC fitting slightly loose, move the RDO sensor toward or away from the brush. The brush should lightly sweep the sensor cap, but not brush too hard or miss the cap completely.

FIGURE 5. View of the brush and sensor cap



2. Tighten the white PVC fitting when the sensor is in the proper location.
3. If the brush is too high or too low, loosen the set screw on the brush mechanism and slide the brush up or down as needed. You may also rotate the brush while it is loose to check the position of the sensor. Tighten the set screw when you have completed the adjustment.

FIGURE 6. View of the brush and set screw



3.2 INSTALLING THE CLEANSING TABLET

1. Remove the cap from the bottom of the buoy motor tube.
2. Place a new chlorine/bromine tablet in the cap.
3. Replace the cap.

FIGURE 7. Installing a cleansing tablet

Chapter 4 Buoy Transceiver

4.1 OVERVIEW

The transceiver consists of:

- A microprocessor that is programmed to take sensor readings at given intervals
- A radio module that transmits the sensor readings to the host PC
- A desiccant pack (PN 0063100)

In between the readings, the radio module operates in sleep mode, enabling the buoy to operate with lower power consumption.

4.2 ADDRESSING

Each transceiver has a different address that identifies the buoy when communicating with the host PC.

If your transceiver arrives with a large number on the outside of the box, your buoy has already been addressed with the number on the transceiver. You will not need to change anything. If a buoy does not arrive pre-addressed or is moved to a different pond, the address will need to be updated.

4.2.1 Changing Buoy Addresses

Note: *If you change the buoy address after powering the system, you will need to disconnect and reconnect power for the address change to take effect.*

A switch module on the transceiver board sets the buoy address. The switch has the following characteristics:

- It is a binary switch
- The address is the sum of the values of the binary switches that are in the “on” position

To access the switch, use a screwdriver to remove the transceiver box lid.

FIGURE 8. Transceiver interior

1	Probe connection—red wire
2	Probe connection—green wire
3	Probe connection—blue wire
4	Probe connection—black wire
5	Probe ground—silver wire
6	Power 9–18 volts DC +
7	Power9–18 volts DC –
8	Radio module with integrated antenna
9	Transceiver addressing dip switches

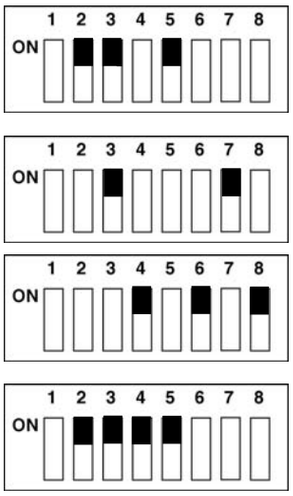
4.2.2 Addressing Explanation and Examples

Switches 1 through 7 have a binary value. These values are shown in the table below:

Switch	Value (if in the "ON" position)
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

By adding all the values of the switches that are in the "ON" position, you can determine the address.

FIGURE 9. Setting the buoy/transceiver address



Switch 2 value = 2
Switch 3 value = 4
Switch 5 value = 16

2 + 4 + 16 = 22

22 is the address

Switch 3 value = 4
Switch 7 value = 64

4 + 64 = 68

68 is the address

Switch 4 value = 8
Switch 6 value = 32
Switch 8 value = 128

8 + 32 + 128 = 168

168 is the address

Switch 2 value = 2
Switch 3 value = 4
Switch 4 value = 8
Switch 5 value = 16

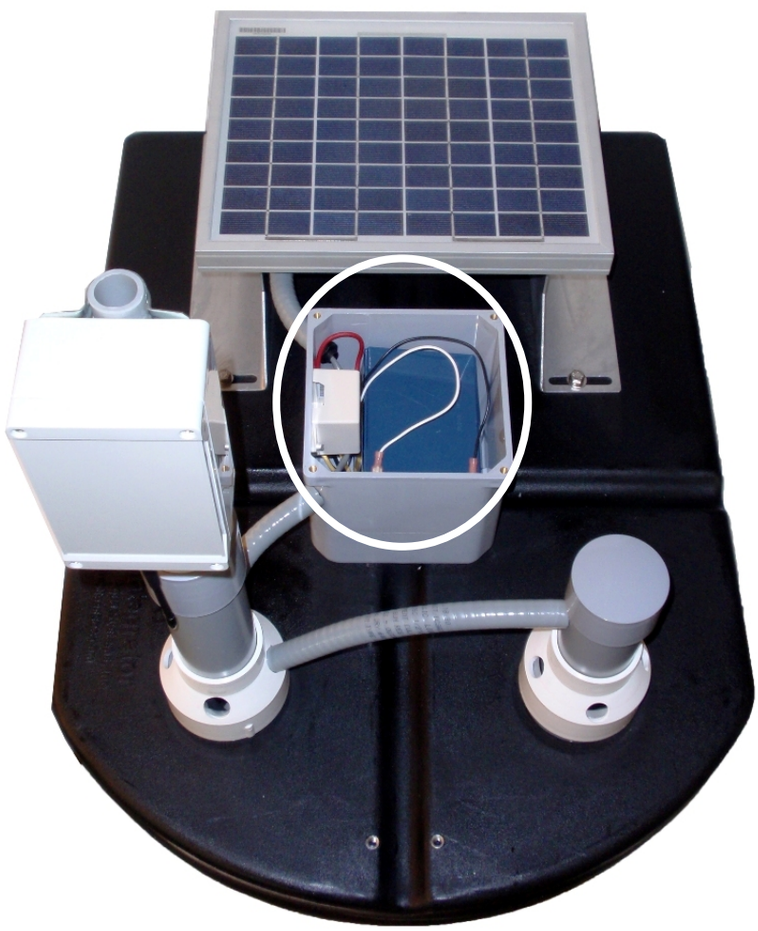
2 + 4 + 8 + 16 = 30

30 is the address

4.3 CONNECTING POWER TO THE TRANSCEIVER AND SENSOR

1. Use a screwdriver to remove the cover from the battery box.
2. Connect the black lead to the black terminal.
3. Connect the white or red lead to the red terminal. If the system is functioning properly, you will hear the brush motor power on for a few seconds.
4. Replace the battery box cover.

FIGURE 10. Connecting the battery terminals



4.4 RADIO DESCRIPTION

The buoy system uses a 900 MHz spread-spectrum radio manufactured by Digi® International Inc. The configuration of these radios is site-specific and usually involves setting the following parameters:

- Hopping Channel
- Destination Address
- Address Mask
- Module VID
- Sleep Mode

Refer to the Radio Replacement Instruction Sheet at www.in-situ.com for information on how to modify these parameters.

4.5 MAINTENANCE

Replace the desiccant pack within the box regularly to ensure continued functioning of the tranceiver and the RDO sensor.

Chapter 5 Host PC

5.1 OVERVIEW

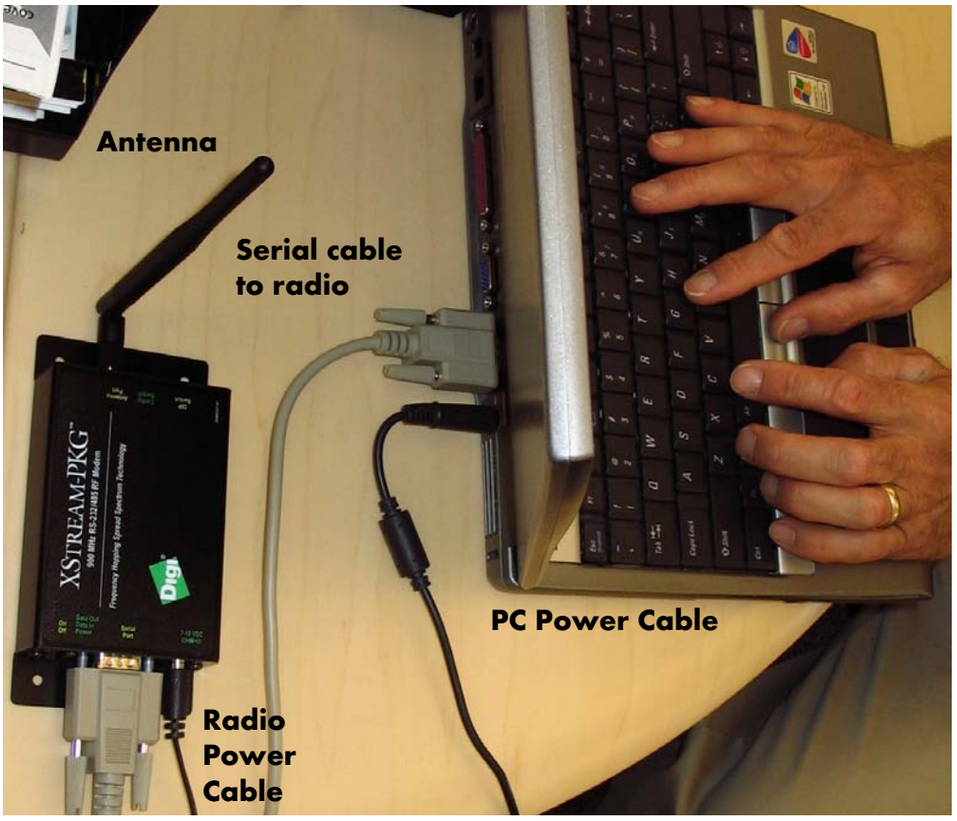
The host computer can be any Microsoft® Widows®-based PC operating with a Windows® 98 or later operating system. Additional PC requirements include:

- At least one serial communications port, or the serial adapter available from In-Situ.
- A radio modem connected to the serial port in order to communicate with the buoys and wireless controllers. (DigiKey® 9X Stream RS232 9.6 kbps, part number (1P) X09-009PKC-RA is recommended and is available from In-Situ Inc.)
- The data retrieval software runs on the host computer at all times. This software receives all transmissions and makes the appropriate control decisions. The software also archives the data, makes logs of all actions, sends alerts for critical situations, displays pond and farm status, and provides for review of historical data.

5.2 PC SETUP

1. Install the Integrator software from the flash drive provided.
2. Attach the antenna, power cord, and serial port to the radio.
3. Connect the radio to power.
4. Connect the serial cable from the radio to the PC.

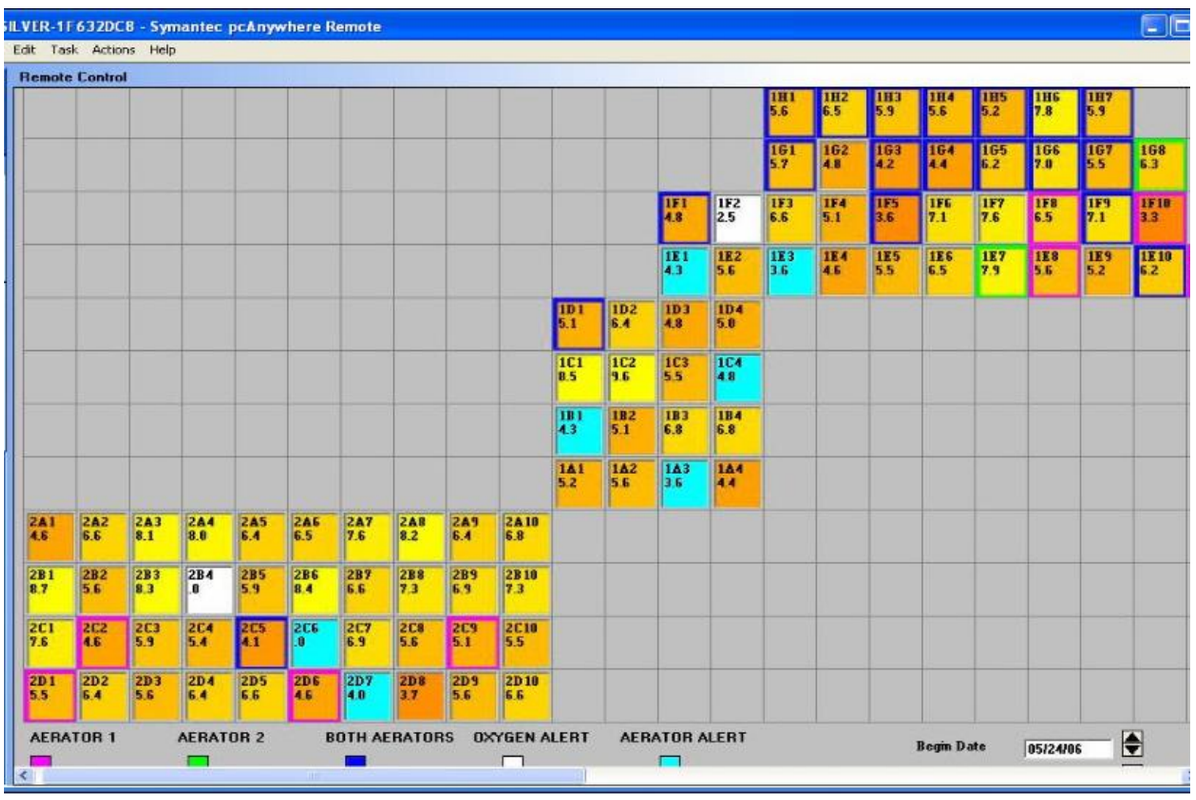
FIGURE 11. PC connections to host radio



5.3 FARM STATUS SCREEN—OVERVIEW OF TOTAL FARM STATUS

The Farm Status screen can quickly reveal problems with ponds and monitoring equipment. This real-time screen is updated every minute and displays a pond icon for each pond of the farm.

FIGURE 12. Farm Status screen



5.3.1 Pond Color—Oxygen Concentration Spectrum

The background color of each pond icon represents the oxygen level of the pond. The color varies from bright yellow, indicating a high oxygen concentration, to deep brownish red, indicating low oxygen concentration.

5.3.2 Pond Border Color—Aerator Status

The status of aerators is indicated by the border color of the pond icon.

- Aerator 1 Running - Pink
- Aerator 2 Running - Green
- Aerator 1 and 2 Running - Blue

The colors show which aerators are running.

5.3.3 Pond Color—Aerator Alert

An aerator alert is indicated by a change in the pond icon background color to aqua. This alert indicates that an aerator is NOT on, but should be.

5.3.4 Pond Color—Oxygen Alert

An oxygen alert is indicated by a change in the pond icon background color to white. It indicates that the oxygen is below a minimum level set by the user in the database.

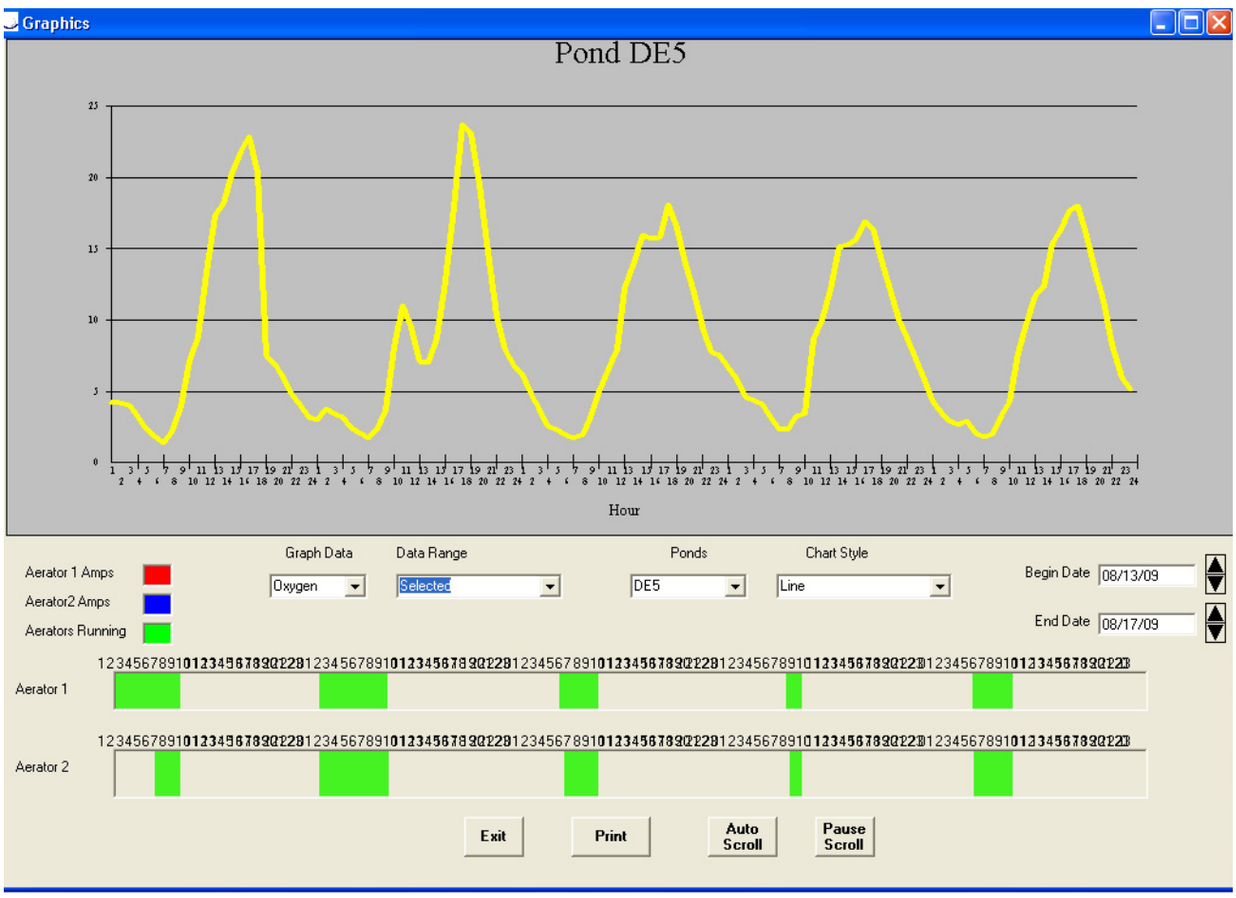
5.4 GRAPHICS VIEW

1. Click on a pond icon, and select Graphics and Aerator Report from the menu that appears.

A chart of oxygen readings and the aerator run-time graph for the same period will be created. This is useful for comparing oxygen levels with aerator run times. If the graph shows low oxygen for a time period and no aerator run time, the aerator should be inspected.

- Erratic readings may indicate that a sensor needs service
- Gaps in the chart indicate a possible communications problem
- Extreme swings in the chart indicate ponds that need extra attention

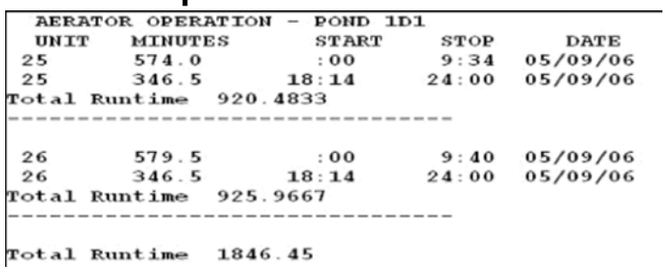
FIGURE 13. Graphical view of aerator operation and DO for one pond



5.5 AERATOR REPORT

The aerator report can be printed and compared to any logs maintained by the crews checking ponds. This report can also produce a report of the total aerator run time for any time period.

FIGURE 14. Example of an aerator report



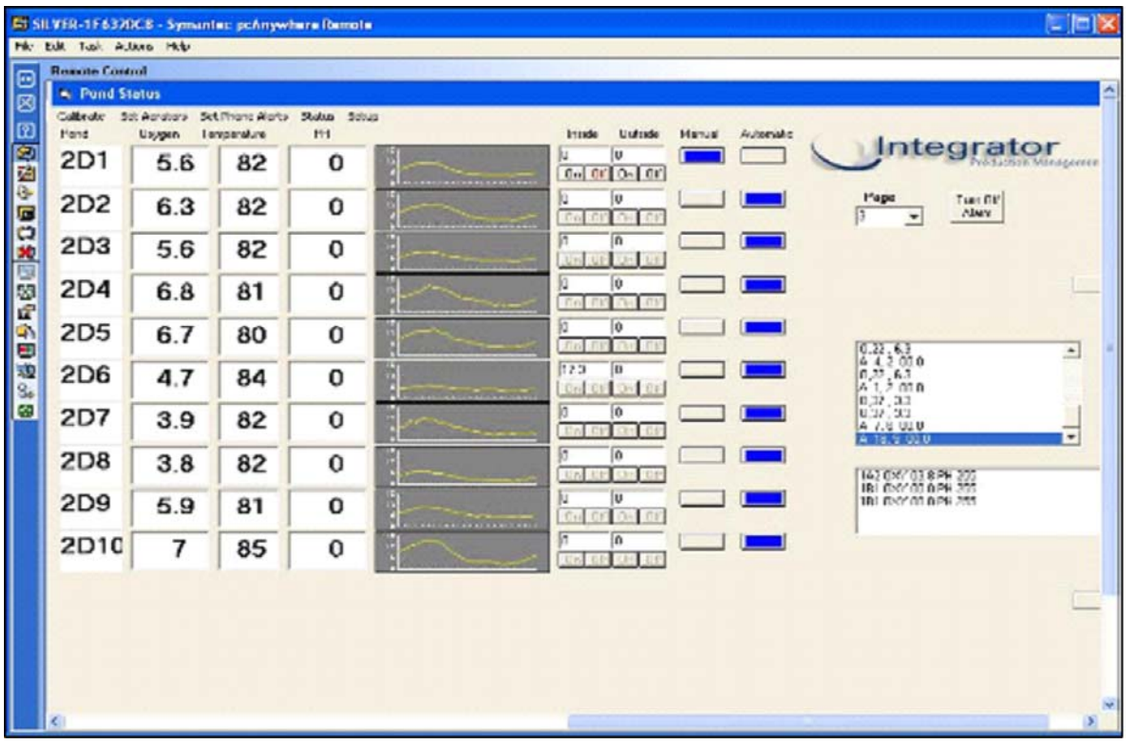
AERATOR OPERATION - POND 1D1

UNIT	MINUTES	START	STOP	DATE
25	574.0	:00	9:34	05/09/06
25	346.5	18:14	24:00	05/09/06
Total Runtime	920.4833			
26	579.5	:00	9:40	05/09/06
26	346.5	18:14	24:00	05/09/06
Total Runtime	925.9667			
Total Runtime	1846.45			

5.6 POND STATUS SCREEN—QUICK VIEW OF LAST 24 HOURS

The menu on the top of the Pond Status Screen offers the following choices: Calibrate, Set Aerators, Set Phone Alerts, Status, and Setup.

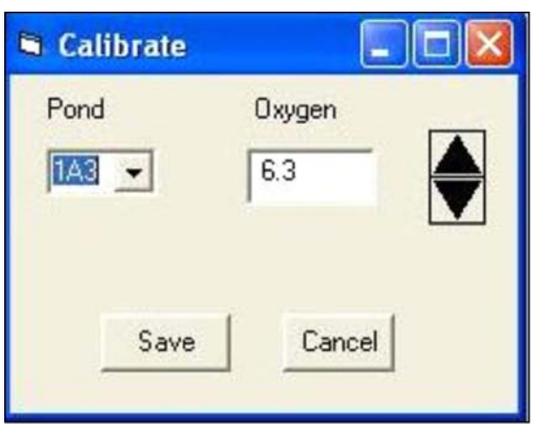
FIGURE 15. Example of pond status screen



5.6.1 Calibrate

1. On the main menu of the Pond Status screen, select Calibrate.
2. Select the pond to be calibrated.
3. Use the up and down spinners at the right to increase or decrease the oxygen reading until the desired level is set.
4. Click the Save button to complete the calibration.

FIGURE 16. Setting up a DO sensor calibration

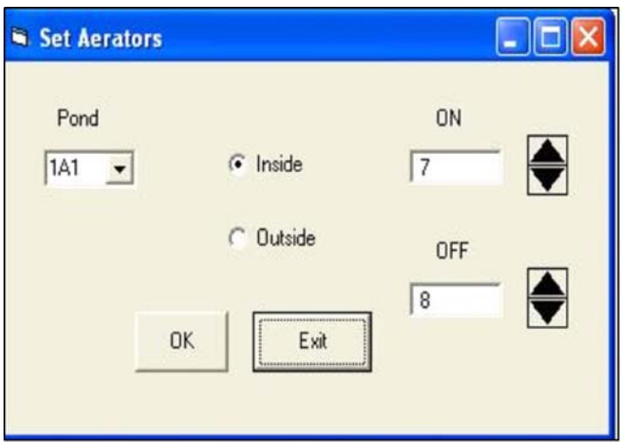


5.6.2 Set Aerators

The Set Aerators window controls the set points for turning the aerators on and off.

1. On the Main menu of the Pond Status screen, select Set Aerators.
2. Select the pond that needs the aerators set.

FIGURE 17. Setting the aerator on/off limits



3. There are two aerators indicated, Inside and Outside. Click one of these options.
4. The current On and Off limits will appear in the text boxes at the right. Use the spinners to change the levels and click OK to save them.
5. Repeat for the other aerator. The aerator will turn on if the oxygen level is below the “on” level. The aerator will turn off if the oxygen reading is above the “off” level.

Additional notes:

- The host computer prevents the system from turning off an aerator between 10PM and 6AM.
- The starting and ending times and the differential can be configured by the user by modifying the CatHostDir.txt file in the application folder.

Adjusting the aerator on/off set points by a user-selected increment. In addition to the on/off levels set above, you can also adjust these levels at certain times of the day. This feature allows for a downward adjustment of the on/off levels by a user-selected differential. This feature is normally used to turn off aerators earlier, but after sunrise when the oxygen levels are starting to increase. For example, the user may use an adjustment differential of 1 point to start at 8 am and end at 4 pm. If the normal “off” level is 6 mg/L, after 8 am, the “off” level is automatically reduced by 1 point to 5 mg/L. If the oxygen reading is greater than 5 mg/L, the aerator will turn off. This adjustment resulting in greater energy savings. Additionally, the “on” level is also adjusted downward by the same amount so the oxygen level will have to drop to a lower level before it turns the aerator on.

5.7 CONFIGURATION FILE

The system configuration file is a text file named CatHostDir.txt. It is located in the application folder and appears as the following:

```
\Data
Start-up Period(Hours),.25
Maximum Interval Between
Communications(Minutes),20
Minimum Time Between Alerts(Minutes), 2
Early Off Start Time,7
Early Off End Time,16
Early Off Diferential,.5
Comm Port,5
Comm Port2,0
```

- The first record is always \Data
- The **Start-up Period** is the amount of time after the program starts before any control action takes place. This time is necessary to allow all the buoys to transmit at least one reading to the host.
- **Maximum Interval Between Communications** is the maximum time allowed between receipts of readings from a buoy. If this time is exceeded, it is assumed that communications between the buoy and the host have failed. The current oxygen reading on the screen will be changed to a red zero to indicate this failure.
- **Minimum Time Between Alerts** is not used.
- **Early Off Start Time** is the hour after which the early off differential will be applied. A time of 7 will cause the differential to be applied after 8 am.
- **Early Off End Time** is the hour after which the differential will be removed.
- **Early Off Differential** is the adjustment amount for the early off feature. This is the amount that will be subtracted from the normal on/off levels between the Early Off Start Time and the Early Off End Time.
- **Comm Port** is the communications port number.
- **Comm Port2** is the communications port number if two ports are used. If only one port is used the value will be zero.

5.8 SET PHONE ALERTS

The Set Phone Alerts window is used to set all alerts.

1. On the main menu of the Pond Status screen, select Set Phone Alerts.
2. Select the pond to be set. The current minimum aerator amperage settings and minimum oxygen levels will appear. If an amperage reading or oxygen reading is returned that is below the minimum, an alert will appear on the Farm Status screen and a telephone alert will be sent.

FIGURE 18. Phone alert limits

The system will call any number set up in the MyPhoneNumbers.txt file in the applications folder. If a number is not answered, the next number in the list of numbers is called. The system continues to cycle through the list of numbers until someone answers.

When the call is answered, a voice message indicates the type of problem. The answerer must press a digit on the phone to signal to the computer that the message was received. Otherwise, the computer will continue to call.

Pressing the digit will cancel the alert for that particular device. No further alerts for that device will be generated until after the problem has been corrected. Alerts for other devices will still be sent.

Additionally, the alert can be turned off by clicking the Turn Off Alarm button on the Pond Status screen or by un-selecting the Active box on the Set Phone Alerts window.

5.9 STATUS

This menu item launches the Farm Status Screen.

5.10 SETUP

This menu item launches the Floor Plan screen that is used to lay out the farm.

5.11 READINGS THAT INDICATE PONDS WITH BUOY PROBLEMS

5.11.1 Black Zero Oxygen Reading

A black zero oxygen reading indicates an oxygen sensor problem. The sensor is not sending a signal to the microprocessor and needs to be serviced.

5.11.2 Red Zero Oxygen Reading

A red zero oxygen reading indicates that the buoy is not communicating with the host. The buoy power supply, microprocessor, and radio module should be checked.

Chapter 6 Care and Storage

6.1 CLEANING THE OUTSIDE OF THE ENCLOSURE

Wipe the enclosure as needed with a damp cloth. Do not use solvents.

6.2 STORAGE RECOMMENDATIONS

- If you remove the buoy from service seasonally, remove the battery from the buoy and store separately.
- If the sensor cap will expire before you redeploy the unit, discard the cap and place a red dust cap over the end of the sensor. If you do not have a dust cap, just keep the sensor cap on. Do not store the RDO sensor without adequate protection over the lens.
- When you redeploy the buoy in the spring, use a new sensor cap.
- Replace the desiccant regularly.

6.3 CLEANING SYSTEM MAINTENANCE

6.3.1 Maintaining the Rotating Brush

A rotating brush removes contaminants and biofouling from the sensors. Periodically check the brush for cleanliness and contact with the sensor cap. For optimum performance, the brush should lightly sweep the sensor cap. Adjust the contact by loosening the clamp that holds the probe, then move the probe toward or away from the brush. The brush itself may be raised or lowered by loosening the set screw in the brush itself. The brush may also be rotated 180° by removing it from the shaft and turning it over.

6.3.2 Maintaining the Cleaner Shaft

The cleaner shaft is connected to the motor shaft with a flexible coupler made of rubber hose that is secured with stainless hose clamps.

When replacing a cleaner shaft, ensure that the shaft extends through the bottom of the buoy, but above the chlorine tablet. Adjust the shaft length by varying the depth of the shaft in the flexible coupling. Also ensure that the coupler clamps do not hit the motor mounting screws.

6.3.3 Maintaining the Chlorine/Bromine Tablet Chamber

The cleaner assembly includes a chamber in the bottom of the down tube that holds a 3" chlorine or bromine tablet. These tablets will slowly dissolve to reduce algae and other organic growth on the probe. The tablets dissolve at varying rates depending on environmental

conditions. Replace as necessary. These tablets are available anywhere swimming pool supplies are sold.

6.3.4 Cleaning the Sensor Cap

If extensive fouling of the sensor occurs, remove the buoy from the pond and complete the following steps:

Note: *Do not use organic solvents—they will damage the sensor cap Do not remove the cap from the sensor prior to brushing.*

1. Leave the cap and nose cone on the sensor!
2. Rinse the sensor with clean water from a squirt bottle or spray bottle.
3. Gently wipe with a soft-bristled brush or soft cloth if biofouling is present. Use Alconox® to remove grease.
4. If extensive fouling or mineral build-up is present, soak the cap end in vinegar for 15 min., then soak in deionized water for 15 min.
5. After cleaning the sensor, perform a 1- or 2-point user calibration or calibration check.

6.3.5 Cleaning the Sensor Body

With the sensor cap installed on sensor, gently scrub sensor body with a soft-bristled brush or nylon dish scrubber. Use Alconox to remove grease or other matter. Soak in vinegar and deionized (DI) water to remove mineral deposits or extensive fouling as described above.

6.3.6 Replacing the Sensor Cap

The sensor cap has a 1-year life after the sensor takes its first reading. Replacement caps are available from In-Situ Inc. or your authorized In-Situ distributor.

1. Remove the sensor nose cone.
2. Pull the used sensor cap off of the sensor, without twisting.
3. Remove the existing O-rings from the sensor.
4. Use a lint-free cloth to remove any moisture from the sensor body. Ensure that there is no moisture in the O-ring grooves. Avoid touching or cleaning the lens with anything other than the supplied lens wipe.
5. Use your finger to apply a very thin layer of lubricant around the O-ring grooves.

Note: *Do not transfer grease to the lens or sensor pins.*

6. Place the O-rings on the sensor. Apply another thin layer of lubricant to the O-rings and grooves.
7. Clean the lens on the sensor with the wipe provided in the kit and allow to dry thoroughly. Inspect for scratches or dirt.
8. Remove the new cap from its sealed packaging and attach it to the sensor, being careful to press firmly, without twisting, until it seals over the probe body. Make sure that the O-rings are not pinched or rolled between the cap and sensor.

6.4 USER-SERVICEABLE PARTS

This device contains no user-serviceable electronic parts. For information regarding service or returns, contact:

In-Situ Customer Service Technicians

- U.S. and Canada at 1-800-446-7488
- Internationally at 1-970-498-1500

By mail:

In-Situ Inc.
Attn: Customer Service Department
221 E. Lincoln Ave.
Fort Collins, CO 80524
U.S.A.

Chapter 7 Troubleshooting

7.1 TROUBLESHOOTING THE BUOY

The buoy operates in extremely harsh environments. If you suspect that something has malfunctioned in the buoy, pull the buoy from the pond and visually inspect the following:

- The probe and brush—Make sure that there is no biofouling, feed, or mud interfering with the operation of these parts.
- The brush motor—Make sure that the brush did not become tangled in algae or other material and burn out the motor.
- The chlorine tablet—Replace as needed.
- The brush shaft—Make sure that the shaft is not damaged.

7.2 CHECKING THE POWER

The system will not work if the solar-powered battery charge falls below 7 volts. Check the voltage on the following items to make sure that they are operational:

- Solar panel
- Voltage regulator
- Battery

Also, check all wiring connections to make sure they are secure.

7.3 CHECKING THE COMMUNICATION

A red zero oxygen reading on the computer screen indicates a lack of communication between the buoy and the host PC. Check the power as described in the previous section.

Check that the radio module is seated firmly in place and that the antenna is properly connected. You may replace the antenna, if desired. Test the radio by swapping it out with a radio from another buoy that is working properly.

If the power is connected, inspect the transmitter housing that holds the oxygen control board and test for power.

1. Remove the housing cover.
2. Check the power input terminal in the bottom right corner. You should measure 11 to 14 volts DC at this connector.
3. If voltage is low, charge or replace the battery. Check the solar panel and charge controller for damage.

Chapter 8 Specifications

8.1 BUOY SPECIFICATIONS

Operating temperature	-25° to 60° C (-13° to 140° F)
Storage temperature	-10° to 60° C (14° to 140° F)
Dimensions (W x H x D)	24 x 36 x 32 in (61 x 91.4 x 81.3 cm)
Weight	40 lbs (18 kg)
Buoy materials	Polyethylene float
Radio type	Frequency hopping; 100 mW
Transmitter	900 mHz spread spectrum; 9600 baud; 7 mi (11.3 km) maximum range, line-of-sight (Achievable range is dependent on site characteristics.)
Solar panel	10 W
Battery	12 V, 12 Ah, SLA
Brush motor	12 VDC
Brush enclosure	PVC
Warranty	1 year from date of manufacture

8.2 RDO® PRO OPTICAL DISSOLVED OXYGEN SENSOR SPECIFICATIONS

Sensor type	Optical luminescent dissolved oxygen sensor
Transmitter/local display	Optional, not required
Range	0 to 20 mg/L concentration
	0 to 200% saturation
Accuracy (DO)	±0.1 mg/L, 0 to 8 mg/L
	±0.2 mg/L, 8 to 20 mg/L
Response time, cap	T90: 30 sec T95: 37 sec @ 25°C
Resolution	0.01 mg/L
Usage life of cap	1 year from the first instrument reading
Shelf life of cap	24 months from date of manufacture (install w/in 12 mo. of manufacture)
Operating temperature	0° to 50° (32° to 122°F)
IP rating	IP-67 with cap off, IP-68 with cap installed
Compliance	Heavy industrial, IEC 61000-6-2:2005
Storage conditions, cap	1° to 60° (33° to 140°F), in factory container
Storage conditions, sensor	-5° to 60° (23° to 140°F)
Salinity range	0 to 42 PSU, fixed or real-time capable
pH range	2-10 pH
Barometric range	507-1115 mbar, fixed or real-time capable
Maximum power consumption	50 mA at 12 VDC
Warranty, probe	3 years from date of shipment
Warranty, sensor cap	Shelf life: 24 months from date of manufacture (install within 12 months of manufacture) Usage life: 1 year from first instrument reading