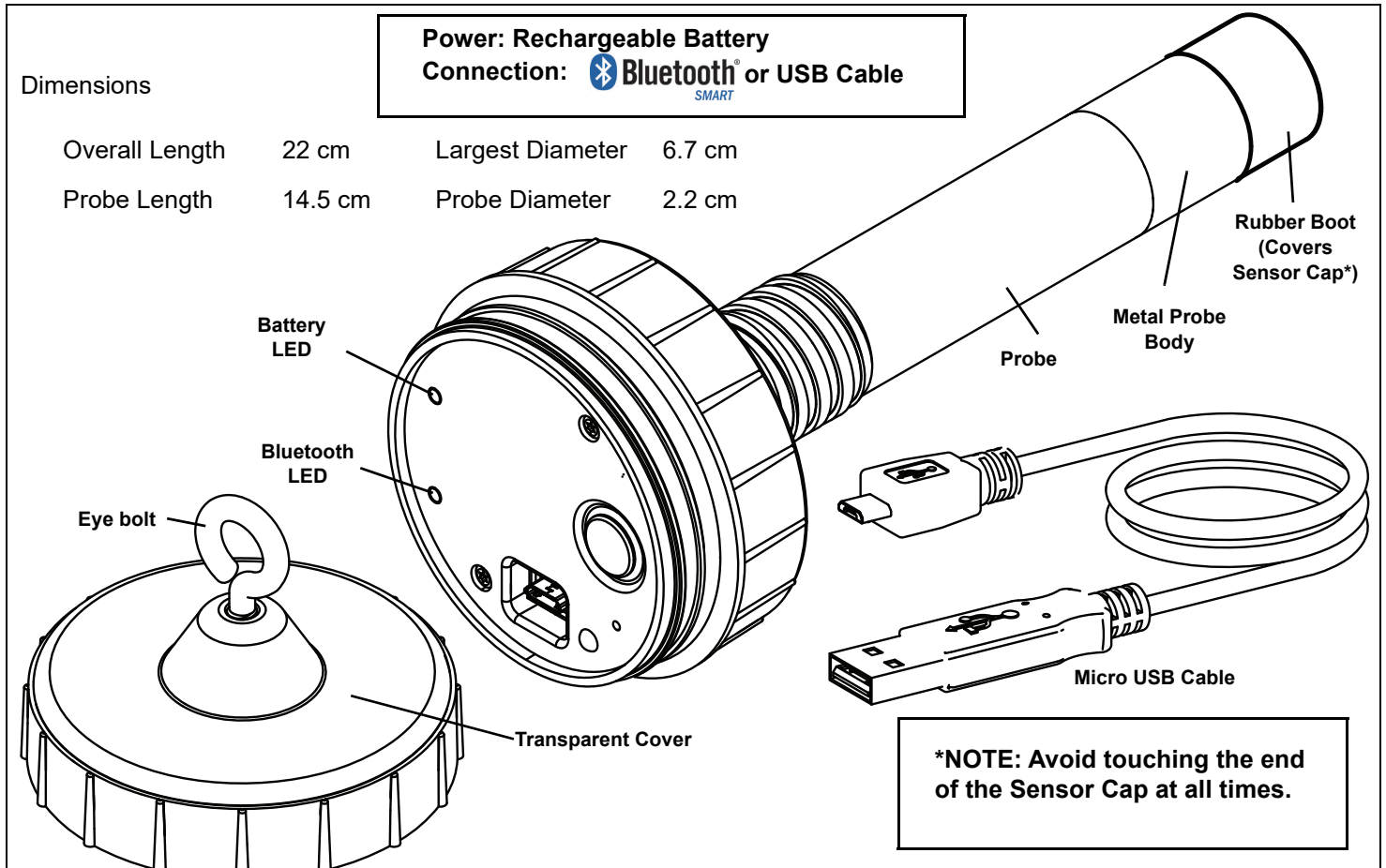


## Wireless Optical Dissolved Oxygen Sensor PS-3224



Equipment Included	
Wireless Optical Dissolved Oxygen Sensor	Micro USB Cable (1 meter)
<b>Recommended Equipment</b>	Optical Dissolved Oxygen Metal Guard (PS-3605)

Required Item*	Part Number*
PASCO Data Collection Software	see <a href="http://www.pasco.com">www.pasco.com</a>

\*See the PASCO catalog or the PASCO web site for more information.

[www.pasco.com](http://www.pasco.com)

## Introduction

The PASCO Wireless Optical Dissolved Oxygen Sensor is a versatile measuring device that can connect to a computer wirelessly through Bluetooth (BLE) or physically through a USB port. It includes a rechargeable battery and a Micro USB Cable. The sensor measures the concentration and the saturation percentage of dissolved oxygen molecules ( $O_2$ ) in aqueous solutions. The sensor also simultaneously measures temperature and barometric pressure. The sensor is particularly useful in applications related to ecological studies of aquatic environments. In the laboratory, students can explore the effects of temperature, water movements, inorganic chemicals, organic matter, and living organisms affect on levels of dissolved oxygen. In the field, students can monitor dissolved oxygen as a part of ecological surveys of aqueous habitats, including Biological Oxygen Demand (BOD) studies.

Note: The sensing element in the end of the probe can be replaced with the PS-3604 Optical Dissolved Oxygen Probe Sensor Cap described at the end of the manual.

SPARKvue allows the sensor to work with a mobile device such as a tablet or smart-phone when the sensor is connected. PASCO Capstone will work on a PC or Mac.

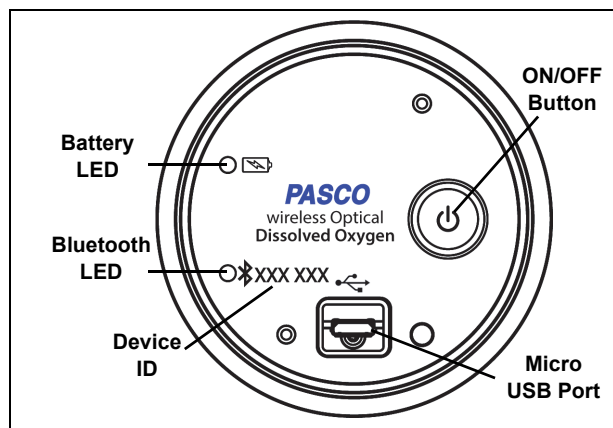
The Optical Dissolved Oxygen Sensor has several advantages when compared to a galvanic (electrochemical) dissolved oxygen sensor including the following:

- No warm up time
- No calibration required
- No filling solution or electrode polishing
- No flow dependency
- built-in temperature and barometric pressure compensation\*

\* Barometric pressure is recorded and stored only when the sensor is initially connected via Bluetooth or USB.

### Initial Step: Charge the Battery

- **Connect the Cable:** Remove the transparent cover from the sensor. Use the included Micro USB Cable to connect the micro USB port on the top of the sensor to a USB **port** or USB **charger** such as the PASCO PS-2575 USB Single Port Charger. Charging begins automatically. The charger circuit inside the sensor turns itself off when the unit is fully charged. The battery status LED will shine yellow as the battery is charging, and will shine green when the battery is charged. The battery is partially charged at the factory. Initial charging time may be three hours or longer depending on the power source and the condition of the battery.

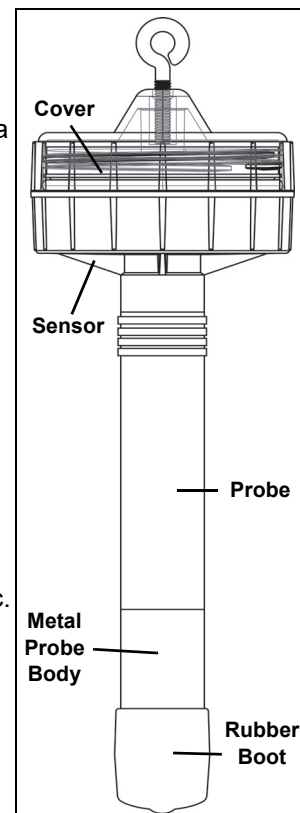


### Using the Sensor

The sensor is designed to work with PASCO data collection software to measure the concentration and saturation percentage of dissolved oxygen.

### ON/OFF Information

To turn the sensor on, remove the clear cover and then press the ON button. The status LEDs will blink. To turn the sensor off, press and **hold** the ON button for a moment until the status LEDs stop blinking. The sensor puts itself to sleep after one hour of inactivity if connected, and after several minutes if not connected.



## Data Collection Software

### PASCO Capstone



- Mac OS X
- Windows

### SPARKvue

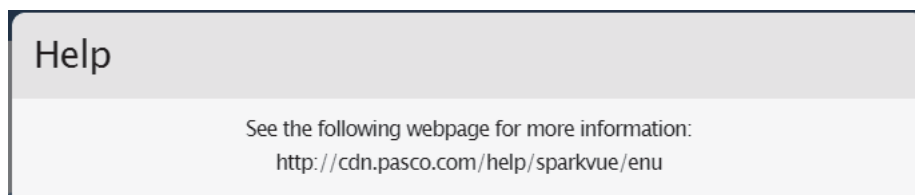


- Mac OS X
- Windows
- iOS
- Android
- Chromebook

See the PASCO web site at [www.pasco.com/software](http://www.pasco.com/software) for help in selecting the right PASCO software and to check for the latest versions.

## Software Help

- In SPARKvue, open the Main Menu and select “Help” for information about collecting, displaying, and analyzing data.
- In the window that opens is the address of the web page for **Help**. Copy and paste the address into a web browser program to open the SPARKvue User’s Guide web page.





SPARKvue “Help” Window


- SPARKvue User’s Guide web page

## SPARKvue User’s Guide

Version: 2.5

Q

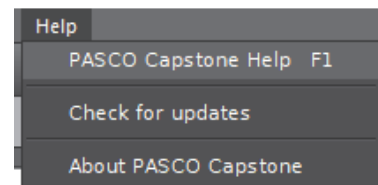




**Bluetooth**  
SMART

Featuring new wireless lab activities: See the “NEW” SPARKlabs in [Experiments](#).

For information on the new PASCO wireless devices, see: [www.pasco.com/wireless](http://www.pasco.com/wireless).

- In PASCO Capstone, select **PASCO Capstone Help** from the **Help** menu, or press **F1**.



## LED Information

The Bluetooth and the Battery Status LEDs operate as follows:

### For a wireless Bluetooth connection:

Bluetooth LED	Status
Red blink	Ready to pair
Green blink	Connected
Yellow blink	Logging*

Battery LED	Status
Red blink	Low power

### For a micro USB cable connection to a USB port:

Bluetooth LED	Status
OFF	--
OFF	--
Yellow blink	Logging*

Battery LED	Status
Yellow ON	Charging
Green ON	Charged

### For a micro USB cable connection to a USB charger:

Bluetooth LED	Status
Red blink	Ready to pair
Green blink	Connected
Yellow blink	Logging*

Battery LED	Status
Yellow ON	Charging
Green ON	Charged

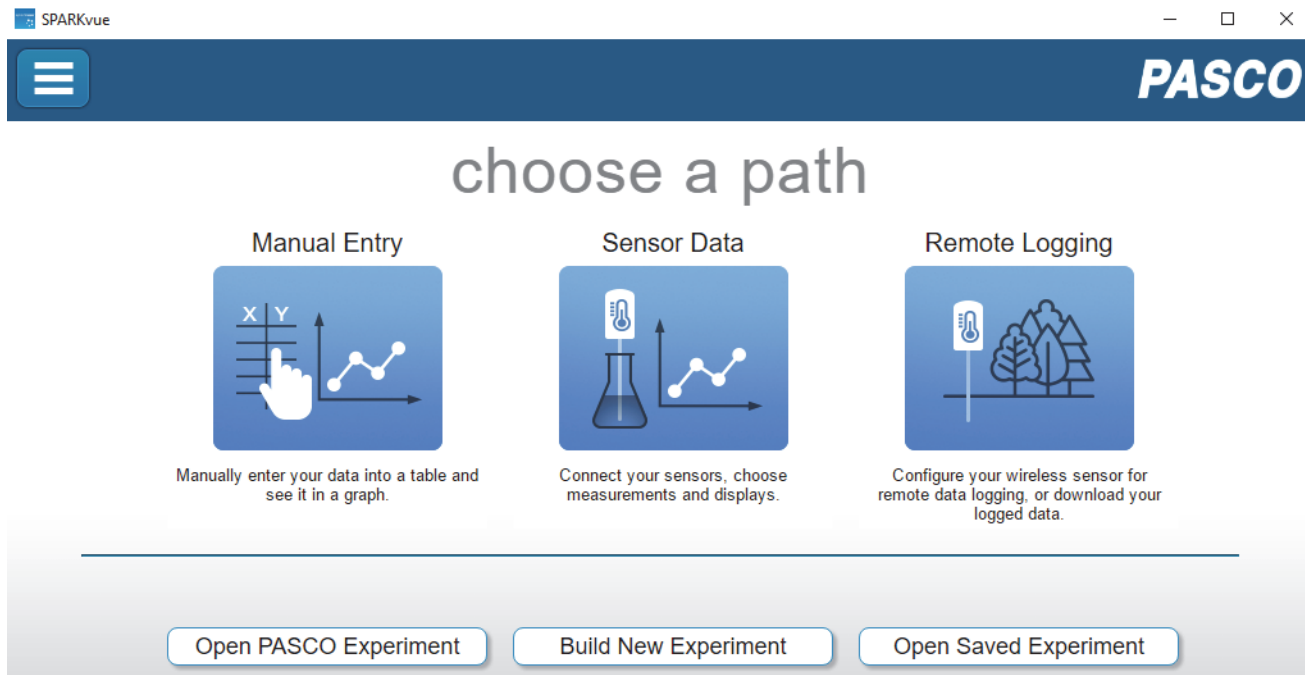
\***Logging**: PASCO wireless sensors can either stream live data to a compatible device or log data (save it to the sensor's memory). The data can then be uploaded to the device for display and analysis at a later time. Logging capability supports long-term or remote data collection while not connected to the device.

Note: The latest versions of SPARKvue and PASCO Capstone support logging. Check the PASCO Web page at [www.pasco.com/software](http://www.pasco.com/software) for the latest software version.

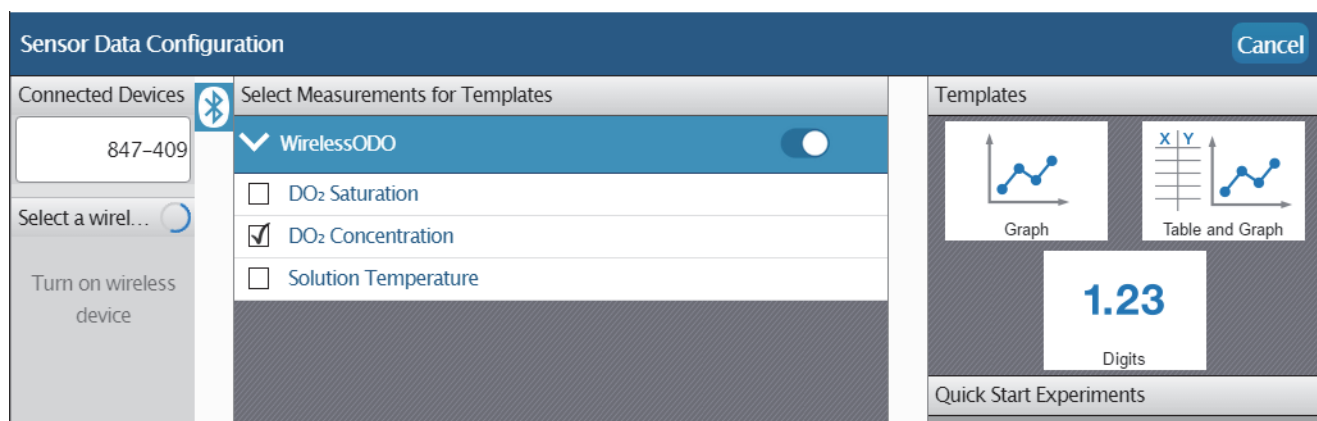
# Set Up the Software

## SPARKvue Set Up

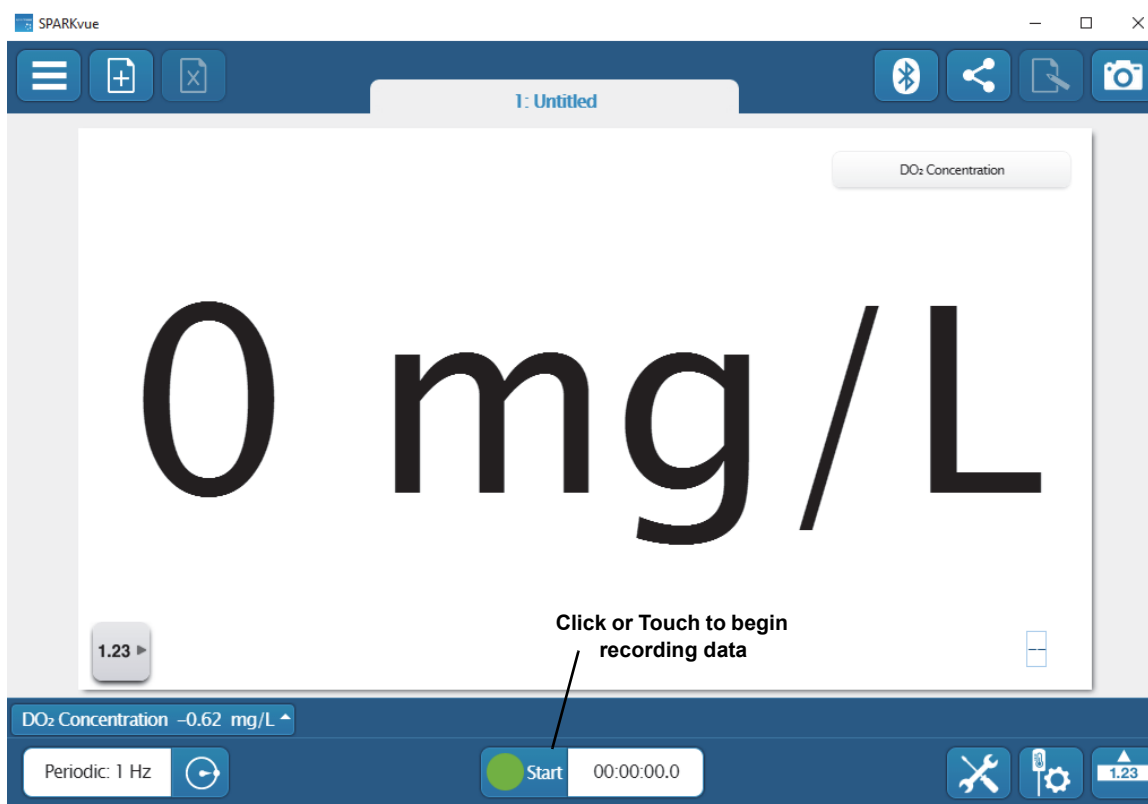
### Connecting the Sensor to a Tablet or a Computer via Bluetooth



- Start SPARKvue. In the Welcome Page, select the “Sensor Data” icon to open the Sensor **Data Configuration window**.
- In the **Sensor Data Configuration** window, look in the “Connected Devices” list. Select the correct address that matches the Device ID XXX-XXX number found on the sensor. Select a measurement and then select one of the “Quick Start Experiments” Templates.
- **SPARKvue Sensor Data Configuration Window:**



- In the selected Template, click or touch “Start” to begin recording data.

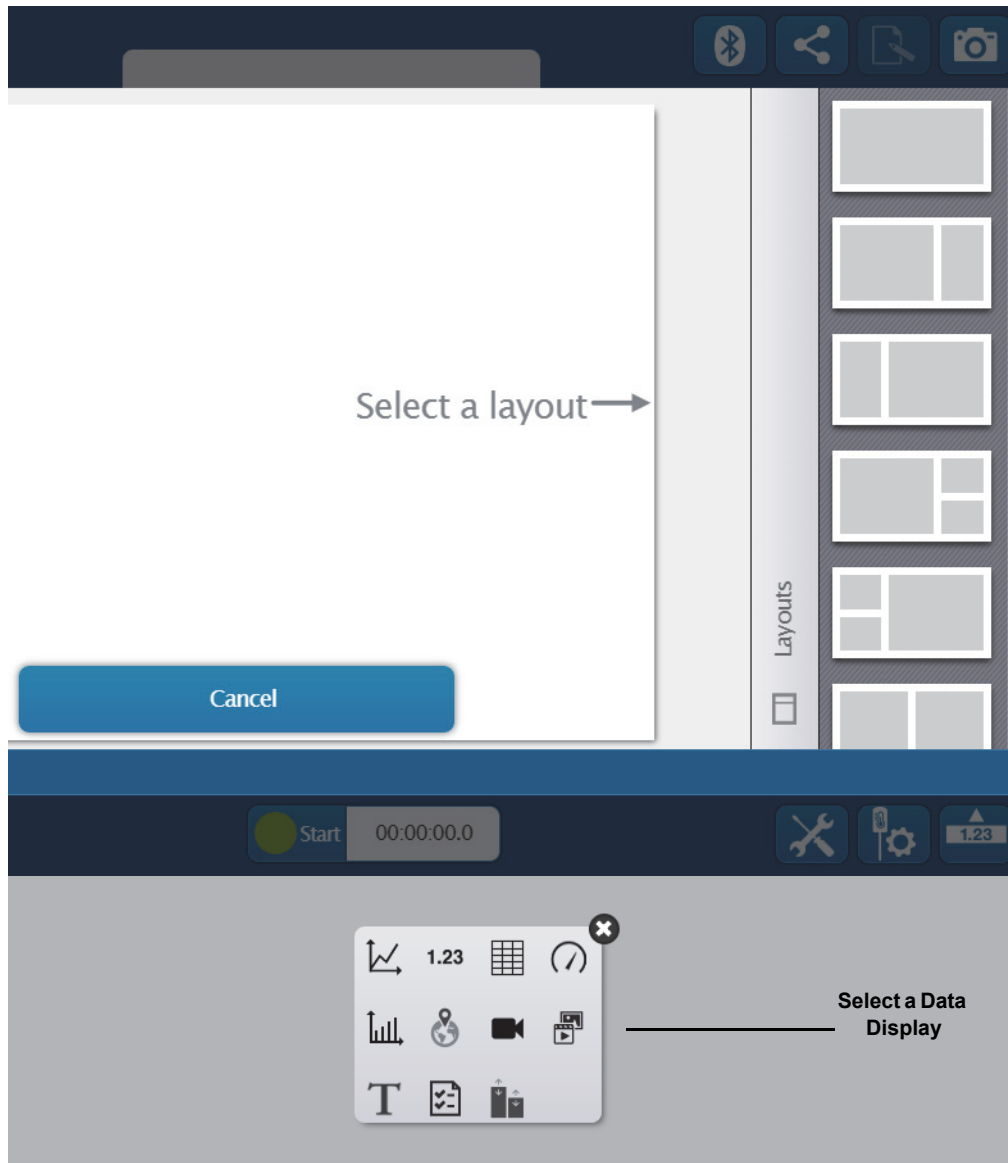


### Connecting the Sensor to a Computer with the Micro USB Cable

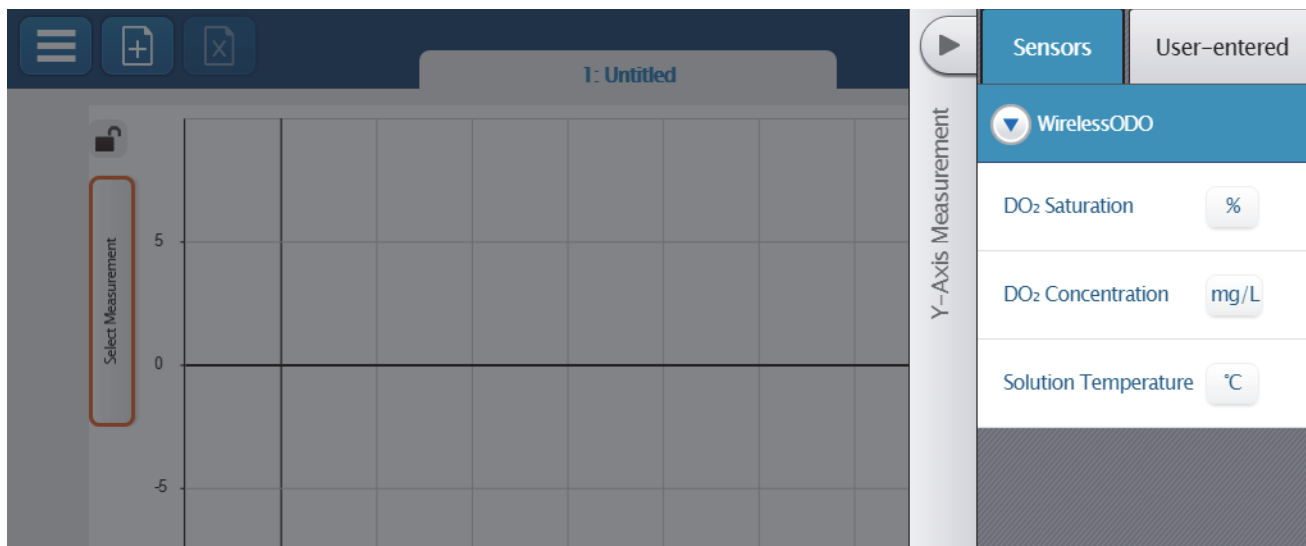
- Connect the micro end of the included Micro USB Cable into the micro USB port on the top of the sensor. Connect the other end of the Micro USB Cable to a USB port on the computer, or into a powered USB hub connected to the computer.
- In the **SPARKvue** Welcome Screen, select “Build New Experiment”.



- Select a Layout, and then select a data display.



- In the Data Display, Click "Select Measurement". Select a measurement from the list under "Sensors".



### SPARKvue Collecting Data

- In SPARKvue, select the Start button to begin collecting data.

### PASCO Capstone Set Up

#### Connecting the Sensor to a computing device (such as a computer) via Bluetooth

- For PASCO Capstone, select **Hardware Setup** in the Tools palette. In **Hardware Setup** the sensors are listed in order by proximity to the device. Select the address that matches the Device ID XXX-XXX number on the sensor.

Select a display in the main window or from the **Display** palette. In the display, use the **<Select Measurement>** menu to pick a measurement to be shown.

#### Connecting the Sensor to a Computer with the Micro USB Cable

- Connect the micro end of the included Micro USB Cable into the micro USB port on the end of the sensor. Connect the other end of the Micro USB Cable to a USB port on the computer, or into a powered USB hub connected to the computer.
- In PASCO Capstone, select a display in the main window or from the **Displays** palette. In the display, use the **<Select Measurement>** menus to pick the measurement to be shown.

### PASCO Capstone Collecting Data

- In Capstone, select **Record** to begin recording data.

## Troubleshooting the Sensor

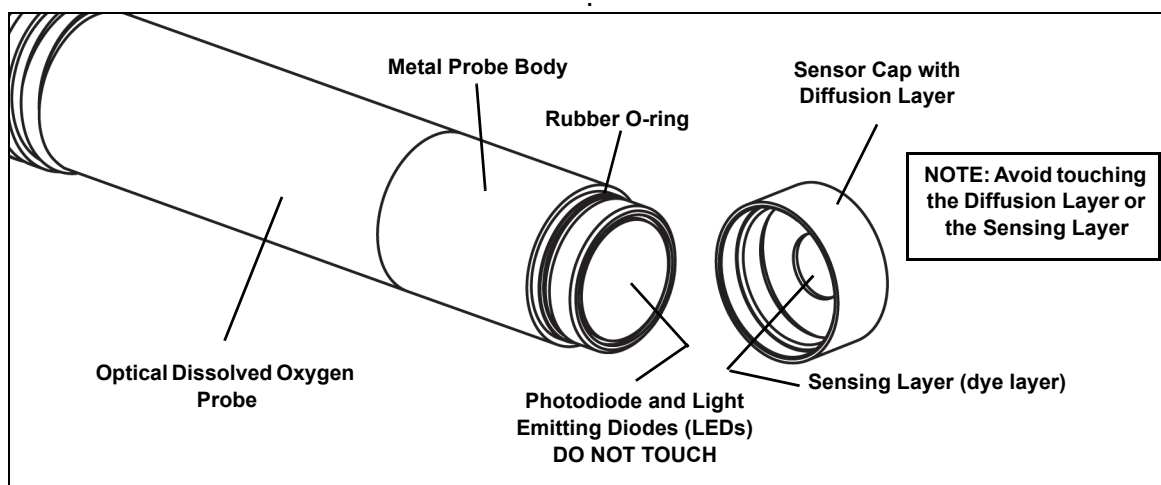
- If the sensor loses Bluetooth connection and will not reconnect, try cycling the ON button. Press and briefly **hold** the button until the status LEDs blink in sequence, and then release the button. Start the sensor in the usual way.
- If the sensor stops communicating with the computer software or tablet application, try restarting the software or application. If the problem remains, press and **hold** the ON button on the sensor for 10 seconds and then release. Start the sensor in the usual way.
- Turn Bluetooth off and then back on. Retry.

## Theory of Sensor Operation

Optical measurement methods that detect dissolved oxygen are based on the principle that dissolved oxygen quenches both the lifetime and the intensity of the luminescence associated with certain chemical dyes. When there is no dissolved oxygen present, the lifetime and intensity of the luminescence are at their maximum. The luminescence of the dye and the amount of oxygen present have an approximately inverse proportionality.

The sensing element of the Optical Dissolved Oxygen Probe is inside the Sensor Cap. The sensing element has two layers, The outer layer is a paint that acts as an oxygen permeable diffusion layer which allows oxygen molecules to pass through while protecting the dye layer. The inner sensing layer is an immobilized polystyrene dye layer that luminesces when excited with light of the correct wavelength. The probe measures dissolved oxygen by emitting a blue light of the proper wavelength that causes the dye in the sensing layer to luminesce (glow) a red color. Oxygen dissolved in the sample being tested continually passes through the diffusion layer to the dye layer, affecting the luminescence lifetime and intensity of the dye. The sensor measures the lifetime of the luminescence as it is affected by the oxygen with a photodiode and compares the reading to a reference.





The reference is a beam of red light emitted by a LED in the probe that reflects from the dye layer back to the photodiode. The lifetime of the luminescence from excitation by the blue light is compared to that of the reference value (red light) and a dissolved oxygen concentration is calculated by the sensor.

Optical and electrochemical dissolved oxygen probes determine the partial pressure of oxygen dissolved in the sample being tested. The dissolved oxygen partial pressure is converted to concentration (mg/l) or saturation percentage. The conversion from dissolved oxygen pressure to saturation percentage is done by dividing the reading by 160, the pressure of oxygen in air at 760 millimeters (mm) of mercury (Hg) and then multiplying by 100%. For example, a measured dissolved oxygen pressure reading of 150 mm Hg would be converted to 93.8% saturation ( $150/160 \times 100\%$ ).

See the PASCO web site at [www.pasco.com](http://www.pasco.com) for more information.

## Factors that Affect Dissolved Oxygen Measurement

Factors that affect dissolved oxygen measurement include temperature, barometric pressure, and salinity.

**Temperature:** The rate of diffusion of oxygen through the Sensor Cap changes with temperature (approximately 1.5% per degree celsius). The Optical Dissolved Oxygen Probe has a built-in thermistor, and the temperature changes are compensated for by proprietary algorithms that use readings from the thermistor.

**Barometric Pressure:** The partial pressure of oxygen in a sample of air or water is not affected by barometric pressure, but dissolved oxygen concentration in milligrams per liter is affected. The Optical Dissolved Oxygen Probe has a built-in barometer sensor, and the reading from that device is used to determine the oxygen pressure during calibration.

**Salinity:** As the salinity of water increases, its ability to dissolve oxygen decreases. (Note: The user will be able to enter a value for the "salinity constant" in the data acquisition software.) For precise measurement of salinity, the PS-2195 Salinity Sensor is recommended (see the web site at [www.pasco.com](http://www.pasco.com)).

Water Type	Average Salinity
Fresh water	<0.5 ppt*
Brackish water	0.5 to 30 ppt
Sea water	33 to 47 ppt
Saline water	30 to 50 ppt
Brine	>50 ppt

\*Salinity is a unitless measurement determined from conductivity and temperature readings according to the Practical Salinity Scale. Historically, salinity values determined with the Practical Salinity Scale were given the designation “ppt” because these values were very close to those determined by the previously used method where the mass of dissolved salts in a given mass of water (parts per thousand) were reported.

## Probe Care and Maintenance

The sensing layer inside the Sensor Cap degrades over time due to bleaching caused by exposure to light, so the Sensor Cap must be replaced periodically. It should also be replaced if it is cracked, scratched, or damaged. The Sensor Cap is warranted for one year and may last much longer. The working life of a Sensor Cap may be extended by keeping it clean and properly stored between uses. The replacement Probe Sensor Cap for the Wireless Optical Dissolved Oxygen Sensor is model number PS-3604 (see [www.pasco.com](http://www.pasco.com) for more information).

**NOTE: Do not remove the Sensor Cap except to replace it with a new cap.**

To clean the Sensor Cap, rinse it with clean water and dry it with a lint free cloth. If necessary, use a mild detergent. Do not use alcohols or other organic solvents that may deteriorate the oxygen permeable diffusion layer and the sensing layer (dye layer). When changing the Sensor Cap, rinse the clear front surface of the nose-piece of the probe with clean water and then dry the surface with a lint free cloth or lens tissue.

## Optical Dissolved Oxygen Probe Attacking Liquids

Alcohols will remove the paint layer of the Sensor Cap. The following will remove the paint and dye layers of the Sensor Cap and will attack the probe housing as well:

Toluene	Benzene	Carbon tetrachloride	Chloroform
Methylene chloride	Acetone	Methyl ethyl ketone	Organic solvents

## Storage

The Optical Dissolved Oxygen Probe should not be allowed to dry out. For storage, keep the Sensor Cap installed on the probe. Moisten the small disk-shaped sponge that is in the end of the Rubber Boot (Sensor Cap Cover) with distilled water, and place the end of the probe in the Rubber Boot so that the Sensor Cap is next to the moist sponge.

Do not store the probe directly in water since that would encourage algae growth on the probe.

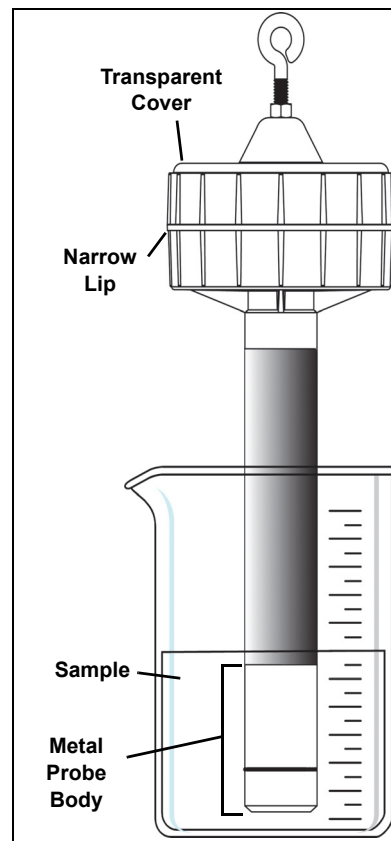
## Experiments

These are some of the experiments that can be done using the Optical Dissolved Oxygen Sensor.

- Photosynthesis, Respiration and Fermentation labs
- Monitoring Water Quality
- Measuring Net Primary Productivity
- Modeling Ecosystems
- Biochemical Oxygen Demand

## Using the Wireless Optical Dissolved Oxygen Sensor

Typically, the probe of the Wireless Optical Dissolved Oxygen Sensor would sit in a beaker of the liquid sample that is being measured. Make sure that the Metal Probe Body is fully immersed in the sample. Alternately, the sensor could be held by a clamp so that the Metal Probe Body is fully immersed in the container with the liquid sample. In addition, the sensor is designed to be submerged for such uses as monitoring water quality in a pond or stream. Turn the sensor on and pair it with the computing device. Set the sensor so that it will record in logging mode. (The sensor will not connect wirelessly when submerged.) To protect the sensor from the liquid sample, screw the transparent cover firmly onto the top of the sensor. Make sure that the bottom edge of the transparent cover touches the narrow lip. Remove but do not discard the Rubber Boot before making a measurement. The sensor is not buoyant so it will sink if dropped into the liquid sample. Therefore, attach a cable or cord to the eyebolt at the top of the transparent cover before submerging the sensor. Be careful to hold the cable or cord securely so that the sensor can be retrieved.



## Using the Wireless Optical Dissolved Oxygen Sensor in Air

The Wireless Optical Dissolved Oxygen Sensor probe was specifically designed to be used in water. However, reasonably good qualitative results may be obtained in air.

The optical dissolved oxygen probes are generally calibrated in 100% air-saturated water or in 'wet' air that is in a 100% relative humidity environment. In either case, the oxygen contribution to the partial pressure of the gas in 'wet' air or in solution is taken to be 20.9%. Given this, it is reasonable to use the probe in a gaseous environment to measure the oxygen present. The sensor outputs a value labeled "O2 Gas Concentration".

This value is calculated by taking the DO2 Saturation value from the sensor (100% in air-saturated water or 'wet' air) and multiplying it by 0.209(20.9%), the assumed partial pressure contribution of O2 in air. For example, if the DO2 Saturation value from the sensor is 80%, the calculated partial pressure contribution of O2 in air is  $80\% \times 0.209 = 16.7\% \text{ O}_2$ .

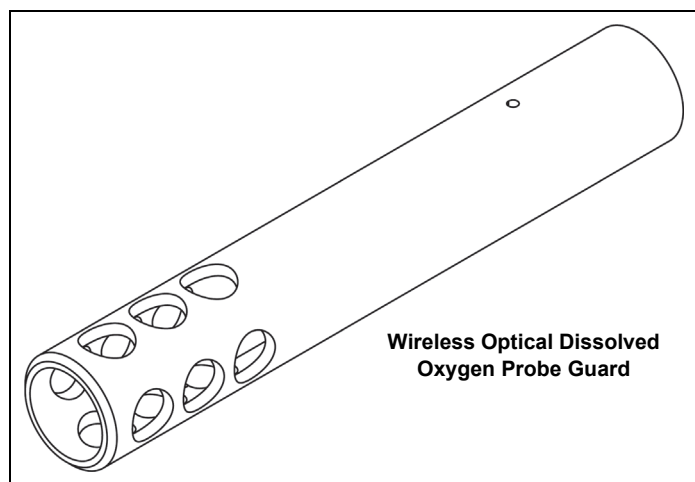
Best accuracy will be achieved in high humidity environments. Long term measurements in dry air are not recommended as this will dry out the probe Sensor Cap and may affect future measurements with the probe.

NOTE: The probe should not be used in an environment with flammable, caustic or corrosive gases.

## Accessory: Optical Dissolved Oxygen Probe Guard (PS-3605)

The Wireless Optical Dissolved Oxygen Probe Guard (PS-3605) is designed to thread onto the probe to protect the Sensor Cap. It also enables the probe to sink more rapidly when the probe is immersed in water.

NOTE: Do not use any tool to thread the Probe Guard onto the probe. Avoid touching the end of the Sensor Cap at all times.



## Calibration: See [www.pasco.com/calibration](http://www.pasco.com/calibration)

The Wireless Optical Dissolved Oxygen Sensor is calibrated at the factory and does not need to be re-calibrated under most circumstances. However, if the Sensor Cap is replaced with a new Sensor Cap (PS-3604), then the Sensor Cap Calibration Code Coefficients (included with the new Sensor Cap) will need to be entered into the sensor using the PASCO data collection software (PASCO Capstone or SPARKvue). The sensor will then need to be re-calibrated. (See Replacement Sensor Cap Calibration.)

For a one-point calibration, you will need one “known standard” with 100% dissolved oxygen saturation.

For a two-point calibration, you will need two “known standards”; one with 100% dissolved oxygen saturation, and one with 0% dissolved oxygen saturation.

### Known Standards (100% dissolved oxygen saturation and 0% dissolved oxygen saturation)

One method for a known standard with 100% dissolved oxygen saturation is to use water-saturated air. Moisten the sponge inside the end of the Probe Cover (Rubber Boot) with water, and then put the probe into the Probe Cover for about fifteen minutes. **WARNING:** Don't calibrate the sensor if the end of the Sensor Cap is under pressure. Therefore, do not push the Probe into the Rubber Boot so far that it compresses the water-moistened sponge.

A second method for a known standard with 100% dissolved oxygen saturation is to use air-saturated water. Connect an air-stone to an air pump, and put the air-stone into water. Allow the air-stone and air pump to run for 10 minutes to make sure that the water is completely saturated.

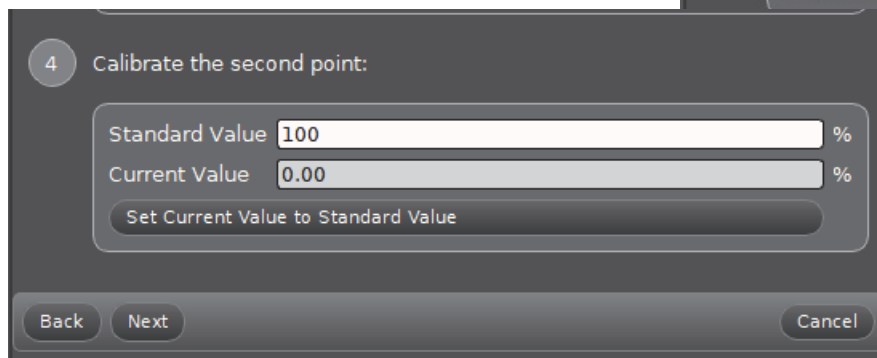
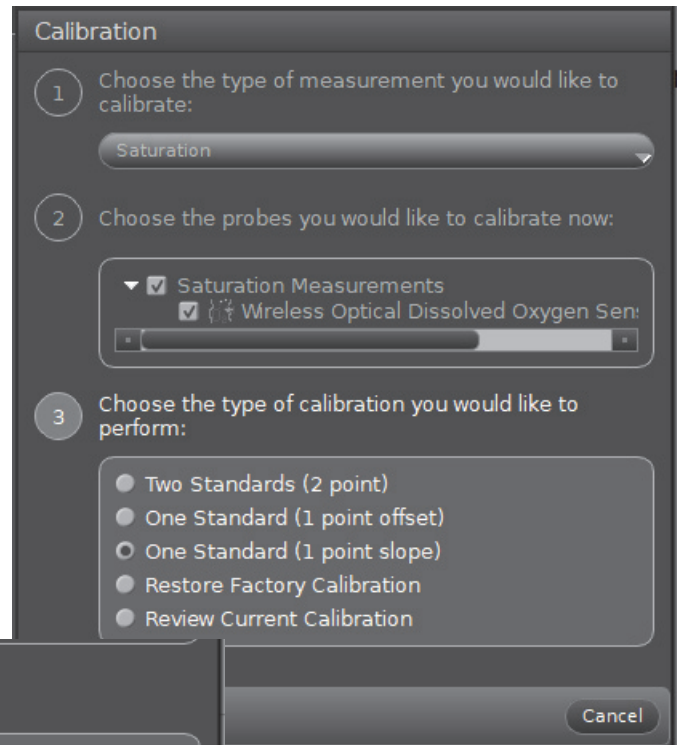
To make a known standard with 0% dissolved oxygen saturation, dissolve enough sodium sulfite, sodium bisulfite, or potassium sulfite in 150 milliliters of distilled water such that a small amount of sodium sulfite remains undissolved in the bottom of the beaker. **WARNING:** Use the same standard lab safety procedures for handling sulfite compounds as for handling any chemical compound.

### PASCO Capstone Calibration. Remember, see [www/pasco.com/calibration](http://www.pasco.com/calibration)

#### Capstone Calibration Steps

- Place the Wireless Optical Dissolved Oxygen Sensor into your known standard for 100% dissolved oxygen saturation (for example, moisten the sponge inside the end of the Probe Cover (Rubber Boot) with water, and then put the probe into the Probe Cover for about fifteen minutes,)
- In PASCO Capstone, click the Calibration icon in the Tools palette to open the Calibration panel.

1. The first step in the Calibration panel says “Choose the type of measurement you would like to calibrate:” The default for the sensor is “Saturation”. Click “Next”.
2. The second step says “Choose the probes you would like to calibrate now:”. The, Wireless Optical Dissolved Oxygen Sensor is automatically selected (if the default measurement is kept). Move to the third step.
3. The third step says “Choose the type of calibration you would like to perform:” Select “**One Standard (1 point slope)**”. Click “Next”.
4. NOTE: The first point of calibration is already set, so the fourth step says (Calibrate the second point:)



5. Wait a few moments until the readings in “Current Value” stabilize and then click “Set Current Value to Standard Value”. After that, click “Next”.
  6. The fifth step says to “Review your calibration and accept.” Click “Finish” to accept, or click “Back” to return to the previous step.
- When you are finished, click the Calibration icon in the Tools palette to close the Calibration panel.

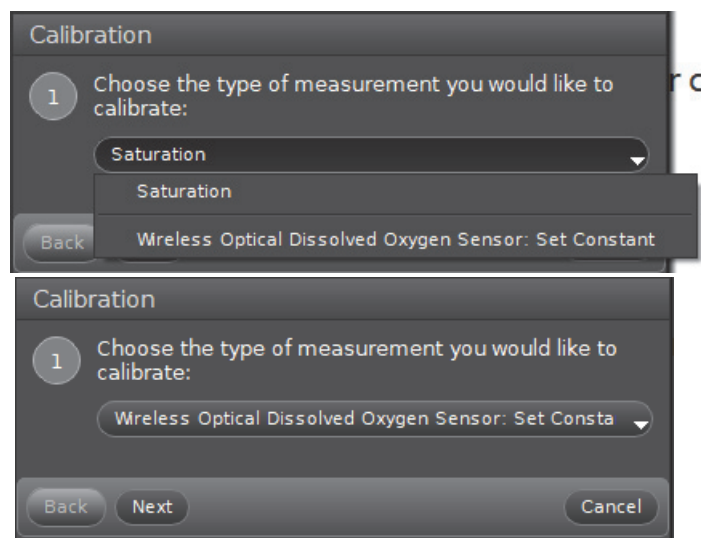
### Notes About Calibration Using Capstone

- Do not calibrate the Wireless Optical Dissolved Oxygen Sensor while another different type of sensor is being used. If you are using two or more different sensors, calibrate the Wireless Optical Dissolved Oxygen Sensor by itself first, and then connect (pair) and calibrate the other sensor(s) if necessary.
- During the calibration process, if you click “Calibrate first point” or “Calibrate second point” and then click “Cancel”, the sensor will be restored to its previous calibration.
- The “Standard Value” text areas cannot be edited because the Optical Dissolved Oxygen Sensor is being calibrated for Saturation.

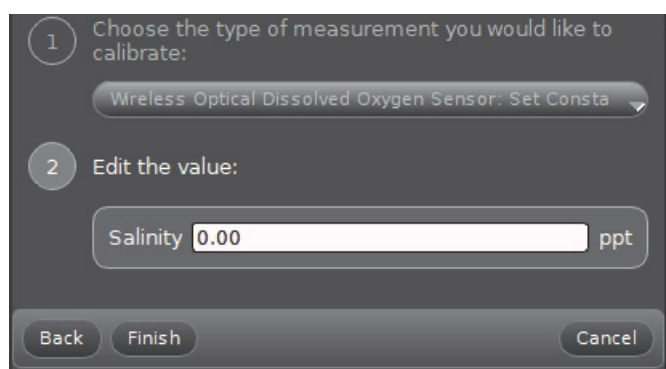
### Capstone Salinity Constant

- Because salinity is one of the factors that can affect dissolved oxygen measurement, a value for salinity can be entered in the Calibration panel.
1. In Capstone, click the Calibration icon in the Tools palette to open the Calibration panel.

- In the first step it says “Choose the type of measurement you would like to calibrate:”, Click the down arrow in the “Saturation” menu and then select “Wireless Optical Dissolved Oxygen Sensor: Set Constant” as the type of measurement. After “Wireless Optical Dissolved Oxygen Sensor Set Constant” is selected click “Next”.



- In the second step it says “Edit the value:”. Refer to the table of salinity values (shown previously.) and enter the correct value in the text area. Click “Finish”.
- Click the Calibration icon in the Tools palette to close the Calibration panel

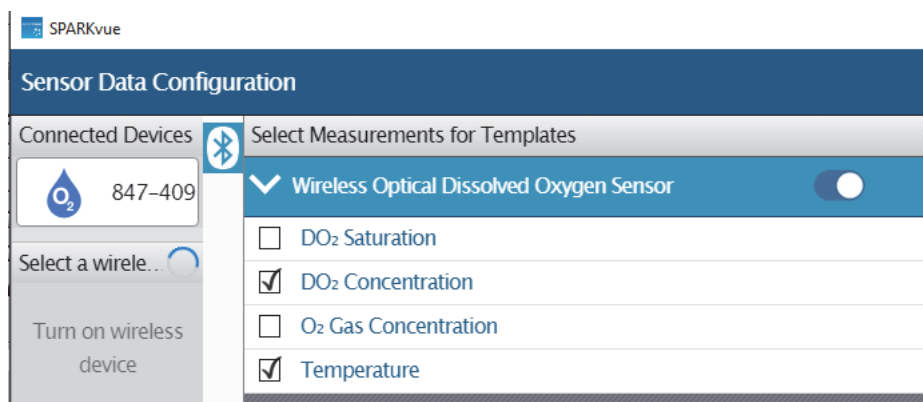


### SPARKvue Calibration. Remember, see [www.pasco.com/calibration](http://www.pasco.com/calibration)

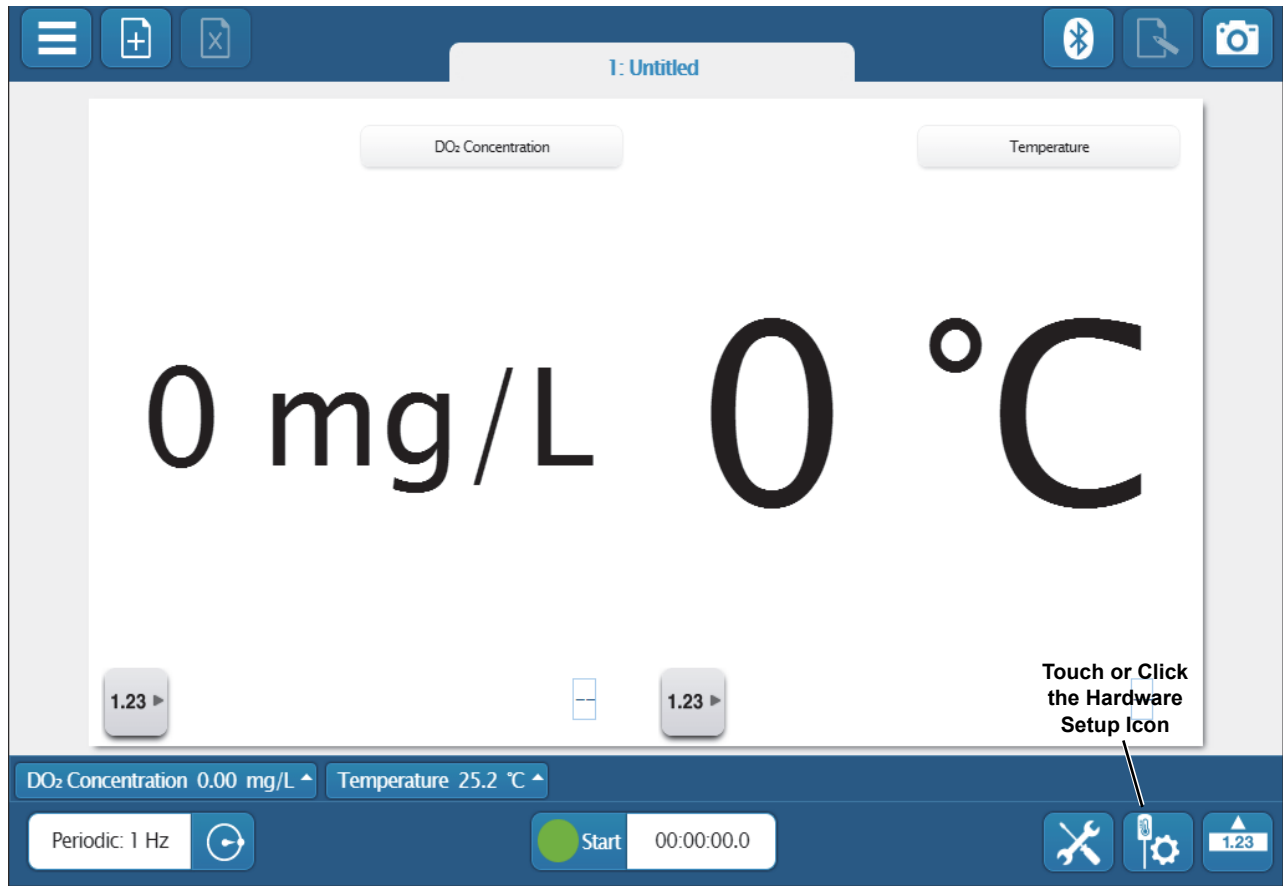
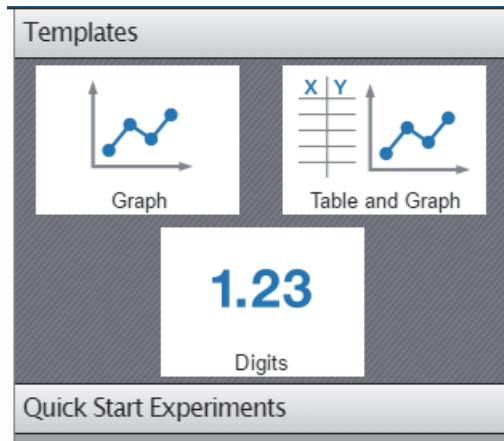
#### SPARKvue Calibration Steps

- Place the Wireless Optical Dissolved Oxygen Sensor into your known standard for 100% dissolved oxygen saturation.
- In SPARKvue, touch or click “Sensor Data” in the Welcome Screen, and connect to the Wireless Optical Dissolved Oxygen Sensor.

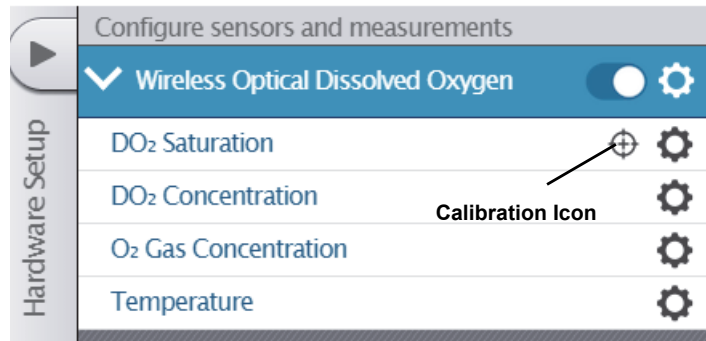
- In the SPARKvue “Sensor Data Configuration” window, check that the “DO<sub>2</sub> Concentration” measurement and Temperature measurement are checkmarked.



- In the “Templates” window next to the “Sensor Data Configuration” window, click one of the Data Display “Templates” (Graph, Table and Graph or Digits) to open a data display.

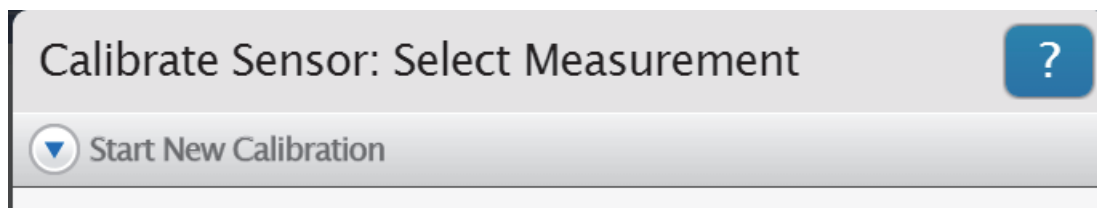


- In the new Data Display, touch/click the Hardware Setup icon to open the “Configure Sensors and Measurements” window.

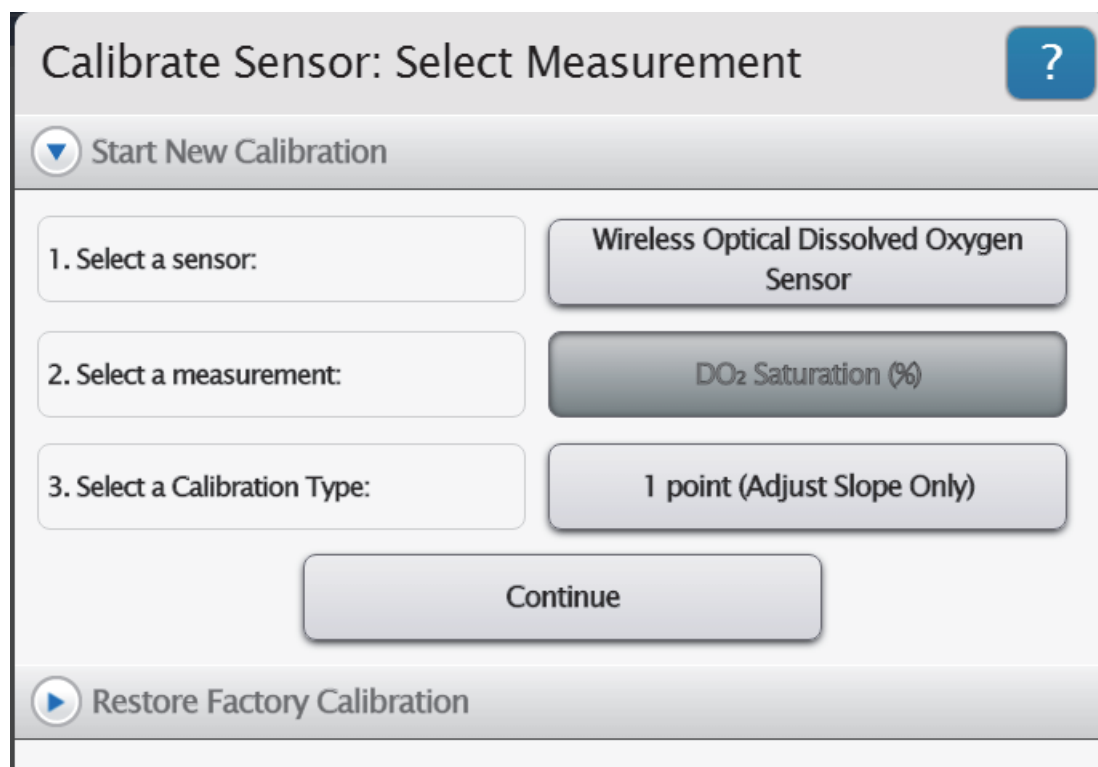




5. In the “Configure sensors and measurements” window, “DO<sub>2</sub> Saturation” is the default choice for calibration. Touch or Click the Calibration icon to open the “Calibrate Sensor: Select Measurement” window

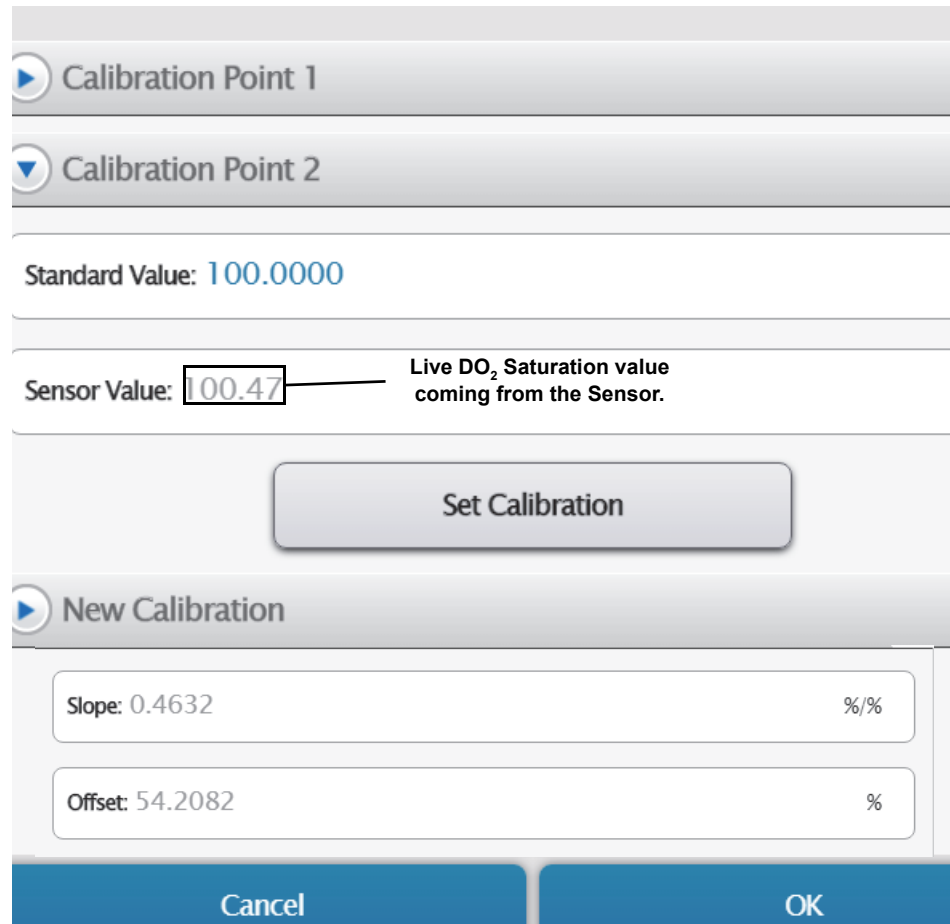


6. In the “Calibrate Sensor: Select Measurement” window, DO<sub>2</sub> Saturation (%) is the default measurement. “1 point (Adjust Slope Only)” is the default Calibration Type. Click or touch “Continue” to open the “Calibrate Sensor: Enter Values” window.





7. In the “Calibrate Sensor: Enter Values” window, “Calibration Point 2” is the default selection with the “Standard Value: 100.0000” and the “Sensor Value:” panel. NOTE: that the “Sensor Value” panel will show the number coming from the Sensor.
8. When the Sensor Value stabilizes, click or touch “Set Calibration”
9. Click or touch “New Calibration” to see the values of the Slope and Offset.
10. Click or touch “OK” to return to the “Configure Sensors and measurements” panel.



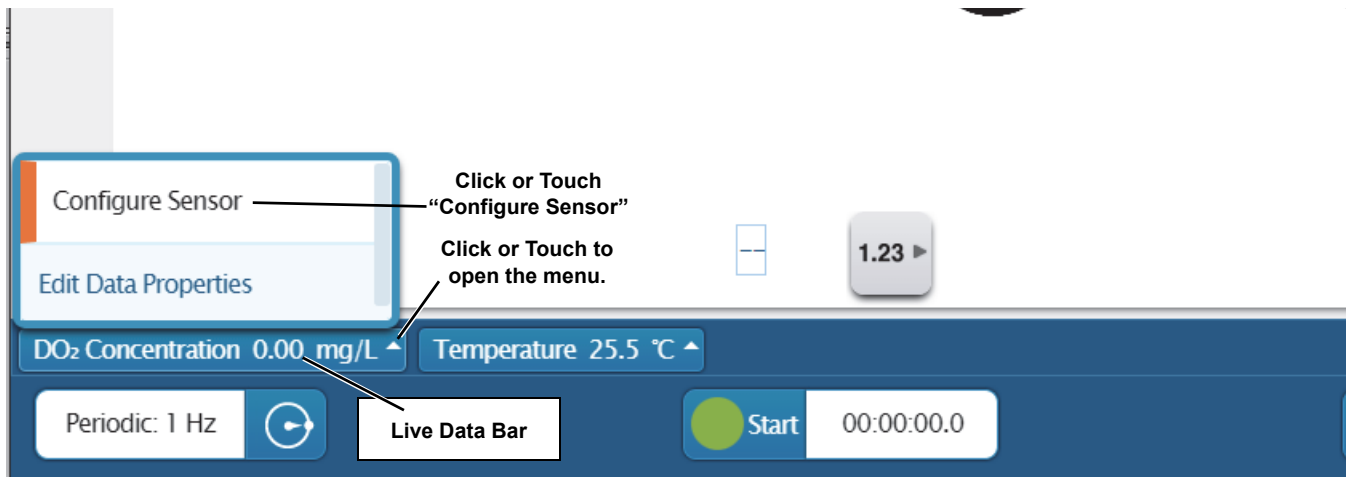
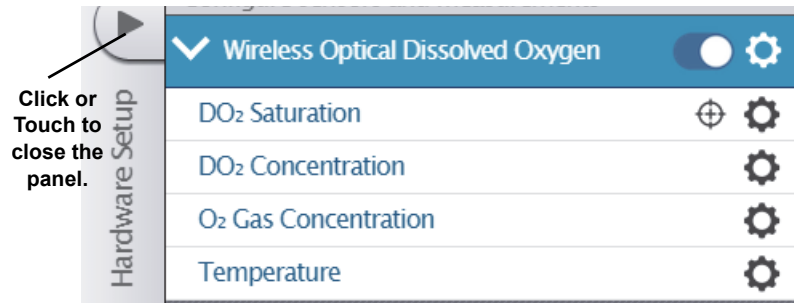
The screenshot displays a calibration interface with the following elements:

- Two radio buttons at the top: "Calibration Point 1" (selected) and "Calibration Point 2" (deselected).
- A "Standard Value" field set to 100.0000.
- A "Sensor Value" field showing 100.47, with a callout line pointing to it from the text "Live DO<sub>2</sub> Saturation value coming from the Sensor."
- A "Set Calibration" button.
- A "New Calibration" section containing two input fields:
  - "Slope: 0.4632" with a unit of %/%
  - "Offset: 54.2082" with a unit of %
- At the bottom, two buttons: "Cancel" and "OK".

## SPARKvue Salinity Constant

- Because salinity is one of the factors that can affect dissolved oxygen measurement, a value for salinity can be entered in the Edit Sensor Properties window.

1. Click the “right arrow” in the “Configure sensors and measurements” panel to close the panel and return to the data display.
2. In the data display, click the up arrow menu icon in the Live Data Bar to open the menu that shows “Configure Sensor” and “Edit Data Properties”.



3. Touch or click the “Configure Sensor” choice in the Live Data Bar menu to open the “Edit Sensor Properties:” window.

4. In the “Edit Sensor Properties:” window in the “Salinity Constant” panel, highlight the value next to “Salinity Constant”. Next, enter a correct salinity value from the table of salinity values shown previously.
5. Touch or click “Set Salinity Constant” and then touch or click “Done” to close the window.

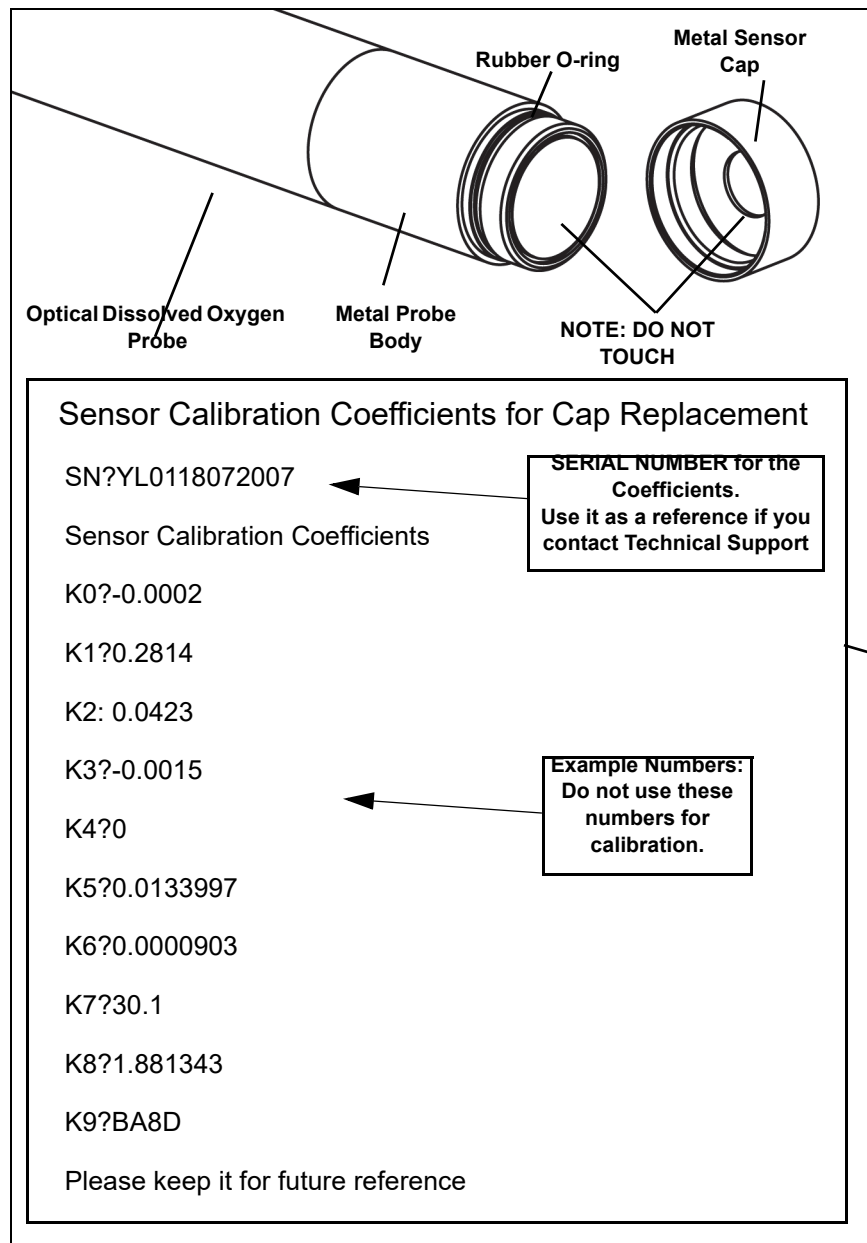
### Replacing the Sensor Cap

The sensing layer inside the Sensor Cap degrades over time due to bleaching caused by exposure to light, so the Sensor Cap must be replaced periodically. It should also be replaced if it is cracked, scratched, or damaged. The Sensor Cap is warranted for one year and may last much longer. The working life of a Sensor Cap may be extended by keeping it clean and properly stored between uses.

The **PS-3604 Replacement Sensor Cap** is designed for the PS-3224 Wireless Optical Dissolved Oxygen Sensor (see [www.pasco.com](http://www.pasco.com) for more information). The Replacement Sensor Cap includes the following:

- **Replacement Sensor Cap**
- **Rubber O-Ring**
- **Page of “Sensor Calibration Coefficients for Cap Replacement** (please see the example).

The screenshot shows a software interface titled "Edit Sensor Properties:". Below the title is a section labeled "Sensor Constants" with a dropdown arrow. There are two input fields: "Salinity Constant" with the value "0" and a unit "ppt", and "Cap Coefficient" which is currently empty. Below each input field is a button: "Set Salinity Constant" and "Set Cap Coefficient". At the bottom of the window is a large blue button labeled "Done".



## Replace the Sensor Cap

To remove the Sensor Cap, first remove the Rubber Boot from the bottom of the probe. Grasp the plastic section of the Probe body in one hand and turn the Metal Sensor Cap counterclockwise to loosen it. **DO NOT USE A TOOL** to unscrew the Sensor Cap. If the Rubber O-ring is damaged, replace it with the O-ring included with the Replacement Sensor Cap. Put the Replacement Sensor Cap onto the end of the probe and turn it clockwise until it meets the metal part of the probe body. **DO NOT USE A TOOL** to install the new Sensor Cap. **NOTE:** The Sensor Cap may be quite difficult to remove and replace. Make sure that your hands, the probe, and the sensor cap, are dry and clean.

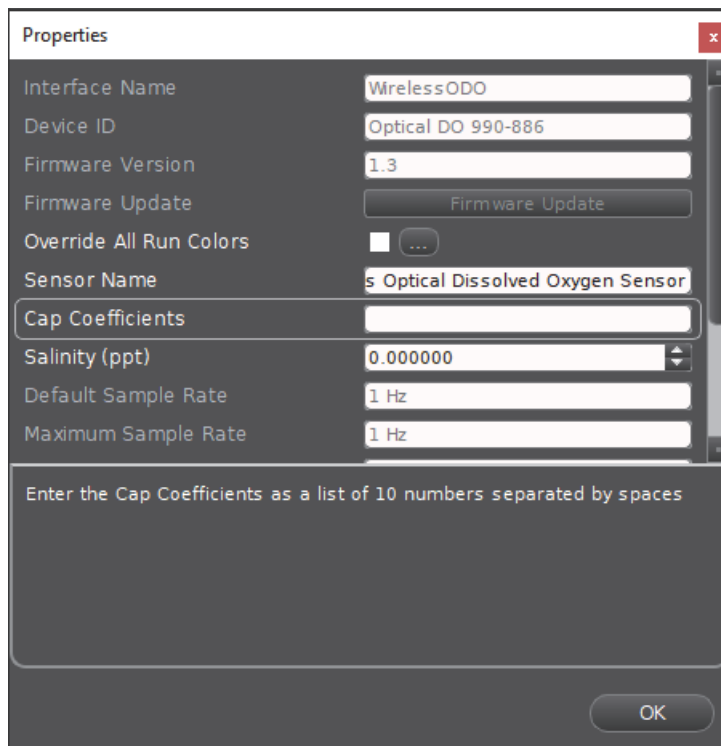
## Replacement Sensor Cap Calibration

After a new Replacement Sensor Cap (PS-3604) is placed on the Optical Dissolved Oxygen probe, there are two parts to the Sensor Cap Calibration process. First, enter the Sensor Calibration Coefficients into the software (PASCO Capstone or SPARKvue). Second, do a one-point or two-point calibration as described previously.

- The Replacement Sensor Cap includes a page with the Sensor Calibration Coefficients for Cap Replacement (please see the example page).

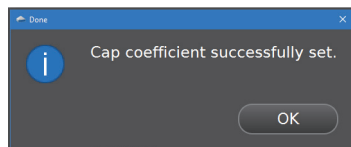
## Capstone Calibration Code Coefficients:

1. With the sensor “paired” (connected to the computing device) use the data collection software to enter the Calibration Code Coefficients (ten number) for the replacement Sensor Cap into the sensor.
2. In the Hardware Setup panel, click the “Properties” icon (⚙️) in the lower right corner to open the Sensor Properties window.
3. In the “Properties” window, touch or click “Cap Coefficients” to select the text panel.
4. Next, enter the ten numbers from the sheet with the Calibration Code Coefficients for Cap Replacement as a list of 10 numbers separated by spaces.
  - NOTE: Enter the numbers with a space between each number.
  - NOTE: Enter the numbers exactly as they appear on the sheet with the Calibration Code Coefficients for Cap Replacement including negative signs, decimal points, and other characters.
5. When finished, touch or click “OK” to close the Properties window.



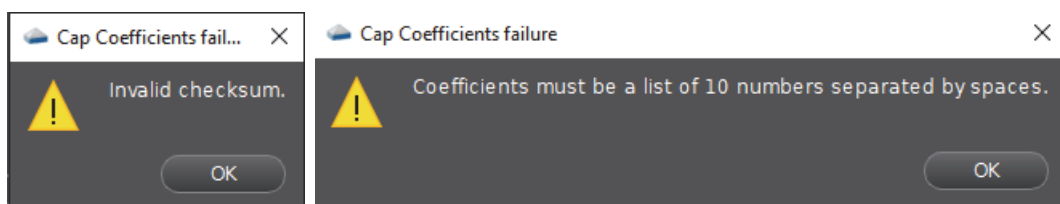
## SUCCESS

A message appears if the Cap Coefficient has been successfully set.



## ERROR MESSAGES

If the message titled “Cap Coefficients failure” appears, it will include a description of the problem.

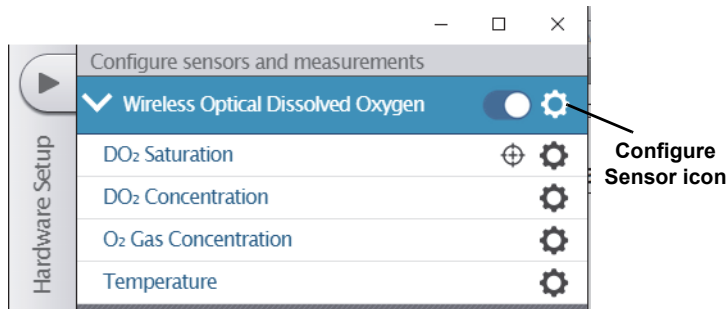
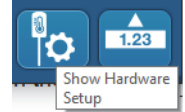


One error message is “Invalid checksum”. Make sure that the 10 numbers exactly match the ones on the Calibration Code Coefficients for Cap Replacement sheet. Another message is “Coefficients must be a list of 10 numbers separated by spaces”. Re-enter the numbers with a space between each one.

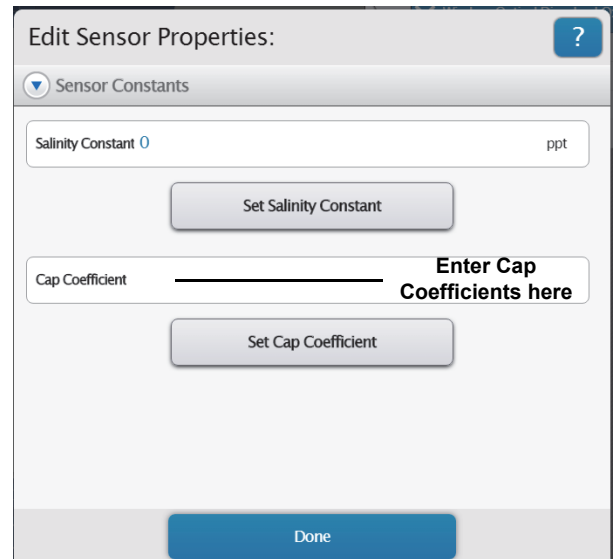
6. After successfully entering the Calibration Coefficients, perform a one-point or a two-point calibration as described previously.

## SPARKvue Calibration Code Coefficients

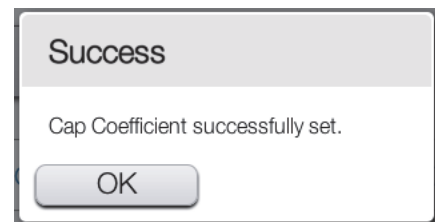
1. In SPARKvue, click or touch the Hardware Setup panel in the data display to open the “Configure Sensors and measurements” window.
2. Click or touch the “Configure Sensor Icon” to open the Edit Sensor Properties Window.



3. In the area next to “Cap Coefficient” enter the ten numbers from the sheet with the Calibration Code Coefficients for Cap Replacement as a list of 10 numbers separated by spaces.



- NOTE: Enter the numbers with a space between each number.
  - NOTE: Enter the numbers in the text area exactly as they appear on the sheet with the Calibration Code Coefficients for Cap Replacement including negative signs, decimal points, and other characters.
4. Touch or Click “Set Cap Coefficient” to save the coefficients. Click or touch “Done” to close the window.
  5. A small window opens to confirm that the procedure was successful.



## Specifications

Specification	Value
<b>Dissolved Oxygen (mg/L and (% concentration))</b>	
<b>Range:</b>	0 - 20 mg/L or 0 - 300% saturation
<b>Accuracy:</b>	$\pm 0.5$ mg/L or $\pm 2.5\%$ , above 200% $\pm 10\%$
<b>Resolution:</b>	0.01 mg/L or 0.01%
<b>Units:</b>	mg/L, g/L, mg/mL, $\mu\text{g}/\mu\text{L}$ , % saturation
<b>Optional Gas Concentration In Air (%)</b>	
<b>Range:</b>	0 - 63%
<b>Accuracy:</b>	Qualitative
<b>Resolution:</b>	0.01%
<b>Units:</b>	%
<b>Temperature (C)</b>	
<b>Range:</b>	0 - 50
<b>Accuracy:</b>	$\pm 1$
<b>Resolution:</b>	0.1
<b>Units:</b>	$^{\circ}\text{C}$ , $^{\circ}\text{F}$ , K
<b>Environmental Operating Range</b>	
<b>Temperature (C):</b>	0 - 50
<b>Humidity:</b>	0 - 100%
<b>Depth:</b>	10 m
<b>Test Standard:</b>	IP-X8
<b>Pressure:</b> The sensor reads barometric pressure to compensate DO readings but does not report the measurement.	

## Technical Support

For assistance with any PASCO product, contact PASCO at:

Address: PASCO scientific  
10101 Foothills Blvd.  
Roseville, CA 95747-7100

Web: [www.pasco.com](http://www.pasco.com)

Phone: +1 916-462-8384 (worldwide)  
877-373-0300 (U.S.)

Email: [support@pasco.com](mailto:support@pasco.com)

Check the PASCO website for the latest version of the instruction manual.

[www.pasco.com/manuals](http://www.pasco.com/manuals)

**Limited Warranty** For a description of the product warranty, see the PASCO catalog. **Copyright** The PASCO scientific *Instruction Manual* is copyrighted with all rights reserved. Permission is granted to non-profit educational institutions for reproduction of any part of this manual, providing the reproductions are used only in their laboratories and classrooms, and are not sold for profit. Reproduction under any other circumstances, without the written consent of PASCO scientific, is prohibited. Rev: 12/18. **Trademarks** PASCO, PASCO Capstone, and SPARKvue are trademarks or registered trademarks of PASCO scientific, in the United States and/or in other countries. For more information visit

[www.pasco.com/legal](http://www.pasco.com/legal)

**Product End of Life Disposal Instructions:**

This electronic product is subject to disposal and recycling regulations that vary by country and region. It is your responsibility to recycle your electronic equipment per your local environmental laws and regulations to ensure that it will be recycled in a manner that protects human health and the environment. To find out where you can drop off your waste equipment for recycling, please contact your local waste recycle/disposal service, or the place where you purchased the product.

The European Union WEEE (Waste Electronic and Electrical Equipment) symbol (to the right) and on the product or its packaging indicates that this product **must not** be disposed of in a standard waste container.

**Battery Disposal Instructions:**

Batteries contain chemicals that, if released, may affect the environment and human health. Batteries should be collected separately for recycling, and recycled at a local hazardous material disposal location adhering to your country and local government regulations. To find out where you can drop off your waste battery for recycling, please contact your local waste disposal service, or the product representative.

The Lithium Polymer (Li-Poly) rechargeable battery used in this product is marked with the International symbols to indicate the need for the separate collection and recycling of batteries.



Li-Poly



## Appendix A:

### Bluetooth Compatibility

Check the PASCO website at [www.pasco.com/compatibility](http://www.pasco.com/compatibility).


Platform	Bluetooth SMART Compatibility
iOS	iPad 3 and later iPhone 4S and later iPod touch 5 and later
SPARK LX / LXi	All models
Android	Android 4.4 and later
Chromebook	Chrome OS (requires PS-3500 Adapter*)
Mac OS X	Models introduced July 2011 or later*
Windows	Windows 7 and later (requires PS-3500 Adapter*)

\*The PS-3500 USB Bluetooth 4.0 Adapter, when connected to a USB port, allows up to three Bluetooth SMART devices, such as this PASCO wireless device, to connect to Windows computers, Chromebooks, and older Macintosh computers.

Note: The PS-3500 USB Bluetooth 4.0 Adapter is the only adapter we can currently recommend. Many other Bluetooth 4.0 adapters are available but this adapter has a specific design that enables in-app pairing of Bluetooth SMART sensors.



<sup>1</sup>To check the Mac computer's Bluetooth compatibility, do the following:

- Click the  (Apple) Menu.
- Select *About This Mac*
- Click the *More Info...* button.
- Click the *System Report...* button.



- Select *Bluetooth* from the sidebar on the left, underneath *Hardware*.
- Scan down the list of information until you find “LMP Version”.
- If your Mac is equipped with Bluetooth SMART, the LMP Version will show **0x6**. (Anything lower than **0x6** means an older version of Bluetooth. Your device will need the PS-3500 USB Bluetooth 4.0 Adapter.)

<sup>1</sup>The Mac Mini and MacBook Air were updated with Bluetooth SMART support in 2011. The MacBook Pro was updated in 2012. The Mac Pro that debuted in December 2013 has Bluetooth SMART support.

**Exception:** Before you upgrade to El Capitan (Mac OS X 10.11.x), if you have a Macintosh with LMP version “0x4” that requires the PS-3500 USB Bluetooth 4.0 Adapter, please contact PASCO Technical Support for further instructions.