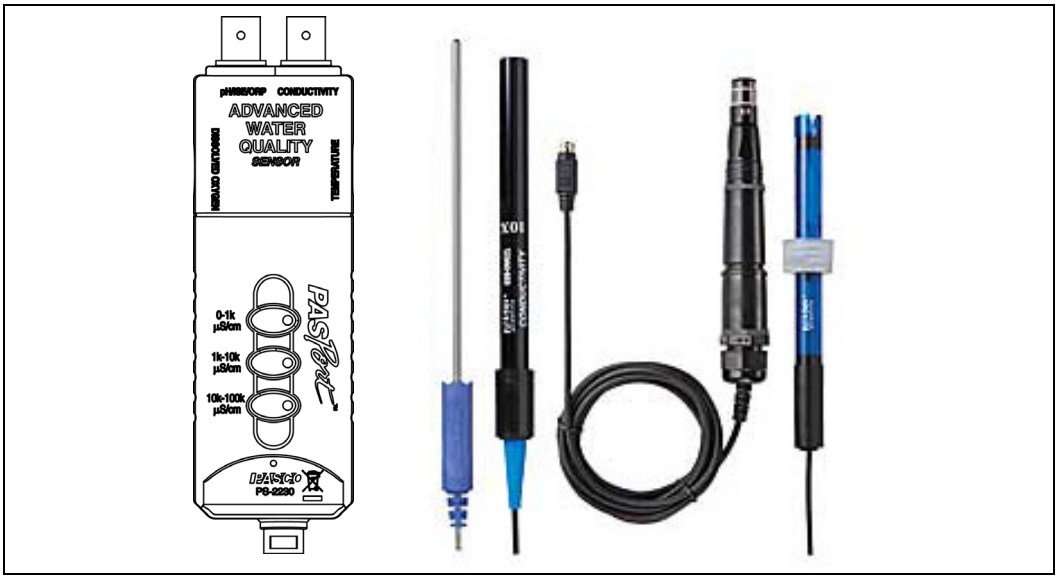
Advanced Water Quality Sensor

PS-2230



Included Equipment	**Part Number**
Advanced Water Quality Sensor	PS-2230
Stainless Steel Temperature Probe	PS-2153
Conductivity Electrode (10x)	PS-2571
Optical Dissolved Oxygen Probe	003-14185
pH Electrode	PS-2573
Required Equipment	
PASPORT Interface and Software	See PASCO catalog or www.pasco.com
Optional Equipment	**Part Number**
Optical Dissolved Oxygen Probe Metal Guard	PS-2588
Skin/surface Temperature Probe	PS-2131
Conductivity Electrode (1x)	699-06620
Various Ion-selective Electrodes (ISE)	See PASCO catalog or www.pasco.com
Oxidation Reduction Potential (ORP) Electrode	CI-6716
Replacement Item	**Part Number**
Optical Dissolved Oxygen Probe Sensor Cap	PS-2587

Introduction

The PS-2230 Advanced Water Quality Sensor combines four sensors in a single unit:

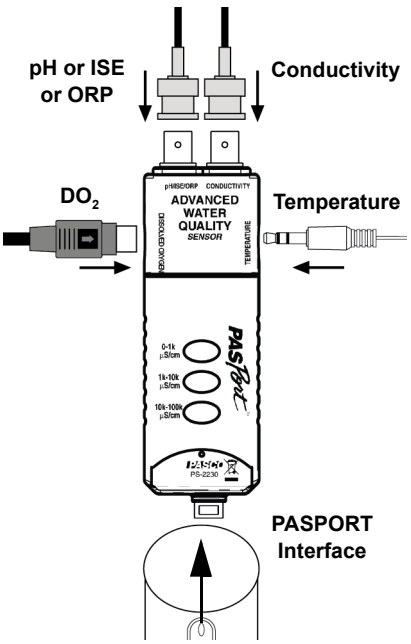
- Temperature
- Conductivity
- pH (or Ion-Selective Electrode, or Oxygen Reduction Potential, optional)
- Dissolved Oxygen (DO_2)

Note: The Optical Dissolved Oxygen Probe also measures barometric pressure and solution temperature.

When connected to a PASPORT interface, the multi-sensor collects data at up to 2 samples per second from each component sensor. One component sensor can be used at a time or any combination can be used simultaneously. If you have a PASPORT interface that supports multiple sensors, or if you have more than one interface connected to your computer, the Advanced Water Quality Sensor can be used in combination with other PASPORT sensors.

Note: No electrical interference will occur between two or more probes connected to a single Advanced Water Quality Sensor.

Sensor, Interface, and Software Setup



Connect the multi-sensor to your PASPORT interface as pictured (right). Connect any or all of the included probes to the multi-sensor. (You can leave any probe disconnected if you do not plan to use it.) If you will be using an ion-selective electrode or oxygen reduction potential electrode, connect it to the pH/ISE/ORP port.

Follow the instructions below to set up the sensor with PASCO Capstone, SPARKvue, SPARK SLS, or the Xplorer GLX (standalone).

For detailed information about each of the multi-sensor's component sensors, see the following pages.

Note: Only the tips and bodies of the probes should be immersed in liquid. Keep the connectors and body of the multi-sensor dry. The probe cables are immersible.

Capstone Setup

Connect the PASPORT interface using a Capstone supported interface. Build one or more displays for data. Click 'Record' to start data collection and 'Stop' to stop data collection.

Note that the sensor will collect data for probes that are not connected. These data are listed in the Data Summary and are displayed if selected on one or more displays. The default sampling rate and other parameters are defined with Hardware Setup in the Tool Palette. If needed, calibration is performed with the Calibration wizard in the Tool Palette. For more instructions on using Capstone, refer to the Capstone Online Help or User's Guide.

SPARKvue and SPARK SLS Setup

Connect the PASPORT interface directly to a SPARK SLS or to a computer using a SPARKvue supported interface. Build one or more displays for data. Press to start data collection and to stop data collection.

The default sampling rate is defined with Sampling Options. Calibration is performed with Experiment Tools > Calibrate Sensor. For more instructions on using the SPARKvue/SPARK SLS, refer to the SPARKvue/SPARK SLS Online Help or User's Guide.

Xplorer GLX Setup

If you are using an Xplorer GLX in standalone mode, press to start data collection.

Note that the sensor may collect data for probes that are not connected. Hide or ignore these measurements. To hide measurements that you do not need, open the Sensors screen (from the Home screen, press F4). In the Sensors screen you can also change the sampling rate and open the calibration dialog box. For more instructions on using the Xplorer GLX, refer to the GLX User's Guide.

Temperature

Use this component of the multi-sensor to measure the temperature of a fluid or object. The measurement can be displayed in units of °C, °F, or K. You can use the included stainless steel probe or a different probe, such as the Fast-response Probe (PS-2135) or Skin/Surface Probe (PS-2131). PASCO physics apparatus containing an embedded 10 kΩ thermistor can also be connected to the multi-sensor. The multi-sensor automatically detects the presence of a temperature probe, and it will only collect temperature data if a probe is connected.

Measuring Temperature

To measure temperature, connect the probe and start data collection. Immerse the tip of the probe in a fluid or place it in contact with an object. The included stainless steel probe can be used in both dry conditions and in liquids, such as water and other mild chemicals and solutions.

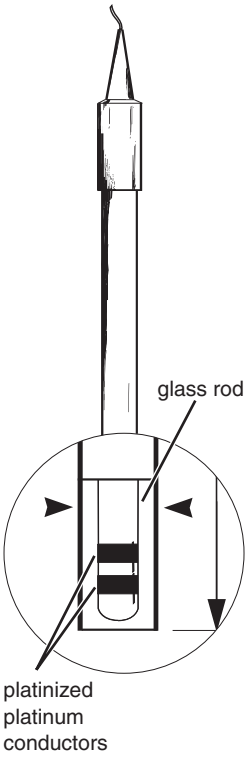
Tip: For better chemical resistance, use a Teflon® cover (CI-6549).

Temperature Calibration

The temperature measurement can be calibrated; however, for most applications calibration is not necessary. Use a two-point calibration with two standards of known temperature. Refer the SPARKvue/SPARK SLS, Capstone, or Xplorer GLX Online Help or User's Guide for calibration instructions.

Conductivity

The conductivity component sensor measures the electrolytic conductivity of aqueous solutions. It determines the conductivity by applying an alternating voltage to the electrode cell at the end of the probe and measuring the resulting current. You can use the included 10x electrode or an optional1x electrode (not included). In the software



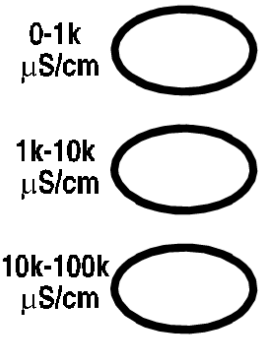
Conductivity Electrode

or on the interface select the **Conductivity (10x)** or **Conductivity (1x)** measurement, depending on which electrode you are using.

Note: The 10x probe can be used to measure conductivity up to 100000 μS/cm. The 1x probe has one tenth of the range (up to 10000 μS/cm) but ten times better resolution.

Measuring Conductivity

Before using the conductivity electrode, soak the end in distilled water for 5 to 10 minutes. Connect the electrode to the multi-sensor and start data collection. Immerse the end of the electrode in the solution to be measured and wait for the reading to stabilize. Rinse the electrode with deionized water before measuring a different solution.



The conductivity sensor has three ranges, which you select using the three buttons on the multi-sensor. To select a range, push one of the buttons: for 0 μS/cm to 1k (1000) μS/cm, for or 1k μS/cm to 10k μS/cm, or for 10k μS/cm to 100k μS/cm. Lights on the buttons indicate which range is selected. To determine which range is appropriate, look at the data (on a Graph display, for instance) while it is being collected; if the measurement appears to be "railed" at the top of the selected range (1k μS/cm or 10k μS/cm), select the next higher range. You can push a button to change the range without stopping data collection.

Note: The ranges specified above are for a 10x probe. Divide each range by 10 if you are using a 1x probe.

The conductivity electrode is sensitive to very low concentrations of dissolved solids, so you will probably never measure a sample with a conductivity of zero. A reading of 25 μS/cm for "pure" water is typical. True pure water is difficult to obtain and store. The table (right) lists typical conductivity values for common aqueous solutions at 25 °C.

Solution	Conductivity (μS/cm)
Ultra-pure Water	0.05 to 0.75
Drinking Water	50 to 1500
Ocean Water	~53000

As a rule of thumb, to estimate total dissolved solids (TDS) in parts per million (ppm), divide the conductivity in μS/cm by 2:

$$\text{TDS (ppm)} = \frac{\text{Conductivity (}\mu\text{S/cm)}}{2}$$

Conductivity Calibration

The conductivity measurement can be calibrated; however, for most applications calibration is not necessary. Use a one-point calibration with a standard solution of known conductivity. For instructions on preparing a standard solution, see Appendix A. Refer to the SPARKvue/SPARK SLS, Capstone, or Xplorer GLX User's Guide or Online Help for calibration instructions.

Conductivity Electrode Maintenance And Storage

To ensure accurate and reproducible results, the electrode must be clean. Substances on the electrode may contaminate the solution being tested and change the conductivity. To clean the electrode, dip the end into a detergent solution or dilute nitric acid (1%) and stir for three minutes, then rinse with deionized water.

For storage, dry the electrode and return it to its box. Before use, soak the electrode in distilled water for at least 5 minutes.

pH/ISE/ORP

The pH/ISE/ORP input of the multi-sensor is a specialized voltage sensor. Its BNC connector accepts the included pH electrode, as well as ISE and ORP electrodes (not included). The sensor measures the voltage produced by any of these electrodes. When used with a pH probe, the sensor also computes the pH based on the measured voltage.

Connect the pH electrode (or other electrode) to the pH/ISE/ORP port and start data collection. On your computer or interface, display the **ISE Voltage** measurement (this measurement is valid for pH and ORP electrodes as well as ISE) or the **pH** measurement for the calculated pH (assuming that the pH electrode is connected).

Measuring pH

The pH electrode produces a voltage proportional to the pH of the solution that it is immersed in. This voltage is measured by the multi-sensor, which computes pH.

Unscrew and remove the storage bottle from the electrode (be careful not to spill the storage solution). Push the O-ring and bottle cap up the electrode handle. Rinse the electrode tip with distilled water. If you see bubbles in the electrode bulb, gently shake the electrode downward (similar to shaking down a thermometer). Start data collection. Place the tip of the electrode in the solution to be measured and wait for the reading on your computer or interface to stabilize. Rinse the electrode with distilled water before measuring another solution.

pH Calibration

The pH measurement can be calibrated; however, for most applications calibration is not necessary. Perform a two-point calibration with two buffer solutions of known pH. Refer to the SPARKvue/SPARK SLS, Capstone, or Xplorer GLX User's Guide or Online Help for calibration instructions.

pH Electrode Maintenance and Storage

Cleaning

If the pH electrode becomes contaminated, use one of these methods to clean and restore it. After any of these procedures, soak the electrode in a pH 7 buffer solution for 30 minutes.

- **General Contamination:** Soak the electrode in 0.1 molar hydrochloric acid (HCl) for 15 minutes.
- **Protein Deposits:** Soak the electrode in a solution of 1% pepsin in 0.1 molar HCl.
- **Inorganic Deposits:** Rinse the electrode with 0.1 molar ethylene diamine tetra-acetic acid (EDTA) tetrasodium solution.
- **Oil and Grease Film:** Wash the electrode carefully in a mild detergent or a solvent known to be effective for the particular film.
- **Unknown Contamination:** Soak the electrode alternately in 12 molar sodium hydroxide (NaOH) and 1 molar HCl. Leave it in each solution for one minute. Rinse completely between soakings. End with HCl. (The NaOH etches the glass and the HCl reestablishes hydrogen ions on the surface.)

If these steps fail to improve the response of the electrode, replace it.

Storage

Store the pH electrode in the included electrode storage bottle with one of the following solutions. (Never store the electrode in distilled water.)

- **Short-term** (up to one week): pH 4 buffer solution or tap water.
- **Long-term** (over one week): 4 molar KCl solution (included with the electrode).

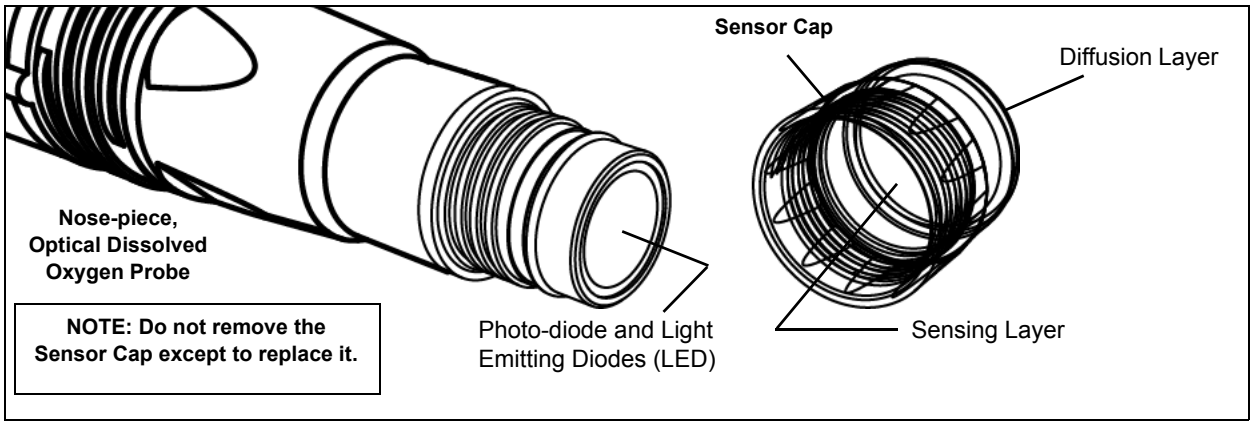
Dissolved Oxygen

The Optical Dissolved Oxygen Probe is designed to measure the concentration and the saturation percentage of dissolved oxygen molecules (O_2) in aqueous solutions.

The Optical Dissolved Oxygen Probe has several advantages when compared to a galvanic (electrochemical) dissolved oxygen sensor. The advantages include:

- no warm up time
- no calibration required
- no filling solution or electrode polishing
- no flow dependency

The sensing element of the Optical Dissolved Oxygen Probe is called 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 though while protecting the dye layer. The 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's photo-diode measures the lifetime of the luminescence as it is affected by the oxygen and compares the reading to a reference.



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, 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).

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 unit-less 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 determine by the previously used method where the mass of dissolved salts in a given mass of water (parts per thousand) were reported.

Dissolved Oxygen Calibration

The Optical Dissolved Oxygen Probe 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-2587), 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 acquisition software. The sensor will then need to be re-calibrated. (See Appendix B.)

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.

Refer to the SPARKvue/SPARK SLS, Capstone, or Xplorer GLX User's Guide or Online Help for calibration instructions, or go to the PASCO Web site at www.pasco.com and enter "Optical Dissolved Oxygen Sensor" or "PS-2196" in the Search window. Download the instruction manual PDF file under "User Resources".

Known Standards

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 (included with the probe) with water, and then put the probe into the Probe Cover for about fifteen minutes.

CAUTION: Do not push the Probe Cover on too tight or it might cause a pressure increase.

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.

For a known standard with 0% dissolved oxygen saturation, dissolve enough sodium sulfite in 150 milliliters of distilled water such that a small amount of sodium sulfite remains undissolved in the bottom of the beaker.

Probe Care and Maintenance

The sensing layer in the Optical Dissolved Oxygen Probe's 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 for the Optical Dissolved Oxygen Probe Sensor Cap is model number PS-2587 (see 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 sensing 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 sponge that is in the end of the Probe Cover, and place the probe in the cover 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.

Appendix A: SpecificationsReference

General	
Included Sensors	Temperature, Conductivity, pH, Optical Dissolved Oxygen
Max. Sampling Rate	20 samples per second (for each component sensor)
Default Sampling Rate	2 samples per second
Temperature	
Range	−35 °C to +135 °C
Accuracy	±0.5 °C
Resolution	0.01 °C or better
Sensing Element	10 kΩ thermistor located in probe tip
Conductivity	
Range	three user-selectable ranges: 0 to 1000 μS/cm, 0 to 10000 μS/cm, 0 to 100000 μS/cm with included 10x probe 0 to 100 μS/cm, 0 to 1000 μS/cm, 0 to 10000 μS/cm with optional 1x probe
Accuracy	±10% of full scale without calibration
Resolution	better than 0.05% of full scale
pH/ISE/ORP probe voltage	
Electrode Connector	standard BNC
Input Resistance	1012 Ω
Voltage Range	−2000 mV to +2000 mV
Voltage Resolution	0.1 mV
pH Range	0 to 14
pH Resolution	0.001

Optical Dissolved Oxygen Probe	
Cable Length	3 meters
Response Time	90% in 35 seconds
Operating Temperature	0 to 50 °C
Operating Pressure	375 to 825 mm Hg
Range	0 to 20 mg per liter or 0 to 300% saturation
Resolution	0.01 °C or better
Accuracy	±0.6 mg per liter or ±3.0% right out of the box ±0.1 mg per liter or ±1.0%, whichever is greater, after calibration above 200% saturation, ±10%

Solutions for Conductivity Calibration

Reference Solution	Approximation Normality of Solution	Method of Preparation	Temperature (°C)	Electrical Conductivity[1] (µS/cm)
A	1	74.2480 g of KCl weighed in air per 1 L of solution at 20 °C	0	65176
			18	97838
			25	111342
B	0.1	7.4365 g of KCl weighed in air per 1 L of solution at 20 °C	0	7138
			18	11167
			25	12856
C	0.01	0.7440 g of KCl weighed in air per 1 L of solution at 20 °C	0	773.6
			18	1220.5
			25	1408.6
D	0.001	Dilute 100 mL of solution C to 1 L at 20 °C	0	77.69
			18	127.54
			25	148.93

[1]*Excluding the conductivity of the water used to prepare the solutions. These tabulated conductivity values are in international units. When using measuring instruments calibrated in absolute units, multiply the tabular values by 0.999505*

Appendix B: Optical Dissolved Oxygen Probe Replacement Cap Calibration

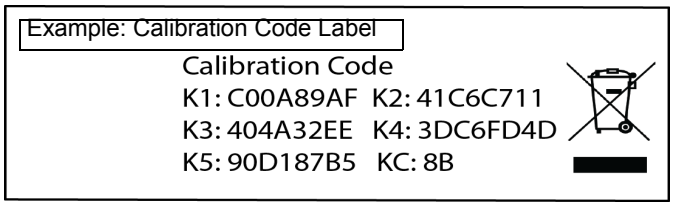
After a new replacement Sensor Cap (PS-2587) is placed on the Optical Dissolved Oxygen probe, there are two parts to the sensor calibration process.

1. With the probe connected to the sensor and the sensor connected to the PASCO Interface, use the data acquisition software to enter the Calibration Code coefficients (six groups of numbers labeled K1 to K5 and KC) for the replacement Sensor Cap into the sensor.

2. Perform a one-point calibration using a "known standard" such as air-saturated water. Alternatively, a two-point calibration could be performed using two calibration standard solutions.

3. Refer to the User's Guide or Online Help for the PASCO software, or go to the PASCO web site at www.pasco.com and enter "Optical Dissolved Oxygen Sensor" or "PS-2196" in the Search window. Download the instruction manual PDF file under the User Resources tab.

Capstone: Calibration Code Coefficients



The replacement Sensor Cap comes with a Calibration Code Label (see the example).

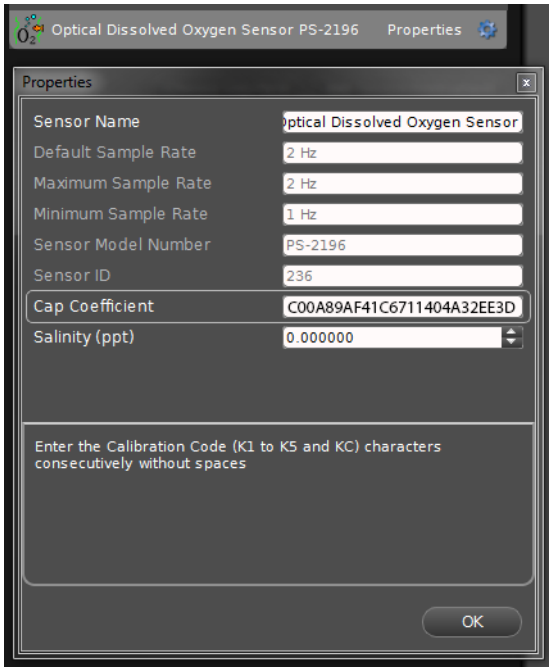
1. In Capstone, click the Hardware Setup icon ( ) in the Tools palette to open the Hardware Setup panel.

2. In the Hardware Setup panel, click the "Properties" icon ( ) in the lower right corner to open the Sensor Properties window.

3. Click "Cap Coefficient" and then enter the Calibration Code characters (K1 to K5 and KC) consecutively without spaces.

4. Click "OK" to close the Properties window.

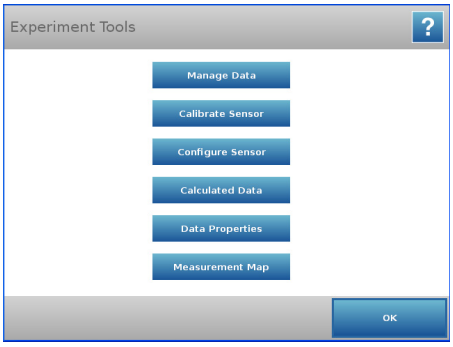
5. Perform a one-point or a two-point calibration. (Go to the PASCO web site at www.pasco.com and enter "Optical Dissolved Oxygen Sensor" or "PS-2196" in the Search window. Download the instruction manual PDF file under the User Resources tab.)



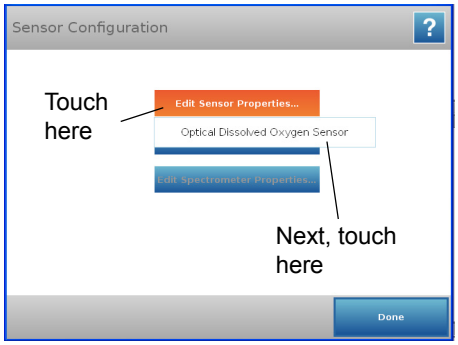
SPARK SLS: Calibration Code Coefficients

1. As in the calibration process, touch "Experiment Tools" in a display to open the "Experiment Tools" screen.

2. In the Experiment Tools screen, touch "Configure Sensor" to open the Sensor Configuration screen.

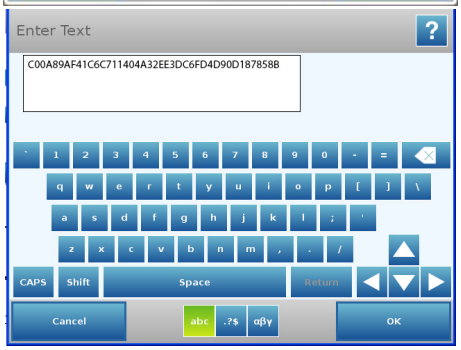


3. In the Sensor Configuration screen, touch “Edit Sensor Properties”. On the drop down menu, touch “Optical Dissolved Oxygen Sensor”.



4. The the “Edit Sensor Properties: Optical Dissolved Oxygen Sensor” screen opens. Touch “Set Cap Coefficients” to open the Enter Text screen.

5. Use the keyboard in the Enter Text screen to enter the Calibration Code Coefficients (K1 to K5 and KC). Enter the coefficients consecutively and without spaces. After the Calibration Code Coefficients have been entered, touch “OK”.



- NOTE: An error message screen will appear if the sensor is not connected to the interface, or the Calibration Code Coefficients were not entered properly. Press “OK”. Check the sensor connection or re-enter the Calibration Code Coefficients.

6. Perform a one point or two point calibration with “known standard” solutions. (Go to the PASCO web site at www.pasco.com and enter “Optical Dissolved Oxygen Sensor” or “PS-2196” in the Search window. Download the instruction manual PDF file under the User Resources tab.)

SPARKvue: Calibration Code Coefficients

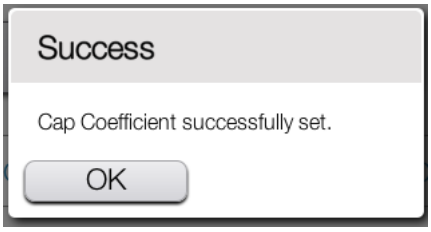
1. In SPARKvue, touch or click the "DO2 Saturation" measurement and then touch/click "Show" to open a Graph display screen.

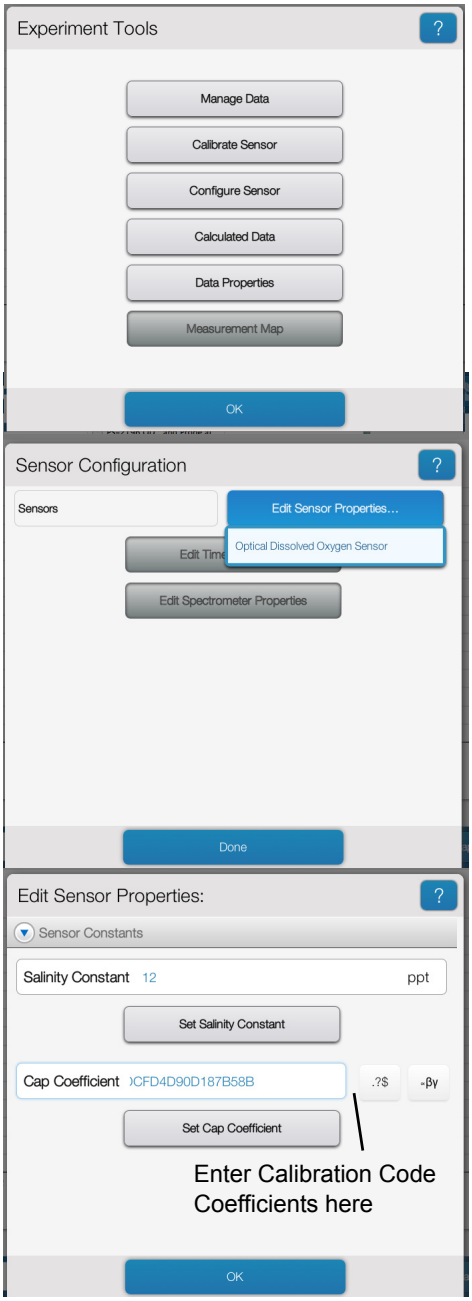
2. In the Graph display, touch/click the "Experiment Tools" icon ( ) to open the Experiment Tools menu.

3. In the Experiment Tools menu, touch/click "Configure Sensor" and then touch/click "OK" to open the Sensor Configuration screen.

4. The screen shows three selections: "Edit Sensor Properties", "Edit Timer Properties" and "Edit Spectrometer Properties". Touch or click Edit Sensor Properties to show the sensor menu, and then touch/click "Optical Dissolved Oxygen Sensor". The Edit Sensor Properties screen changes to show "Salinity Constant" and "Cap Coefficient".

5. In the text area for "Cap Coefficient", enter the Calibration Code Coefficients (K1 through K5 and KC) consecutively without spaces. Touch or click "Set Cap Coefficient" to save the coefficients. A small window opens to confirm that the procedure was successful.





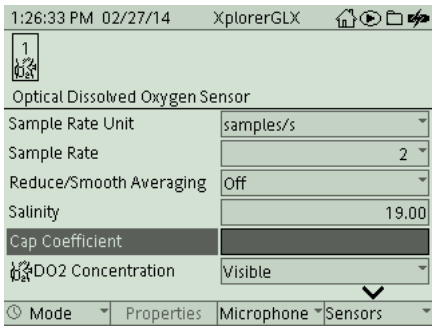
6. Touch or click "OK" to return to the Graph display screen.

Xplorer GLX: Calibration Code Coefficients

1. With the replacement sensor cap installed, the sensor connected to the interface, and the interface turned on, go to the Home Screen ( ).

2. In the Home Screen, press F4 ( ) to go to the Sensors screen.

3. In the Optical Dissolved Oxygen Sensor screen, use the down arrow ( ) to highlight the "Cap Coefficient" text area. Press "Check" ( ) to select the text area for the coefficients.



4. Use the keypad to enter the Calibration Code Coefficients (K1 to K5, and KC) consecutively without spaces. After the forty-two letters and numbers are entered, press "Check" to save the coefficients.

   - REMINDER: Press a numeric key twice to switch to the alphabetic characters that are on the key.
   - NOTE: An error message screen will appear if the sensor is not connected to the interface, or the Calibration Code Coefficients were not entered properly. Press "OK". Check the sensor connection or re-enter the Calibration Code Coefficients.

5. Perform a one point or two point calibration with "known standard" solutions. (Go to the PASCO web site at www.pasco.com and enter "Optical Dissolved Oxygen Sensor" or "PS-2196" in the Search window. Download the instruction manual PDF file under the User Resources tab.)

Software Requirements

As of November 2014, the minimum software requirements are as follows:

- PASCO Capstone: 1.2
- SPARKvue: 2.1.3
- SPARK SLS: v1.4.1
- Xplorer GLX: v1.54

For the latest and most complete information about minimum software requirements, go to www.pasco.com. Enter "PS-2230" in the "Search" window to go to the product page.

Technical Support

For assistance with any PASCO product, contact PASCO at:

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

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

Web: www.pasco.com

Email: techsupp@pasco.com

Limited Warranty
For a description of the product warranty, see the PASCO catalog.

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.