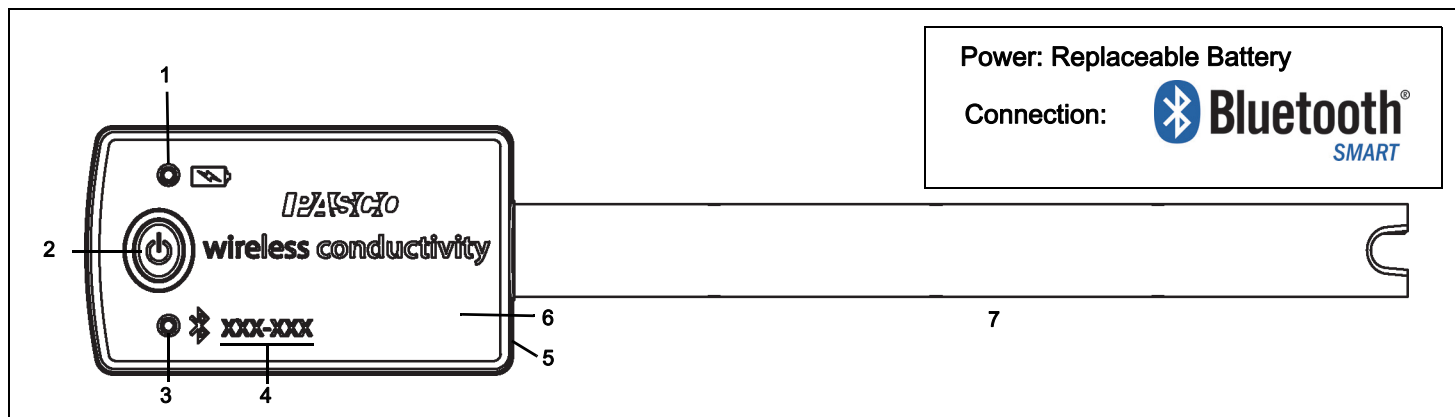


# Wireless Conductivity Sensor

PS-3210



1	Battery Status LED	5	Water Resistant Gasket
2	ON Button	6	Sensor Housing (-15°C to +50°C)
3	Bluetooth Status LED	7	Probe (0°C to 80°C)
4	Device ID Number		

## Hardware

Included Equipment	Part Number
Wireless Conductivity Sensor	PS-3210

## Introduction

The Wireless Conductivity Sensor measures conductivity over a range from 0 to 20,000 microsiemens/centimeter ( $\mu\text{S}/\text{cm}$ ). The conductivity probe is able to work in a variety of solutions. The conductivity measurement is transmitted wirelessly through Bluetooth and recorded and displayed by the PASCO software on a connected wireless device such as a tablet or computer. The Wireless Conductivity Sensor is powered by a replaceable three volt coin cell battery (included) and is well-suited for continuous recording and discrete measurements. The sensor is designed to optimize the battery usage time.

Since each sensor has a unique Device ID number, more than one can be connected to a computer or tablet at the same time.

The sensor housing is water resistant, but immersing it in liquid may cause a loss of wireless connection. Put only the Conductivity Probe into the substance being measured.

## Background

Electrolytic conductivity is defined as the ability of a liquid to conduct electrical current. In conductive solvents, dissolved ions are the principle conductors of electricity. By selecting the appropriate electrode, one can easily measure the electrical conductivity of liquids ranging from ultra-pure water to the most salty solutions.

How well a solution conducts electricity is dependent on the following parameters:

- concentration of ions
- mobility of ions

- valence of ions
- solution temperature

The Wireless Conductivity Sensor determines the electrical conductivity (EC) of a solution by measuring the alternating current (AC) flowing through a circuit when an AC signal is applied to a 2-cell electrode submerged in the solution.

The accuracy of conductivity measurements depends on the following factors:

- Absence of contamination
- Resistance of the electrodes to polarization
- Consistent electrode geometry (cell constant) between calibration and measurement
- Consistent temperature between calibration and measurement

#### Other Features

- Data from the Wireless Conductivity Sensor can be used to determine Total Dissolved Solids (TDS).
- The sensor measures temperature and automatically compensates for it.

#### Sensor Theory

Conductance is the reciprocal of resistance. Conductivity is the specific conductance of a material. The conductivity is the conductance measured between the opposite faces of a one centimeter cube of the material.

The electrode cell in the end of the Conductivity Probe is constructed of an insulating material embedded with stainless steel pins. These metal contacts serve as sensing elements and are placed at a fixed distance apart.

#### ON/OFF Information

To turn the sensor on, press and hold the ON button until the status LEDs start blinking. To turn the sensor off, press and momentarily hold the ON button until the status LEDs stop blinking. (See the LED information.)

The sensor puts itself to sleep after several minutes of inactivity if not connected, and after about one hour of inactivity if 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 the latest versions.

## Software Help

See the SPARKvue Help or PASCO Capstone Help for information about collecting, displaying, and analyzing data.

- In SPARKvue, select the HELP button ( ? ) in any screen including the Home Screen.
- In PASCO Capstone, select PASCO Capstone Help from the Help menu, or press F1.

## Bluetooth<sup>®</sup> Compatibility

Check the PASCO Web page at

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

for the latest information. See Appendix A for more information about Bluetooth compatibility, the PS-3500 USB Bluetooth Adapter, and older Mac OS X models.

## LED Information

The Bluetooth connection LED (light-emitting diode) and the battery status LED operate as follows:

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

Battery LED	Status
Red blink	Low power

**\*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.

Check the PASCO Web page at:

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

for the latest software version.

## Set-up

### Connecting the Sensor to a Wireless Device or a Computer via Bluetooth

#### SPARKvue

##### Software Help

See the SPARKvue Help for information about collecting, displaying, and analyzing data.

- In SPARKvue, select the HELP button in any screen, including the Home Screen.

##### Connect the Sensor

- In SPARKvue, select the Bluetooth icon. In the Wireless Devices list that opens, select the desired sensor that matches the XXX-XXX Device ID number on the sensor. Select Done.

##### Collect Data

- In SPARKvue, select a measurement from the list under the sensor in the Home Screen. A graph of the measurement versus time opens.
- Select the Start button to begin collecting data.

#### PASCO Capstone

##### Software Help

See the PASCO Capstone Help for information about collecting, displaying, and analyzing data.

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

#### Connect the Sensor

- In PASCO Capstone, click Hardware Setup in the Tools palette to confirm that the sensor is recognized. Select the desired sensor in the Hardware Setup window that matches the XXX-XXX Device ID number on the sensor. Close the Hardware Setup window.

#### Collect Data

- In PASCO Capstone, select a display in the main window. In the display, use the <Select Measurement> menu(s) to set up the desired measurement in the display.
- Select Record to begin collecting data.

### Setting the Conversion Coefficient

Electrical Conductivity (EC) measured in microsiemens per centimeter ( $\mu\text{s}/\text{cm}$ ) can be converted to Total Dissolved Solids (TDS) in parts per million (ppm) using a conversion coefficient. This coefficient is determined by the ions in solution, the specific mixture of which is frequently unknown. The following ranges are recommended with any value from 0.01 to 0.99 acceptable.'

- 0.5 to 0.57 for Potassium Chloride (KCl), which is the most common calibration standard.
- 0.45 to 0.5 for Sodium Chloride (NaCl), commonly used for testing brackish and seawater.
- 0.65 to 0.85 which is the 442™ solution (40% Sodium Bicarbonate, 40% Sodium Sulfate and 20% Chloride) that simulates natural freshwater (rivers, lakes, wells, etc.). [Developed by the Myron L Company.]

The software default coefficient is 0.65.

NOTE: The coefficient is not stored in the sensor. It is used when needed on an experiment-by-experiment basis.

### Calibrating the Sensor

The sensor is calibrated at the factory. Further calibration is not needed or possible.

### Battery Usage

The Wireless Conductivity Sensor includes a 3 V coin cell battery (CR2032). Battery life is very important to making the sensor simple and always ready to use, so all of the PASCO wireless products are designed for

long battery life. For example, the sensor turns itself off after a short time of inactivity.

We expect more than one year of battery life, but the actual amount depends on factors such as the data collection sampling rate.

### Sensor Storage

If the sensor will be stored for many months, we recommend that you remove the battery to avoid damaging the sensor in case of a battery leak.

## Battery Removal and Replacement

If the sensor's battery status LED blinks red, the battery may need to be replaced. Replacing the small, disk-shaped battery involves removing the Battery Compartment Door on the bottom of the sensor, removing the old battery, installing a new battery of the same type, and replacing the Battery Compartment Door. The procedure needs a coin and a CR2032 three volt battery.

- PS-3504 Coin-cell Battery Replacement Pack (10 pack)

NOTE: This battery is commonly available in electronic and commercial stores.

### Remove the Battery Compartment Door

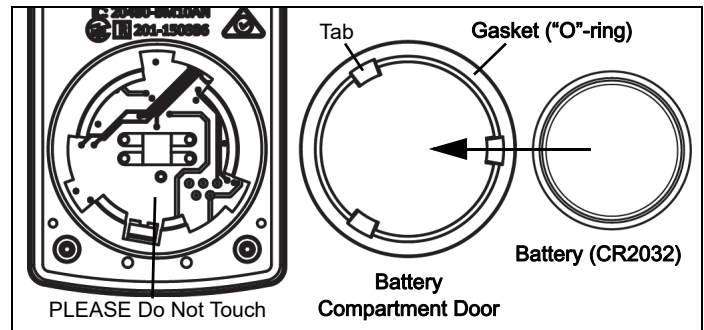
Hold the sensor bottom-side up. Use a coin in the slot to turn the Battery Compartment Door counterclockwise (left-to-right) until the indicator on the door is aligned with the second mark on the sensor.

Turn the sensor bottom-side down so that the Battery Compartment Door can drop into the palm of your hand.

Make sure that the battery door gasket stays on the door. The gasket is an "O-ring" that is held in place by



the tabs on the door. Please do not touch the inside of the battery compartment

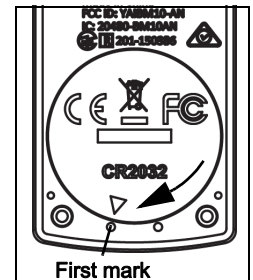


Remove the used battery from the Battery Compartment Door and replace it with a new identical type battery.

*Note that the battery is held in place by the small tabs on the door.* The side of the battery with the "+" on it should be against the door.

### Replace the Battery Compartment Door

Put the Battery Compartment Door with the new battery back onto the sensor. Align the indicator on the door with the second mark, and use the coin in the slot to turn the door clockwise (right-to-left) until the indicator is aligned with the first mark on the sensor.



(See "Battery Disposal Instructions" under Technical Support.)

### Related Item

- PS-3504 Coin-cell Battery Replacement Pack (10 pack)

## Troubleshooting the Wireless Conductivity 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, and then release the button
- 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 for ten seconds and then release the button. Turn on the sensor in the usual way.
- Turn Bluetooth off and then turn it back on. Retry.

## Conductivity Probe Maintenance

Rinse and dry the conductivity probe before putting the sensor away for storage. The probe fits in the PS-3505 Electrode Support.

### Cleaning

Select an appropriate solvent for the contaminants to which the probe is exposed:

- For oils, hot water with dish detergent can be used for cleaning.
- For lime and other hydroxide containing solutions, clean with a 5-10% solution of hydrochloric acid. or when a stronger cleaning solution is required, use concentrated hydrochloric acid mixed into 50% isopropanol.
- For algae and bacteria containing solutions, use chlorine bleach.
- Rinse with 0.1 M nitric acid and then rinse several times with distilled water.

Clean by dipping or immersing the end of the probe in the cleaning solution, agitating for two or three minutes, and rinsing first with tap water and then several times with distilled or deionized water.

Before measurement, immerse the probe in distilled water, gently tap out any trapped air bubbles, soak for at least an hour in distilled water and recalibrate.

## Suggested Experiments

Practically any experiment that uses a conductivity measurement can be done with the PS-3210 Wireless Conductivity Sensor. See the PASCO Web site at

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

for more information about experiments

### Accessories

- PS-3505 Electrode Support
- PS-3504 Coin-cell Battery Replacement Pack (10 pack)
- PS-2117 PASPORT High Accuracy Drop Counter

## Sensor Specifications

Item	Value
<b>Range</b>	0 to 20,000 microsiemens/centimeter
<b>Accuracy: Conductivity</b>	10% of value from 200 $\mu\text{S/cm}$ to 20,000 $\mu\text{S/cm}$ Below 200 $\mu\text{S/cm}$ : qualitative
<b>Accuracy: Total Dissolved Solids (TDS)</b>	15% of value from 100 parts per million (ppm) to 10,000 ppm Below 100 ppm: qualitative
<b>Response Time</b>	95% of final reading in 5 seconds
<b>Temperature Compensation for TDS</b>	5°C to 35°C
<b>Temperature Accuracy</b>	$\pm 0.5^\circ\text{C}$
<b>Operating Temperatures</b>	Sensor Housing: $-15^\circ$ to $+50^\circ\text{C}$ Probe: $0^\circ\text{C}$ to $80^\circ\text{C}$
<b>Battery</b>	Coin Cell (3 V, CR2032) Expected Battery Life > 1 Year
<b>Max Wireless Range</b>	30 m (unobstructed)
<b>International Protection Mark</b>	IP67 (water resistant at 1 meter for 30 minutes)

For conductivity of various aqueous solutions at  $25^\circ\text{C}$ , see Appendix B.

## Technical Support

For assistance with any PASCO product, contact PASCO at:

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

Phone: +1 916 462 8384 (worldwide)  
800-772-8700 (U.S.)

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

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

The Reference Guide will be updated periodically. For the latest revision of this Reference Guide, visit the PASCO Web site at

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

and enter the product number, PS-3210, in the text window.

#### Limited Warranty

For a description of the product warranty, see the PASCO catalog. For more information visit [www.pasco.com/legal](http://www.pasco.com/legal).

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#### FCC Statement

This Class A digital device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

#### CE Statement

This device has been tested and found to comply with the essential requirements and other relevant provisions of the applicable EU Directives.

#### 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.

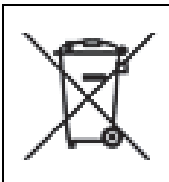
The European Union WEEE (Waste Electronic and Electrical Equipment) symbol (to the right) and on the product or its packaging indicates that this product **must not** be disposed of in a standard waste container.



#### 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 battery used in this product is marked with the International symbols to indicate the need for the separate collection and recycling of batteries.





## Appendix A: Bluetooth<sup>®</sup> Compatibility SMART

Check the PASCO Web page at

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

for the latest information on Bluetooth SMART compatibility.


Platform	Bluetooth SMART Compatibility
iOS	iPad 3 and later iPhone 4S and later iPod touch 5 and later
SPARK Element	All models
Android	Android 4.3 and later
Chromebook	Chrome OS (requires PS-3500 Adapter*)
Mac OS X <sup>1</sup>	Models introduced July 2011 or later
Windows	Windows 7 and later (requires PS-3500 Adapter*)

\*The PS-3500 USB Bluetooth 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 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 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 Adapter, please contact PASCO Technical Support for further instructions.

### What is Bluetooth SMART<sup>®</sup>?

Bluetooth SMART (also known as Bluetooth Low Energy or Version 4.0 of the Bluetooth specification) is the latest protocol of the proprietary open wireless technology standard created by telecoms vendor Ericsson in 1994. It is the power- and application-friendly version of Bluetooth that was built for the Internet of Things (IoT).

**Appendix B: Conductivity of Various Aqueous Solutions at 25°C**

<b>Solution</b>	<b>Conductivity (microS/cm)</b>
<b>Drinking water</b>	50 to 1,000
<b>Wastewater</b>	900 to 9,000
<b>KCl solution (0.01 M)</b>	1,400
<b>Potable water maximum</b>	1,500
<b>Brackish water</b>	1,000 to 80,000
<b>Industrial process water</b>	3,000 to 140,000