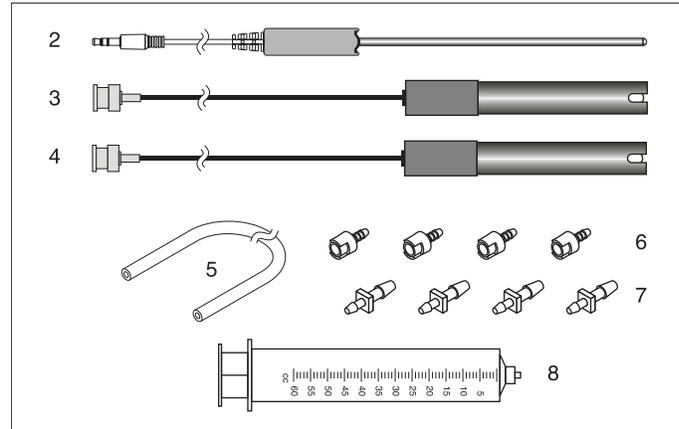
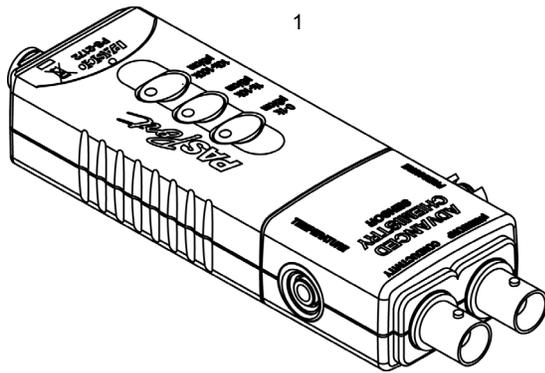


Advanced Chemistry Sensor

PS-2172



Included Equipment

Part Number

- 1. Advanced Chemistry Sensor
- 2. Stainless Steel Temperature Probe
- 3. Conductivity Probe (10x)
- 4. pH Electrode
- 5. Polyurethane Tubing (60 cm long, 1/8 inch ID)
- 6. Quick-release Connectors (qty. 4)
- 7. Tubing Connectors (qty. 4)
- 8. Syringe (60 cc)

- PS-2172
- PS-2153
- PS-2571
- PS-2573

Required Equipment

PASPORT Interface

See PASCO catalog or www.pasco.com

Optional Equipment

- Fast-response Temperature Probe PS-2135 (3-pack)
- Skin/surface Temperature Probe PS-2131
- Various Ion-selective Electrodes (ISE) See PASCO catalog or www.pasco.com
- Oxidation Reduction Potential (ORP) Electrode CI-6716

Introduction

The PS-2172 Advanced Chemistry Sensor combines four sensors in a single unit:

- Temperature
- pH, ORP and ion-selective electrode voltage
- Absolute gas pressure
- Conductivity

When connected to a PASPORT interface, the Advanced Chemistry Sensor collects data at up to 100 samples per second from each component sensor. You can use just one component sensor at a time or any combination simultaneously. If you have a PASPORT interface that supports multiple sensors, or if you have more than one interface connected to your computer, you can use the Advanced Chemistry Sensor in combination with other PASPORT sensors.

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 of the probes 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. If you plan to measure pressure in an apparatus or the included syringe, connect it to the sensor's pressure port using the included tubing and a quick-release connector.

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

For detailed information about each of the multi-sensor sensor's component sensors see pages 3–5.

Capstone Setup

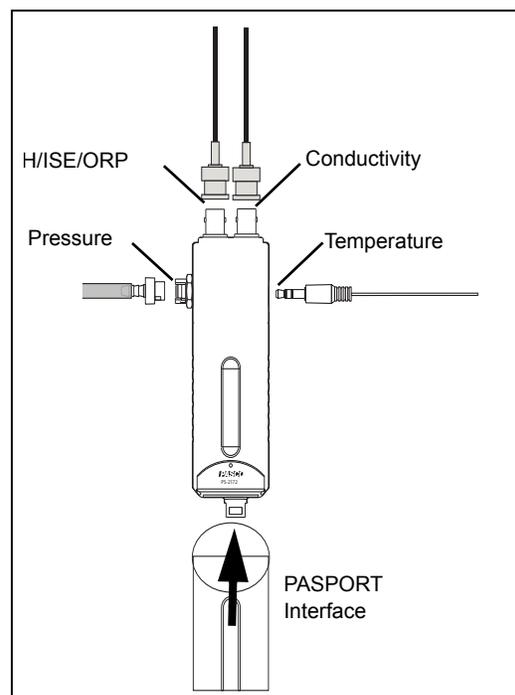
Connect the PASPORT interface using a Capstone supported interface. Build one or more displays for data. Press  to start data collection and  to stop data collection.

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. 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/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 ). 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. (In DataStudio, click the Setup button to change units.) 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 apparatus containing an embedded 10 k Ω 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 to the SPARKvue/SPARK SLS, Capstone, or Xplorer GLX User's Guide for calibration instructions.

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. 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 pH measurement for the calculated **pH** (assuming that the pH electrode is connected). For other electrodes, display **ISE Voltage** (this is valid for ISE, ORP, and pH.)

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 (or remove if using the Drop Counter). 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 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).

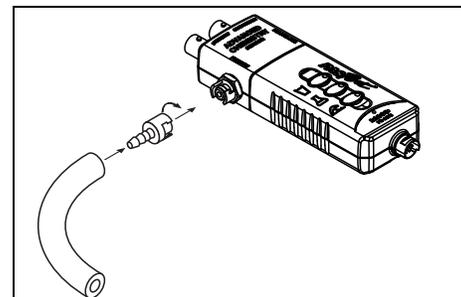
Pressure

This component of the multi-sensor measures absolute gas pressure from 20 kPa to 400 kPa. The measurement can be displayed in units of kPa, N/m², pounds per square inch (p.s.i.), atmospheres (atm), or torr.

With nothing connected to pressure port, the sensor measures atmospheric pressure.

To measure the pressure in an apparatus or the included syringe, connect it to the sensor using the included tubing and connectors. Insert the barbed end of a quick-release connector into a piece of tubing. Push the quick-release connector onto the sensor's pressure port and twist it clockwise to secure it. If your apparatus has a barbed or tapered connector (such as the included syringe), plug it directly into the other end of the tubing. If the apparatus has a quick-release pressure port, use another quick-release connector on the other end of the tubing. Use one of the included tubing connectors to connect the tubing to larger-diameter tubing or to a rubber stopper with a hole.

Note: Do not allow liquid to enter the pressure port.



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 a 1x electrode (PASCO part 699-06620). In the software 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 $\mu\text{S}/\text{cm}$. The 1x probe has one tenth of the range (up to 10000 $\mu\text{S}/\text{cm}$) but ten times better resolution.

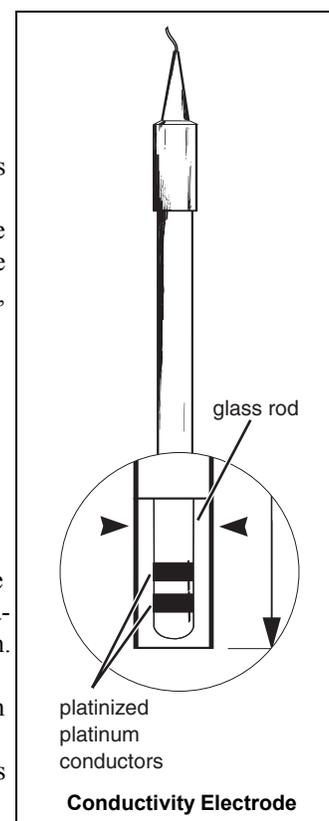
Measuring Conductivity

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: 0 $\mu\text{S}/\text{cm}$ to 1000 $\mu\text{S}/\text{cm}$, 1000 $\mu\text{S}/\text{cm}$ to 10000 $\mu\text{S}/\text{cm}$, or 10000 $\mu\text{S}/\text{cm}$ to 100000 $\mu\text{S}/\text{cm}$. Light emitting diodes (LEDs) 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 (1000 $\mu\text{S}/\text{cm}$ or 10000 $\mu\text{S}/\text{cm}$), 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 $\mu\text{S}/\text{cm}$ for “pure” water is typical. True pure water is difficult to obtain and



Range ($\mu\text{S}/\text{cm}$)
10X Probe

0-1k
 $\mu\text{S}/\text{cm}$

1k-10k
 $\mu\text{S}/\text{cm}$

10k-100k
 $\mu\text{S}/\text{cm}$

LED indicates selected range.

store. The table (right) lists typical conductivity values for common aqueous solutions at 25 °C.

As a rule of thumb, to estimate total dissolved solids (TDS) in parts per million (ppm), divide the conductivity in $\mu\text{S}/\text{cm}$ by 2:

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

Solution	Conductivity ($\mu\text{S}/\text{cm}$)
Ultra-pure Water	0.05 to 0.75
Drinking Water	50 to 1500
Ocean Water	~53000

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 the Appendix section. Refer to the SPARKvue/SPARK SLS, Capstone, or Xplorer GLX User's Guide 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.

Specifications

General	
Component Sensors	Temperature, pH/ISE/ORP probe voltage, Absolute Pressure, Voltage
Max. Sampling Rate	100 samples per second (for each component sensor)
Default Sampling Rate	10 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
pH/ISE/ORP probe voltage	
Electrode Connector	standard BNC
Voltage Range	-2000 mV to +2000 mV
Voltage Resolution	0.1 mV
pH Range	0 to 14
pH Resolution	0.001
Absolute Pressure	
Range	20 kPa to 700 kPa
Accuracy	2 kPa
Resolution	0.1 kPa
Repeatability	1 kPa
Conductivity	
Range	three user-selectable ranges: 0 to 1000 μS/cm, 1000 to 10000 μS/cm, 10000 to 100000 μS/cm with included 10x probe 0 to 100 μS/cm, 100 to 1000 μS/cm, 1000 to 10000 μS/cm with optional 1x probe
Accuracy	±10% of full scale without calibration
Resolution	better than 0.05% of full scale

Appendix A: DataStudio Calibration

In DataStudio, click the Setup button to open the Experiment Setup window; in that window, click the Calibrate button to open the Calibrate Sensors dialog box. For a two-point calibration, you will need two “known standards,” such as two buffer solutions of known pH or two liquids of known temperature.

1. From the Sensor field, select **Chemistry**.
2. From the Measurement field, select **Temperature or pH**.
3. Ensure that “Calibrate all similar measurements simultaneously” is *not* selected.
4. From the Calibration Type menu, select **2 Point (Adjust Slope and Offset)**, if it is not already selected.
5. Place the temperature or pH probe in the first known standard.
6. Enter the known temperature or pH of the standard in the **Standard Value** field for Point 1.
7. Observe the **Present Sensor Measurement** and wait until it has stabilized.
8. Click the **Read From Sensor** button for Point 1.
9. Place the probe in the second known standard.
10. Enter the known temperature or pH of the standard in the **Standard Value** field for Point 2.
11. Observe the **Present Sensor Measurement** and wait until it has stabilized.
12. Click the **Read From Sensor** button for Point 2.
13. Click **OK** to accept the new calibration.

Sensor, Measurement, Unit

Chemistry

Temperature (°C)

Calibrate all similar measurements simultaneously.

Previous Calibration

Slope 1.000 DegC/°C Offset 0.000 DegC

Present Sensor Measurement

25.35 °C 25.35 DegC

Calibration Type

2 Point (Adjust Slope and Offset)

1 Point (Adjust Offset Only)

1 Point (Adjust Slope Only)

Calibration Point 1

Standard Value 0.000 °C Sensor Value 0.000 DegC Read From Sensor

Calibration Point 2

Standard Value 100.0 °C Sensor Value 100.0 DegC Read From Sensor

New Calibration

Slope 1.000 DegC/°C Offset 0.000 DegC

OK Cancel

Appendix B: Reference 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

¹Excluding 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

Technical Support

For assistance with any PASCO product, contact PASCO at:

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

Phone: 916-462-8343 (worldwide)
877-373-0300 (U.S.)

Web: www.pasco.com

Email: support@pasco.com

Limited Warranty

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

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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.

