

# pH Sensor

(Order Code PH-BTA)



Our pH Sensor can be used for any lab or demonstration that can be done with a traditional pH meter, including acid-base titrations, monitoring pH in an aquarium, and investigating the water quality of streams and lakes.

## Inventory of Items Included with the pH Sensor

- pH Sensor
- Electrode Storage bottle, containing pH 4/KCl solution

**NOTE:** Vernier products are designed for educational use. Our products are not designed nor are they recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

## Collecting Data with the pH Sensor

This sensor can be used with the following interfaces to collect data.

- Vernier LabQuest<sup>®</sup> 2 or original LabQuest as a standalone device or with a computer
- Vernier LabQuest Mini with a computer
- Vernier LabPro<sup>®</sup> with a computer or TI graphing calculator
- Vernier Go!<sup>®</sup>Link
- Vernier EasyLink<sup>®</sup>
- Vernier SensorDAQ<sup>®</sup>
- CBL 2<sup>™</sup>
- TI-Nspire<sup>™</sup> Lab Cradle

Here is the general procedure to follow when using the pH Sensor:

1. Connect the pH Sensor to the interface.
2. Start the data-collection software.
3. The software will identify the pH Sensor and load a default data-collection setup. You are now ready to collect data.

**Important:** Do not fully submerge the sensor. The handle is not waterproof.

## Data-Collection Software

This sensor can be used with an interface and the following data-collection software.

- **Logger Pro 3** This computer program is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go! Link.
- **Logger Lite** This computer program is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go! Link.
- **LabQuest App** This program is used when LabQuest 2 or LabQuest is used as a standalone device.

- **DataQuest<sup>™</sup> Software for TI-Nspire<sup>™</sup>** This calculator application for the TI-Nspire<sup>™</sup> can be used with the EasyLink or TI-Nspire<sup>™</sup> Lab Cradle.
- **EasyData App** This calculator application for the TI-83 Plus and TI-84 Plus can be used with CBL 2, LabPro, and Vernier EasyLink. We recommend version 2.0 or newer, which can be downloaded from the Vernier website, [www.vernier.com/easy/easydata.html](http://www.vernier.com/easy/easydata.html), and then transferred to the calculator. See the Vernier website, [www.vernier.com/calc/software/index.html](http://www.vernier.com/calc/software/index.html) for more information on the App and Program Transfer Guidebook.
- **DataMate program** Use DataMate with LabPro or CBL 2 and TI-73, TI-83, TI-84, TI-86, TI-89, and Voyage 200 calculators. See the LabPro and CBL 2<sup>™</sup> Guidebooks for instructions on transferring DataMate to the calculator.
- **LabVIEW<sup>™</sup>** National Instruments LabVIEW<sup>™</sup> software is a graphical programming language sold by National Instruments. It is used with SensorDAQ and can be used with a number of other Vernier interfaces. See [www.vernier.com/labview](http://www.vernier.com/labview) for more information.

This sensor is equipped with circuitry that supports auto-ID. When used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, Go! Link, SensorDAQ, TI-Nspire<sup>™</sup> Lab Cradle, EasyLink, or CBL 2<sup>™</sup>, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor.

## How the pH Sensor Works

The pH amplifier inside the handle is a circuit which allows the standard combination pH electrode to be monitored by a lab interface. The cable from the pH amplifier ends in a BTA plug.

The pH Sensor will produce a voltage of approximately 1.75 volts in a pH 7 buffer. The voltage will increase by about 0.25 volts for every pH number decrease. The voltage will decrease by about 0.25 volts/pH number as the pH increases.

The Vernier gel-filled pH Sensor is designed to make measurements in the pH range of 0 to 14. The gel-filled reference half cell is sealed; it cannot be refilled.

## Prepare the Electrode for Use

To prepare the electrode to make pH measurements, follow this procedure:

- Remove the storage bottle from the electrode by first unscrewing the lid and then removing the bottle and lid. Thoroughly rinse the lower section of the probe, especially around the bulb-shaped tip, using distilled or deionized water.
- Connect the pH Sensor to your lab interface and run data-collection software.  
**Note:** Do not completely submerge the sensor. The handle is not waterproof.

When you are finished making measurements, rinse the electrode with distilled water. Slide the cap onto the electrode body, and then screw the cap onto the storage bottle so the tip of the electrode is immersed in the storage solution. When the probe is not being stored in the storage bottle, it can be stored for short periods of time (up to 24 hours) in pH 4 or pH 7 buffer solution.

It should never be stored in distilled water. It is a good idea to prepare a quantity of pH 4 buffer/KCl storage solution (see the section on Maintenance and Storage) and use it to replace lost solution.

## Calibration

For many experiments, calibrating the pH Sensor is not required. We store a calibration equation on each pH sensor before shipping it, which is used as a default by our software.

For the most accurate measurements with this sensor, we recommend calibration. It is a simple process that takes only a few minutes.

### Calibrate the pH Sensor Using Logger Pro 3

Before starting the calibration, obtain two buffer solutions and some distilled water for rinsing. pH 4 and pH 7 buffer solutions work well, but any two buffers will be suitable.

1. Connect the pH Sensor to your computer with a Vernier computer interface (LabPro, Go! Link, LabQuest Mini, LabQuest or LabQuest 2).
2. Choose Calibrate ► CH1: pH from the Experiment menu and then click Calibrate Now.
3. Remove the storage bottle from the pH Sensor, rinse the tip of the sensor with distilled water, and place the sensor in the first buffer solution so the tip is immersed.
4. Near the middle right of the calibration dialog box, you will see the potential output of the pH sensor, in volts. Type the pH of the buffer solution, in which the sensor rests, in the edit box. When the displayed voltage reading stabilizes, click Keep.
5. Rinse the pH sensor with distilled water and place it in the second buffer solution. The potential (voltage) will change. Type the pH of the second buffer solution in the second edit box. When the displayed voltage reading stabilizes, click Keep.
6. (Optional) If you wish to store the calibration on the sensor itself, click the Calibration Storage tab. If you wish to use the calibration only for the current experiment, skip to Step 9.
7. Click Set Sensor Calibration. Make sure the Default Page corresponds to your new calibration. Click Set.
8. Click Done. You will be prompted by the message, “Warning: You are about to change information in your sensor. Configuration data stored on the sensor will be lost. Pressing ‘Write’ will apply your changes to the sensor.” Click Write.
9. Click Done to complete the calibration process.

After you store a calibration to the pH Sensor, this new calibration will be used automatically, regardless of the interface to which the pH Sensor is connected.

You can set the pH sensor back to its factory calibration by following these steps:

1. Select Calibrate ► CH1: pH from the Experiment menu.
2. Click the Calibration Storage tab.
3. Click Set Sensor Factory Defaults.

### Calibrate the pH Sensor Using LabQuest

1. Connect the pH Sensor to your LabQuest. The pH reading will be displayed.
2. Choose Calibrate ► CH1: pH from the Sensors menu and tap Calibrate Now.
3. Remove the storage bottle from the pH Sensor, rinse the tip of the sensor with distilled water, and place the sensor in the first buffer solution so the tip is immersed.
4. Enter the pH of the buffer solution as the known value for Reading 1. When the voltage reading stabilizes, tap Keep.
5. Rinse the pH sensor with distilled water and place it in the second buffer solution.
6. In the Reading 2 field, enter the pH of the second buffer solution. When the voltage reading stabilizes, tap Keep.
7. (Optional) If you wish to store the calibration on the sensor itself, tap the Storage tab at the top of the screen. If you wish to use the calibration only for the current experiment, skip to Step 9.
8. On the Storage page, tap Save Calibration to Sensor. A message will appear: “Saving this calibration to the sensor will result in it being the new Custom Calibration 1”. Tap OK to proceed.
9. Tap OK to complete the calibration process.

After you store a calibration to the pH Sensor, this new calibration will be used automatically, regardless of the interface to which the pH Sensor is connected.

You can set the pH sensor back to its factory calibration by following these steps:

1. Choose Calibrate ► CH1: pH from the Sensors menu.
2. Tap the Storage tab.
3. Tap Restore Sensor Factory Defaults.

### pH Buffer Solutions

In order to calibrate a pH Sensor, or to confirm that a saved pH calibration is accurate, you should have a supply of pH buffer solutions that cover the range of pH values you will be measuring. We recommend buffer solutions of pH 4, 7, and 10.

- Vernier sells a pH buffer kit (order code PHB). The kit contains 4 tablets each of buffer pH 4, 7, and 10 and a small bottle of buffer preservative. Each tablet is added to 100 mL of distilled water to prepare respective pH buffer solutions.
- Flinn Scientific ([www.flinnsci.com](http://www.flinnsci.com), Tel: 800-452-1261) sells a wide variety of buffer tablets and prepared buffer solutions.
- You can prepare your own buffer solutions using the following recipes:

|          |  |
|----------|--|
| pH 4.00  | Add 2.0 mL of 0.1 M HCl to 1000 mL of 0.1 M potassium hydrogen phthalate.    |
| pH 7.00  | Add 582 mL of 0.1 M NaOH to 1000 mL of 0.1 M potassium dihydrogen phosphate. |
| pH 10.00 | Add 214 mL of 0.1 M NaOH to 1000 mL of 0.05 M sodium bicarbonate.            |

## Maintenance and Storage

Short-term storage (up to 24 hours): Place the electrode in pH 4 or pH 7 buffer solution.

Long-term storage (more than 24 hours): Store the electrode in a pH 4 buffer/KCl storage solution in the storage bottle. The pH Electrode is shipped in this solution. Vernier sells 500 mL bottles of pH Storage Solution (order code PH-SS), or you can prepare additional storage solution by adding 10 g of solid potassium chloride (KCl) to 100 mL of pH 4 buffer solution. Flinn Scientific (800-452-1261) sells a Buffer Solution Preservative (order code B0175) that can be added to this storage solution. By storing the electrode in this solution, the reference portion of the electrode is kept moist. Keeping the reference junction moist contributes to electrode longevity and retains electrode response time when the unit is placed back into service. If the electrode is inadvertently stored dry, immerse the unit in pH 4 buffer/KCl storage solution for a minimum of eight hours prior to service.

When testing a pH Sensor, it is best to measure a buffer solution because it is easier to determine if the sensor is reading correctly. Do not test your sensor by measuring distilled water. Distilled water can have a pH reading in the range of 5.5–7.0, due to varying amounts of dissolved carbon dioxide. Furthermore, due to a lack of ions, the pH values reported with the sensor in distilled water will be erratic.

If your pH Sensor is reading differently from the pH of a buffer solution (e.g., reads 6.7 in a buffer 7), you may simply need to calibrate the sensor.

If your readings are off by several pH values, the pH readings do not change when moved from one buffer solution to another different buffer, the sensor was stored dry, or the sensor's response seems slow, the problem may be more serious. A method called "shocking" can be used to revive pH electrodes. To shock your pH Sensor, perform the following:

1. Soak the pH Electrode for 4–8 hours in an HCl solution of 0.1 M–0.5 M.
2. Rinse off the electrode and soak the tip in pH 7 buffer for 30–60 minutes.
3. Rinse the electrode and test it with buffer solutions of known pH.

Occasionally, mold will grow in the pH 4 buffer/storage solution. Mold will not harm the electrode and can easily be removed using a mild detergent solution. Mold growth in the storage solution can be inhibited by adding a buffer preservative.

The pH sensor is designed to be used in aqueous solutions. The polycarbonate body of the sensor can be damaged by many organic solvents. In addition, do not use the sensor in solutions containing: perchlorates, silver ions, sulfide ions, biological samples with high concentrations of proteins, or Tris buffered solutions.<sup>1</sup> Do not use the sensor with hydrofluoric acid or in acid or base solutions with a concentration greater than 1.0 molar.

The electrode may be used to measure the pH of sodium hydroxide solutions with a concentration near 1.0 molar, but it should not be left in this concentration of sodium hydroxide for periods longer than 5 minutes. Using or storing the electrode at very high temperatures (>80°C) or very low temperatures (near 0°C) can damage it beyond repair.

## Specifications

|                            |   |        |
|----------------------------|---|--------|
| Type                       | Sealed, gel-filled, epoxy body, Ag/AgCl         |        |
| Response time              | 90% of final reading in 1 second in a buffer    |        |
| Temperature range          | 5 to 80°C (readings not compensated)            |        |
| Range                      | pH 0–14   |        |
| Accuracy                   | ± 0.2 pH units                                  |        |
| Isopotential pH            | pH 7 (point at which temperature has no effect) |        |
| Default calibration values | slope   | –3.838 |
|                            | intercept                                       | 13.720 |
| Shaft diameter             | 12 mm OD  |        |

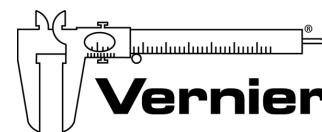
## pH Sensor Accessories

| Item                               | Order Code |
|------------------------------------|------------|
| Electrode Storage Solution, 500 mL | PH-SS      |
| Buffer Tablets                     | PHB        |
| Storage Solution Bottles, pkg of 5 | BTL        |

<sup>1</sup> Vernier offers a Tris-Compatible Flat pH Sensor which features a double junction electrode, so it can be used with proteins, sulfides, and Tris buffers. Order code FPH-BTA.

## Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use. Additionally, the warranty does not cover accidental breakage of the glass bulb of the pH Sensor.



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