

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. This sensor offers the additional advantages of automated data collection, graphing, and data analysis. Typical activities using our pH sensor include studies of household acids and bases, acid-base titrations, monitoring pH change during chemical reactions or in an aquarium as a result of photosynthesis, investigations of acid rain and buffering, and investigations of water quality in streams and lakes.

Collecting Data with the pH Sensor

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

- Vernier LabQuest[®] as a standalone device or with a computer
- Vernier LabQuest[®] Mini with a computer
- Vernier LabPro[®] with a computer, TI graphing calculator, or Palm[®] handheld
- Vernier Go![®]Link
- Vernier EasyLink[®]
- Vernier SensorDAQ[®]
- CBL 2[™]

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 software¹.
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, LabQuest Mini, LabPro, or Go!Link.
- **Logger Pro 2** This computer program is used with ULI or Serial Box Interface.
- **Logger Lite** This computer program is used with LabQuest, LabQuest Mini, LabPro, or Go!Link.
- **LabQuest App** This program is used when LabQuest is used as a standalone device.
- **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 web site, www.vernier.com/easy/easydata.html, and then transferred to the calculator.

¹ If you are using Logger Pro 2 with either a ULI or SBI, the sensor will not auto-ID. Open an experiment file for the pH Sensor in the Probes & Sensors folder.

See the Vernier web site, 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 Guidebooks for instructions on transferring DataMate to the calculator.
- **Data Pro** This program is used with LabPro and a Palm handheld.
- **LabVIEW** National Instruments LabVIEW[™] 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 for more information.

pH Electrode Specifications

Type:	Sealed, gel-filled, epoxy body, Ag/AgCl
Response time:	90% of final reading in 1 second
Temperature range:	5 to 80°C
12 mm OD	
Range:	pH 0–14
13-bit Resolution (SensorDAQ):	0.0025 pH units
12-bit Resolution (LabQuest, LabQuest Mini, Go!Link, LabPro, ULI, SBI):	0.005 pH units
10-bit Resolution (CBL 2):	0.02 pH units
Isopotential pH:	pH 7 (point at which temperature has no effect)
Output:	59.2 mV/pH at 25°C
Stored Calibration Values ² :	
Intercept (k_0):	13.720
Slope (k_1):	-3.838

NOTE: This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

How the pH Sensor Works

The pH Amplifier inside the handle is a circuit which allows a standard combination pH electrode (such as the Vernier 7120B) 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 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. A polycarbonate body that extends below the glass sensing bulb of the

² These are average calibration values. Actual values may vary because sensors are individually calibrated by Vernier before shipping.

electrode makes this probe ideal for the demands of a middle school, high school, or university level science class or for making measurements in the environment. The gel-filled reference half cell is sealed—it never needs to be refilled.

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

Preparing 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, then removing the bottle and lid. Thoroughly rinse the lower section of the probe, especially the region of the bulb, using distilled or deionized water.
 - 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.
 - Connect the pH Sensor to your lab interface, load or perform a calibration (as described in the next section), and you are ready to make pH measurements.
- Note:** Do not completely submerge the sensor. The handle is not waterproof.

When you are finished making measurements, rinse the tip of the electrode with distilled water. Slide the cap onto the electrode body, then screw the cap onto the storage bottle. Note: When the level of storage solution left in the bottle gets low, you can replenish it with small amounts of tap water the first few times you use the probe (but not indefinitely!). A better solution is 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.

Do I Need to Calibrate the pH Sensor?

We feel that you should not have to perform a new calibration when using the pH Sensor for most experiments in the classroom. We have set the sensor to match our stored calibration before shipping it. You can simply use the appropriate calibration file that is stored in your data-collection program from Vernier in any of these ways:

- If you ordered the PH-BTA version of the sensor, and you are using it with a LabQuest, LabQuest Mini, LabPro or CBL 2 interface, then a calibration (in pH) is automatically loaded when the pH Sensor is connected. **Note:** Each pH Sensor (PH-BTA version) is calibrated at Vernier. This custom calibration is then stored on the sensor. This means that when you first use it, you will see pH readings that are accurate to +/- 0.10 pH units, without calibration! With time, you may see some minor loss of the initial custom calibration accuracy, but for most purposes (see below), it should not be necessary to calibrate the pH Sensor.
- If you are using Logger *Pro* software (version 2.0 or newer) on a Macintosh or Windows computer, open an experiment file for the pH Sensor, and its stored calibration will be loaded at the same time. **Note:** If you have an earlier version of Logger *Pro*, a free upgrade is available from our web site.

- Any version of the DataMate or EasyData program (with LabPro or CBL 2) has stored calibrations for this sensor.
- Any version of Data Pro has stored calibrations for this sensor.

If you are performing a chemistry experiment, or doing water quality testing that requires a very accurate calibration, you can calibrate the Vernier pH Electrode following this procedure:

- Use the 2-point calibration option of the Vernier data-collection program. Rinse the tip of the electrode in distilled water. Place the electrode into one of the buffer solutions (e.g., pH 4). When the voltage reading displayed on the computer or calculator screen stabilizes, enter a pH value, “4”.
- For the next calibration point, rinse the electrode and place it into a second buffer solution (e.g., pH 7). When the displayed voltage stabilizes, enter a pH value, “7”.
- Rinse the electrode with distilled water and place it in the sample.

pH Buffer Solutions

In order to do a calibration of the pH Sensor, or to confirm that a saved pH calibration is accurate, you need to 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 has 12 tablets: four tablets each of buffer pH 4, 7, and 10. Each tablet is added to 100 mL of distilled or deionized water to prepare respective pH buffer solutions.
- Flinn Scientific (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 buffer pH-4/KCl storage solution in the storage bottle. The pH Electrode is shipped in this solution. Vernier sells 500 mL bottles of replacement 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 buffer pH-4 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 adds to electrode longevity and retains electrode response time when the unit is placed back into

service. If the electrode is inadvertently stored dry (we don't recommend this!), immerse the unit in soaking solution for a minimum of eight hours prior to service.

When testing a pH Sensor, it is best to place it into a known buffer solution. This allows you to see if the sensor is reading correctly (e.g., in a buffer pH 7, is the sensor reading close to pH 7). Do not place your sensor into distilled water to check for readings—distilled water can have a pH reading anywhere between 5.5 and 7.0, due to variable amounts of carbon dioxide dissolved from the atmosphere. 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 slightly off of the known buffer pH (e.g., reads 6.7 in a buffer 7), you may simply need to calibrate the sensor. You can calibrate the sensor in two buffer solutions for two calibration points. If you do not remember or know how to perform a calibration, refer to the booklet that came with the pH 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, or the sensor's response seems slow, the problem may be more serious. Sometimes a method called "shocking" is used to revive pH electrodes. To shock your pH Sensor, perform the following:

1. Let the pH Electrode soak for 4-8 hours in an HCl solution between 0.1 and 1.0 M.
2. Rinse off the electrode and let it sit in some buffer pH 7 for an hour or so.
3. Rinse the electrode and give it another try.

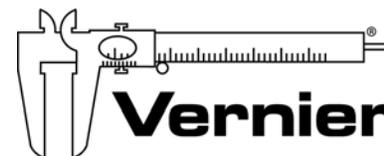
Mold growth in the buffer/KCl storage solution can be prevented by adding a commercial growth inhibitor. This mold will not harm the electrode and can easily be removed using a light detergent solution.

This 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.³ Do not use it in 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 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 or very low temperatures (near 0°C) can damage it beyond repair.

³ Vernier now offers 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.



Measure. Analyze. Learn.™

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