Salinity Sensor

(Order Code SAL-BTA)

The Salinity Sensor measures the conductivity of a solution with a high ion concentration. Salinity is the total of all non-carbonate salts dissolved in water, usually expressed in parts per thousand (1 ppt = 1000 mg/L). Salinity is an important measurement in seawater. The salinity level in seawater is fairly constant, at about 35 ppt (35,000 mg/L).

- Use this sensor for an accurate on-site measurement of salinity in ocean water.
- Allow students to qualitatively see the difference between the ionic and molecular nature of substances in aqueous solution.
- Use the sensor to confirm the direct relationship between salinity and ion concentration in an aqueous solution. Concentrations of unknown samples can then be determined.
- Monitor the rate of reaction in a chemical reaction in which dissolved ions and solution salinity varies with time due to an ionic species being consumed or produced.

Collecting Data with the Salinity Sensor

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

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

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

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

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.
- **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.
- **DataMate program** Use DataMate with LabPro or CBL 2 and TI-73, TI-83, TI-84, TI-86, TI-89, and Voyage 200 calculators.
- **DataQuest™ Software for TI-Nspire™** This calculator application for the TI-Nspire can be used with the EasyLink or TI-Nspire Lab Cradle.
- **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.

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.

Specifications

Range of Salinity Sensor	0 to 50 ppt (0 to 50,000 ppm)
Accuracy using factory calibration	±3% of full-scale (calibrated at 17.5 and 35 ppt)
Accuracy using custom calibration	±1% of full-scale (user calibrated)
Response time	90% of full-scale reading in 10 s
Temperature compensation	automatic from 5 to 35°C
Temperature range (can be placed in)	0 to 80°C
Cell constant	10 cm^{-1}
Description	dip type, epoxy body, parallel platinum electrodes
Dimensions	12 mm OD and 150 mm length
Calibration values	
slope	16.3 ppt/V
intercept	0

How the Salinity Sensor Works

The Vernier Salinity Sensor measures the ability of a solution to conduct an electric current between two electrodes. In solution, the current flows by ion transport; therefore, an increasing concentration of ions in the solution will result in higher conductivity values.

The Salinity Sensor is actually measuring *conductance*, defined as the reciprocal of resistance. Even though the Salinity Sensor is measuring conductance, we are interested in finding *conductivity* of a solution. A potential difference is applied to the two probe electrodes in the Salinity Sensor. The resulting current is proportional to the conductivity of the solution. This current is converted into a voltage.

Alternating current is supplied to prevent the complete ion migration to the two electrodes. As shown in Figure 1, with each cycle of the alternating current, the polarity of the electrodes is reversed, which in turn reverses the direction of ion flow. This very important feature of the Salinity Sensor prevents most electrolysis and polarization from occurring at the electrodes. Thus, the solutions that are being measured for conductivity are not fouled. It also greatly reduces redox products from forming on the electrodes.

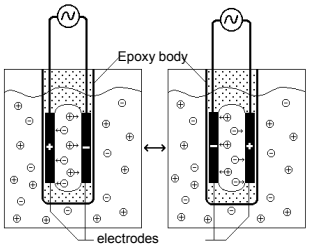


Figure 1

Taking Measurements with the Salinity Sensor

- Rinse the tip of the Salinity Sensor with distilled water. Blot the inside of the electrode cell dry to avoid water droplets diluting or contaminating the sample to be tested.
- Insert the tip of the sensor into the sample to be tested. **Important:** Be sure the electrode surfaces in the elongated cell are completely submerged in the liquid and that there are no bubbles around the electrode surface.
- While gently swirling the probe, wait for the reading on your data-collection device to stabilize. This should take about 10 seconds.
- **Important:** Do not completely submerge the sensor. The handle is not waterproof.
- Rinse the end of the probe with distilled water before taking another measurement.
- If you are taking readings at temperatures below 15°C or above 30°C, allow more time for the temperature compensation to adjust and provide a stable salinity reading.
- **Important:** Do not place the electrode in viscous, organic liquids, such as heavy oils, glycerin (glycerol), or ethylene glycol. Do not place the probe in acetone or non-polar solvents, such as pentane or hexane.

Calibration

For many experiments, calibrating the Salinity Sensor is not required. We store a calibration equation on each 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.

Calibrating the Salinity Sensor Using Logger *Pro* 3

Before starting the calibration, obtain two standard solutions and some distilled water for rinsing. For best results, it is recommended that the two-point calibration be performed using two standard solutions that bracket the expected range of salinity or concentration values you will be testing. For example, if you expect to measure salinity in the range of 30 ppt, you may want to use a standard solution that is 25 ppt for one calibration point and another standard that is 35 ppt for the second calibration point.

1. Connect the Sensor to your computer with a Vernier computer interface (LabPro, Go! Link, LabQuest Mini, LabQuest, or LabQuest 2).
2. Choose Calibrate ▸ CH1: Salinity from the Experiment menu and then click Calibrate Now.
3. Rinse the tip of the sensor with distilled water, and place the sensor in the first standard solution so the tip is immersed.
4. Near the middle right of the calibration dialog box, you will see the potential output of the sensor, in volts. Type the salinity of the standard solution, in which the sensor rests, in the edit box in the appropriate units. When the displayed voltage reading stabilizes, click Keep.
5. Rinse the sensor with distilled water and place it in the second standard solution. The potential (voltage) will change. Type the salinity of the second 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, click Done.
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.

You have now stored the calibration on the sensor itself. This new calibration will be used from now on, until you replace it by conducting another calibration or by reverting to the factory calibration.

You can set the Salinity Sensor back to its factory calibration by following these steps:

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

Calibrating the Salinity Sensor Using a LabQuest

1. Connect the Sensor to LabQuest. The salinity reading will be displayed.
2. Choose Calibrate ▸ CH1: Salinity from the Sensors menu and tap Calibrate Now.
3. Rinse the tip of the sensor with distilled water, and place the sensor in the first standard solution so the tip is immersed.
4. Enter the salinity value of the standard solution as the known value for Reading 1. When the voltage reading stabilizes, tap Keep.
5. Rinse the sensor with distilled water and place it in the second solution.
6. In the Reading 2 field, enter the salinity of the second standard 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 Salinity Sensor, this new calibration will be used automatically, regardless of the interface to which the sensor is connected.

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

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

Storage and Maintenance of the Salinity Sensor

When you have finished using the Salinity Sensor, simply rinse it off with distilled water and blot it dry using a paper towel or lab wipe. The probe can then be stored dry.

Making Standard Calibration Solutions

If you choose to calibrate the Salinity Sensor, you will want an accurate standard solution. Vernier sells a 35 ppt standard solution (order code SAL-ST). To prepare your own 35 ppt standard solution using solid NaCl, use a container with accurate volume markings (e.g., volumetric flask). Add 33.03 g NaCl to enough distilled water to make 1 liter of solution. Use reagent grade NaCl.

Note: The Practical Salinity Scale 1978 was developed relative to a KCl solution. *Standard Methods for the Examination of Water and Wastewater* states that "A seawater with a conductivity at 15°C equal to that of a KCl solution containing a mass of 32.4356 g in a mass of 1 kg of solution is defined as having a practical salinity of 35."

Automatic Temperature Compensation

Your Vernier Salinity Sensor is automatically temperature compensated between temperatures of 5°C and 35°C. Note that the temperature of a solution is being read by a thermistor that extends into the space between the graphite electrodes. Readings are automatically referenced to a salinity value at 25°C. Therefore, the Salinity Sensor will give the same reading in a solution that is at 15°C as it would if the same solution were warmed to 25°C. This means you can calibrate your probe in the lab, and then use these stored calibrations to take readings in colder (or warmer) water in a lake or stream. If the probe was not temperature compensated, you would notice a change in the reading as temperature changed, even though the actual ion concentration did not change.

Using the Salinity Sensor with Other Vernier Sensors

Some combinations of sensors interfere with each other when placed in the same solution. The degree of interference depends on many factors, such as the combination of sensors being used and the interface to which the sensors are connected. For more information, see www.vernier.com/til/638/

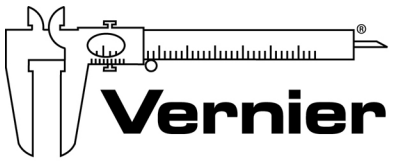
Sampling in the Field

In free-flowing streams, there will usually be good mixing of the water, so that samples taken near the current will be a good representative of the stream as a whole. If you are sampling an impounded stream or a lake, there will be very little mixing. Therefore, it is important to sample away from shore and at different depths, if possible. Do not immerse the Vernier Salinity Sensor above the top of the electrode because the connection between the electrode and the handle is not waterproof. The electrode is not constructed to withstand higher pressures, thus seepage into electronic components of the electrode will result. Although it is better to take readings at the collection site, readings of salinity should not change significantly if you collect samples and take readings at a later time. However, be sure that samples are capped to prevent evaporation.

If sample bottles are filled brim full, then a gas such as carbon dioxide, which is capable of forming ionic species in solution, is prevented from dissolving in the water sample. Since the probe has built-in temperature compensation, you can do your calibration in the lab. This means that even though you will be sampling in water that has a different temperature than your calibration temperature, the probe will take correct readings at the new sampling temperature.

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.



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