ORP Sensor
(Order Code ORP-BTA)

The ORP sensor measures the ability of a solution to act as an oxidizing agent or reducing agent. ORP stands for oxidation-reduction potential. For example, ORP electrodes are often used to measure the oxidizing ability of chlorine in swimming pools, or to determine when the equivalence point has been reached in an oxidation-reduction reaction.

Collecting Data with the ORP 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 ORP Sensor:

1. Connect the ORP Sensor to the interface.
2. Start the data-collection software.
3. The software will identify the ORP 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** Use this 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.
- **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 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.

How the ORP Sensor Works

The electrode has two components: a *measuring* half cell comprised of platinum metal immersed in the solution in which the redox reaction is taking place, and a *reference* half cell (sealed gel-filled Ag/AgCl) to which the platinum half cell is referenced.

The Vernier ORP can measure redox potential in the range of –450 to +1100 mV. Readings toward the positive region of this range indicate a strong oxidizing agent, while readings toward the negative region indicate a strong reducing agent.

This sensor is equipped with circuitry that supports auto-ID. When used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, Go! Link, SensorDAQ, TI-Nspire™ Lab Cradle, 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.

Optional Calibration Procedure

In most experiments done with an ORP Sensor the precise potential in mV is not critical; rather, the large change in potential is the most important factor. As a result, we feel that you should not have to perform a new calibration when using the ORP Sensor for most experiments. You can simply use the appropriate calibration that is stored with this auto-ID sensor.

If you are doing water quality testing or performing a chemistry experiment that requires a very accurate calibration, you will need two commercial ORP standards. Using these standards, perform the following calibration, using the 2-point calibration option in all Vernier data-collection programs (this calibration assumes you have two ORP calibration standards, one at 100 mV, another at 300 mV):

- For the first calibration point, rinse the tip of the electrode with distilled water, and place the electrode into the first standard. When the voltage reading displayed by the data-collection program stabilizes, enter the mV value of the first ORP standard (e.g., 100).
- For the second calibration point, remove the electrode from the first standard, rinse it with distilled water, and place it into the second standard. When the voltage stabilizes, enter the mV reading of the second standard (e.g., 300).
- Rinse the electrode with distilled water and place it into the sample. You are now ready to take measurements with the calibrated ORP Sensor.

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.

Specifications

ORP Electrode

Type	Sealed, gel-filled, epoxy body, Ag/AgCl reference
Storage solution	pH-4/KCl solution (10 g KCl in 100 mL buffer pH-4 solution)
Cable	1 meter coaxial cable with BNC connector
Temperature range	0–60ºC
	12 mm OD
	Impedance: ~20 kΩ at 25ºC
ORP element	99% pure platinum band sealed on a glass stem

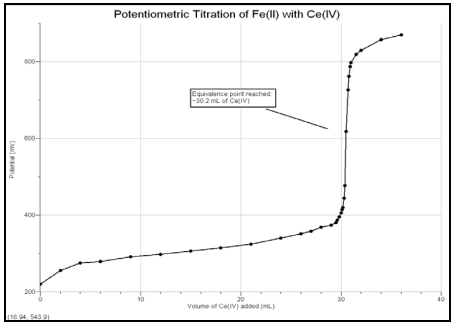
Electrode Amplifier (included with each ORP Sensor)

Calibration (mV)	
slope:	466.875
intercept:	–559.793
13-bit resolution (SensorDAQ):	0.25 mV
12-bit resolution (LabPro, LabQuest 2, LabQuest, LabQuest Mini, TI-Nspire™ Lab Cradle, Go! Link, or EasyLink):	0.5 mV
10-bit resolution (CBL 2™):	2.0 mV
Power:	7 mA @ 5VDC
Input Range:	–450 to 1100 mV

Note: Do not completely submerge the sensor. The handle is not waterproof.

Suggested Experiments

The ORP Sensor can be used to perform a potentiometric titration. This is a fairly common experiment in AP® Chemistry or college general chemistry classes. When a redox titration just exceeds its equivalence point volume, the potential measured by an ORP electrode will increase rapidly (if there is an excess of oxidizing agent) or decrease rapidly (with excess reducing agent), as seen in the graph below.

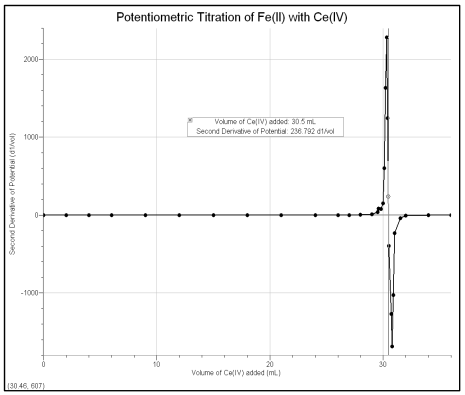


ORP titration of Fe^{2+} solution with Ce^{4+}

In the reaction for the titration curve shown previously

$$Ce^{4+} + Fe^{2+} \rightarrow Fe^{3+} + Ce^{3+}$$

a solution containing Fe^{2+} of unknown concentration is titrated with an oxidizing agent, ~0.1 M Ce^{4+} standard solution (from $(NH_4)_2Ce(NO_3)_6$). When the equivalence point is reached, and excess Ce^{4+} is added, a large increase in potential results. By examining these data, or performing a second derivative (also shown) or Gran plot, the equivalence point of the titration can easily be determined. With Vernier Logger *Pro* software, the experiment can be done in one of two ways: using the ORP Sensor in Events with Entry mode (where buret volumes are manually entered), or using the Vernier Drop Counter to measure titrant volumes.



Second derivative plot for the titration of Fe^{2+} solution with Ce^{4+}

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.

Measure. Analyze. Learn.™
Vernier Software & Technology
13979 S.W. Millikan Way • Beaverton, OR 97005-2886
Toll Free (888) 837-6437 • (503) 277-2299 • FAX (503) 277-2440
info@vernier.com • www.vernier.com

Rev 10/7/13