Potassium Ion-Selective Electrode

(Order Code K-BTA)

The Vernier Potassium Ion-Selective Electrode is used to measure the concentration of potassium (K^+) ions in aqueous samples.

Inventory of Items Included with the Potassium ISE

- Ion-Selective Electrode, packed with a storage bottle
- Bottle of High Standard solution with SDS (1000 mg/L K^+)
- Bottle of Low Standard solution with SDS (10 mg/L K^+)

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 sets pre-defined data-collection parameters.

Data Collection Interfaces

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

Data-Collection Software

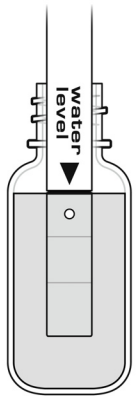
This sensor can be used with an interface and the following data-collection software.

- **Logger *Pro* 3** This computer program is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go!Link. Version 3.8.6.1, or newer, is required for use with the Potassium ISE.
- **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. Version 1.7.1, or newer, is required for use with the Potassium ISE.
- **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. 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.
- **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.

Preparing the Potassium ISE for Use

Note: Follow this two-part process before taking measurements with your ISE.

Part I: Soak the Electrode



1. Soak the electrode in the High Standard solution (included with the ISE) for approximately 30 minutes. The ISE should not rest on the bottom of the container, and the small white reference contact near the tip of the electrode should be immersed. Make sure no air bubbles are trapped below the ISE.
2. If the ISE needs to be transported to the field during the soaking process, use the Short-Term ISE Soaking Bottle. Remove the cap from the bottle and fill it 3/4-full with High Standard. Slide the bottle's cap onto the ISE, insert it into the bottle, and tighten. **Important**: Do not leave the ISE soaking for more than 24 hours.

Part II: Calibrate the ISE

Follow the calibration process for using the Potassium ISE with a computer or with a LabQuest 2 (or original LabQuest). The ISE must be calibrated before each use.

Calibrating the Potassium ISE with a Computer

1. Connect the Potassium ISE to an interface, and connect the interface to your computer. Open Logger *Pro* 3.
2. Choose Calibrate from the Experiment menu and then click Calibrate Now.
3. **High Standard Calibration Point** The Potassium ISE should still be soaking in the High Standard. Enter the concentration value of the High Standard (e.g., **1000** for 1000 mg/L) in the edit box.
4. When the voltage reading for Reading 1 stabilizes (~1 minute), click Keep.
5. **Low Standard Calibration Point** Remove the Potassium ISE from the High Standard, rinse well with distilled water from a wash bottle, and gently blot it dry with a paper towel. Place the electrode into the Low Standard (included with your ISE). **Important**: Make sure the ISE is not resting on the bottom of the container, and that the reference mark is immersed. Make sure no air bubbles are trapped below the ISE.

6. Enter the concentration value of the Low Standard (e.g., **10** for 10 mg/L).
7. When the voltage reading stabilizes, click Keep and then click Done.

Calibrating the Potassium ISE with LabQuest App

1. Connect the Potassium ISE to LabQuest 2 or original LabQuest. Choose Calibrate from the Sensors menu and select Calibrate Now.
2. **High Standard Calibration Point** The Potassium ISE should still be soaking in the High Standard. Enter **1000** as the concentration of the High Standard for Reading 1.
3. When the voltage reading stabilizes, tap Keep.
4. **Low Standard Calibration Point** Rinse the Potassium ISE thoroughly with distilled water and gently blot it dry with a paper towel.
5. Place the tip of the ISE into the Low Standard (10 mg/L K^+). Be sure that the ISE is not resting on the bottom of the bottle and that the reference mark is immersed. Make sure no air bubbles are trapped below the ISE.
6. Enter **10** as the concentration of the standard in mg/L K^+ for Reading 2.
7. When the voltage reading stabilizes, tap Keep.
8. Select OK.

Calibrating the Potassium ISE with TI Graphing Calculators

Enter the calibration routine for your data-collection program. Consult the reference material for the software on your handheld to get specific information concerning the calibration steps.

- **High Standard Calibration Point** The ISE should still be soaking in the High Standard. Enter the concentration value of the High Standard (e.g., **1000** for 1000 mg/L).
- **Low Standard Calibration Point** Remove the ISE from the High Standard, rinse well with distilled water from a wash bottle, and gently blot dry with a paper towel. Place the electrode into the Low Standard (included with your ISE). **Important**: Make sure the ISE is not resting on the bottom of the container, and that the small white reference contacts are immersed. Make sure no air bubbles are trapped below the ISE. After 60 seconds, enter the concentration value of the Low Standard (e.g., **10** for 10 mg/L). To collect data, continue with the steps below.

Collecting Data

1. Rinse off the end of the ISE, and blot it dry with a paper towel.
2. Insert the tip of the ISE into the sample to be tested. **Important**: Make sure the ISE is not resting on the bottom of the container, and that the small white reference contacts are immersed. Make sure no air bubbles are trapped below the ISE. **Note**: Do not completely submerge the sensor. The handle is not waterproof.
3. Hold the ISE still until the reading stabilized and record the displayed reading.

Using Your Potassium ISE 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. For more information, see www.vernier.com/til/638/

Storing an Ion-Selective Electrode

Proper care and storage is important for optimal longevity.

- Long-term storage of the ISE (longer than 24 hours): Moisten the sponge in the bottom of the long-term storage bottle with distilled water. When you finish using the ISE, rinse it off with distilled water and blot it dry with a tissue. Loosen the lid of the bottle and insert the ISE. **NOTE**: The tip of the ISE should NOT be touching the sponge. Check to be sure the reference mark is inside, rather than outside the bottle or under the grommet. Tighten the lid. This keeps the electrode in a humid environment, which prevents the reference junctions from completely drying out.
- Short-term, wet storage (less than 24 hours): Fill the short-term soaking bottle 3/4 full with High Standard. Loosen the cap, insert the electrode into the bottle, and tighten.

Specifications

Range	1–39,000 mg/L
Interfering Ions	Rb^{2+}, Cs^{2+}, NH_4^+, Ca^{2+}, Mg^{2+}, Li^+
pH Range	2–12
Temperature Range	0–40°C (not compensated)
Electrode Slope	56 ±4 mV/decade at 25°C
Calibration Voltages, typical	2.7 V (1000 ppm), 1.9 V (10 ppm)
Electrode Resistance	1–10 MΩ
Reproducibility (Precision)	±11% of full scale
Minimum Sample Size	3 mL in a 50 mL beaker
Accuracy	±16% of full scale

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 Your Ion-Selective Electrode Works

The Vernier Potassium Ion-Selective Electrodes (ISE) is a membrane-based electrode that measures a specific ion (K^+) in an aqueous solution. When the membrane of the electrode is in contact with a solution containing the specific ion, a voltage, dependent on the level of that ion in solution, develops at the membrane. The ISE is a combination style electrode. The voltage develops in relation to an internal Ag/AgCl reference electrode. The ISE measures for the specific ion concentration directly. Samples need to be aqueous to avoid contaminating or dissolving the membrane. The Vernier Potassium Ion-Selective Electrode has a solid polymer membrane. The membrane is a porous plastic disk, permeable to the ion exchanger, but impermeable to water. It allows the sensing cell to contact the sample solution and separates the internal filling solution from the sample. The membrane module has a shelf life of 12–24 months and is replaceable.

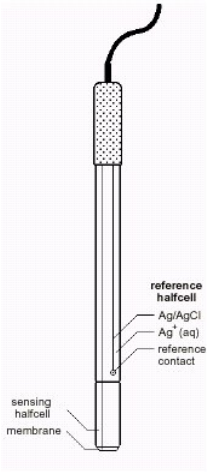


Figure 2

The voltage developed between the sensing and reference electrodes is a measure of the concentration of the reactive ion being measured. As the concentration of the ion reacting at the sensing electrode varies, so does the voltage measured between the two electrodes.

As described in the Nernst equation, ISE response is a linear equation:

$$E = E_o + m(\ln a)$$

where E is the measured voltage, E_o is the standard potential for the combination of the two half cells, m is the slope, ln is natural log, and a is the activity of the measured ion species.

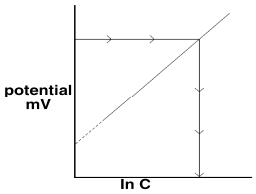


Figure 3

Assuming the ionic strength is fairly constant, the Nernst equation may be rewritten to describe the electrode response to the concentration, C, of the measured ionic species:

$$E = E_o + m(\ln C)$$

A graph of the natural log of concentration (lnC) *vs*. potential (V) can be plotted (see Figure 3).

The method for determining the concentration of K^+ ions is based on the following:

- The interface reads a voltage that is related to ion concentration.
- Using the voltage reading and the principle described in Figure 3, the natural log of concentration of the specific ion can be determined.
- The ion concentration can be determined from the natural log of concentration.

Maintaining and Replacing the ISE Standard Calibration Solutions

Having accurate standard solutions is essential for performing good calibrations. The two standard solutions that were included with your ISE can last a long time if you take care not to contaminate them. At some point, you will need to replenish your supply of standard solutions.

Vernier sells replacement standards in 500 mL bottles. Order codes are:

Potassium Low Standard: K-LST
Potassium High Standard: K-HST

To prepare your own standard solutions, use the information in the table below. **Note**: Use glassware designed for accurate volume measurements, such as volumetric flasks or graduated cylinders. All glassware must be very clean.

Standard Solution	Concentration (mg/L or ppm)	Preparation Method using High Quality Distilled Water
Potassium (K^+) ISE High Standard	1000 mg/L K^+	1.907 g KCl / 1 L solution
Potassium (K^+) ISE Low Standard	10 mg/L K^+	Dilute the High Standard by a factor of 100 (from 1000 mg/L to 10 mg/L)

Replacement Membrane Modules

The Potassium ISE has a PVC membrane module with a limited life expectancy. The module is warranted to be free from defects for a period of twelve (12) months from the date of purchase. It is possible, however, that you may get somewhat longer use than the warranty period. If you notice a reduced response (e.g., distinctly different voltages or voltage ranges during calibration), it is probably time to replace the membrane module. **Important**: Do not order membrane modules far in advance of the time you will be using them; the process of degradation takes place even when they are stored on the shelf.

Using Ionic Strength Adjuster (ISA) Solutions to Improve Accuracy

For optimal results at low concentrations of ions, a standard method for making measurements with ion-selective electrodes is to add ionic strength adjuster (ISA) solutions to each of your standard solutions and samples.

Adding an ISA ensures that the total ion activity in each solution being measured is nearly equal, regardless of the specific ion concentration. This is especially important when measuring very low concentrations of specific ions. The ISA contains no ions common to the Ion-Selective Electrode itself. **Note**: The additions of ISA to samples or standards does not need to be highly accurate. You can add the ISA solution dropwise to a sample using a disposable Beral pipet. We recommend using 1M NaCl solution as the ISA solution for the Potassium ISE.

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. ISE modules are covered by a one-year warranty.

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