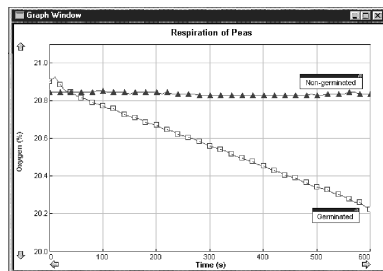# O$_2$ Gas Sensor
(Order Code O2-BTA)

The Vernier O$_2$ Gas Sensor is used to monitor gaseous oxygen levels in a variety of biology and chemistry experiments.

Very important: Do not place the sensor into any liquid. The sensor is intended only for measuring gaseous, not aqueous, O$_2$ concentration.

Typical experiments for the O$_2$ Gas Sensor include:

- Monitor the oxygen concentration in human respiration.
- Measure the concentration of oxygen gas generated during decomposition of hydrogen peroxide by catalase.
- Monitor the changes in oxygen concentration during photosynthesis and respiration of plants.
- Monitor the respiration of animals, insects, or germinating seeds.
- Monitor the oxidation of metals.
- Monitor the consumption of oxygen by yeast during respiration of sugars.

Cell respiration of germinated peas

Inventory of Items Included with the O$_2$ Gas Sensor

Check to be sure that each of these items is included with your O$_2$ Gas Sensor:

- O$_2$ Gas Sensor
- 250 mL gas sampling bottle (Nalgene bottle with lid)
- O$_2$ Gas Sensor booklet (this booklet)

Collecting Data with the O$_2$ Gas 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 O$_2$ Gas Sensor:

1. Connect the O$_2$ Gas Sensor to the interface.
2. Start the data-collection software.
3. The software will identify the O$_2$ Gas 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 *Pro* 2** This computer program is used with ULI or Serial Box Interface
- **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 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.

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 O$_2$ Gas Sensor Works

The Vernier O$_2$ Gas Sensor measures the oxygen concentration in the range of 0 to 27% using an electrochemical cell. The cell contains a lead anode and a gold cathode immersed in an electrolyte. Oxygen molecules entering the cell are electrochemically reduced at the gold cathode. This electrochemical reaction generates a current that is proportional to the oxygen concentration between the electrodes. The sensor output is a conditioned voltage proportional to the reaction current.

IMPORTANT: The O$_2$ Gas Sensor must be stored upright when not in use. This is necessary to maintain the sensor. Failure to store upright will shorten the life of the sensor.

Optional Calibration Procedure

For many measurements, it will not be necessary to calibrate the O$_2$ Gas Sensor. We have set the sensor to match our stored calibration before shipping it.

For more accurate measurements, the sensor can be calibrated at 0 and 20.9% oxygen. Follow the 2-point calibration procedure. For the first point, push and hold the zero button with a pointed object such as a straightened paper clip. The button is located on the side of the sensor next to CAL. Enter a value of 0 for this reading.

Release the button and take a second reading. Enter a value of 20.9% oxygen or a corrected value from the table below. Once finished, the sensor should now read 20.9% (or the value entered from the table below) while resting in the gas sampling bottle. To calibrate in parts per thousand, multiply the second value by 10 (for example, you would enter 209 instead of 20.9).

As your O_2 Gas Sensor ages, the readings will decrease. This is normal, as the chemicals in the electrochemical cell are depleted. It does not mean the sensor is no longer functional; rather, it simply requires that you perform the easy two-point calibration described in the previous paragraph. Once the readings in air are below 12% prior to calibration, the sensor should be replaced. You may choose to have your sensor refurbished and a new element installed, or you may purchase a new sensor.

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.

Effect of Humidity

Because the oxygen concentration varies with the amount of water vapor in the atmosphere, you may want to adjust your atmospheric oxygen calibration value to improve accuracy when using the O_2 Gas Sensor. The accepted value of 20.9% for atmospheric oxygen levels is calculated in dry air (0% humidity). If you know the relative humidity of the location at which you are calibrating, you can substitute one of the values below in place of 20.9%.

Relative Humidity	0%	25%	50%	75%	100%
Oxygen in % by volume	20.9	20.7	20.5	20.3	20.1

Tips

- Even though the sensor responds rather quickly to changes in O_2 concentration, the gas has to diffuse into the electrochemical cell located at the top of the sensor shaft before any changes in concentration can be detected. Because the diffusion of a gas is a slow process, there can be some delay in readings.
- To collect data in a controlled environment, we recommend that you use the 250 mL Nalgene collection bottle that is included with your sensor. Place the tip of the sensor into the opening of the bottle and push the sensor into the bottle. When the sensor will go no further, you have a seal. **Very important**: Do not place the sensor into any liquid. The sensor is intended only for measuring gaseous, not aqueous, O_2 concentration.
- To collect data in a controlled environment and also use our CO_2 Gas Sensor, we recommend purchasing either the BioChamber 250 (250 mL capacity) or the BioChamber 2000 (2 L capacity). Each BioChamber has a second, grommetted opening so that you can insert two probes at once.

Accessories for the O_2 Gas Sensor

In addition to the 250 mL gas sampling bottle that ships with the O_2 Gas Sensor, the following accessories are available for purchase separately:

- BioChamber 250   BC-250
- BioChamber 2000   BC-2000

The BioChambers have two openings, with grommets, so that you can insert both the CO_2 Gas Sensor and the O_2 Gas Sensor to take measurements of the atmosphere inside the BioChamber simultaneously.

Specifications

Measurement range of O_2 Gas Sensor:	0–27% (0-270 ppt)
Accuracy (at standard pressure 760 mmHg):	+/- 1% volume O_2
Resolution:	13 bit (SensorDAQ) = 0.005%
	12 bit (LabQuest 2, LabQuest, LabQuest Mini, LabPro, TI-Nspire Lab Cradle, Go! Link) = 0.01%
	10 bit (CBL2) = 0.04%
Response time:	~12 seconds to 90% of final value
Warm-up time:	Less than 5 seconds to 90% of final value
Pressure effect:	Directly proportional
	$V_{out} = V_{out}$ (standard) x (P/1013)
	Pressure range: 0.5 atm to 1.5 atm
Output signal range:	0 to 4.8 VDC; 2.7 to 3.8 VDC @ 21% O_2
Output impedance:	1 KΩ
Input voltage:	5 VDC +/–0.25 VDC
Gas sampling mode:	Diffusion
Normal operating temperature range:	20 to 30°C
Operating temperature range:	5 to 40°C (with calibration)
Operating humidity range:	0 to 95% RH
Storage temperature range:	–20 to +60°C
Dimensions:	Sensor tube: 45 mm length, 28 mm OD; total length: 120 mm
Calibration information	slope (gain): 6.5625 %/V
	intercept (offset): 0 %

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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