Gas Pressure Sensor

(Order Code GPS-BTA or GPS-DIN)

The Vernier Gas Pressure Sensor is a sensor for Vernier LabPro®, Go!®Link, Vernier EasyLink®, and CBL 2™. It can be used to monitor pressure changes in gas-law experiments in chemistry and physics, such as Boyle's law (pressure *vs.* volume) and Gay-Lussac's law (pressure *vs.* absolute temperature). Vapor pressure of various liquids and solutions can be monitored using this sensor. Biology teachers can use the Gas Pressure Sensor to monitor the production or consumption of oxygen or carbon dioxide gases in an enclosed atmosphere. The following is a partial list of activities and experiments that can be performed using this sensor.

- Investigate the relationship between pressure and volume, Boyle's law.
- Measure vapor pressure of liquids.
- Study the effect of temperature on gas pressure, Gay-Lussac's law.
- Monitor the production of O_2 during photosynthesis of an aquatic plant in a closed system.
- Determine the rate of transpiration for a plant under different conditions.
- Determine the rate of respiration in germinating pea or bean seeds.
- Monitor the pressure of a confined air pocket as water moves in and out of a semi-permeable membrane by osmosis.
- Study the effect of temperature and concentration on the rate of decomposition of H_2O_2.
- Study human respiratory patterns using the Vernier Respiration Monitor Belt.

Gas Pressure Sensor Accessories

Included with your Gas Pressure Sensor are accessories to allow you to connect it to a reaction container, such as an Erlenmeyer flask. Check to be sure that each of these items is included:

- two tapered valve connectors inserted into a No. 5 stopper.
- one tapered valve connector inserted into a No. 1 stopper.
- one two-way valve
- two Luer-lock connectors (white) connected to either end of a piece of plastic tubing.
- one 20 mL syringe
- two transpiration tubing clamps (white)

Here is a summary of some of the uses of the accessories included with your Gas Pressure Sensor:

The white stem on the end of the Gas Pressure Sensor Box has a small threaded end called a luer lock. With a gentle half turn, you may attach the plastic tubing to this stem using one of the Luer connectors already mounted on both ends of the tubing. The Luer connector at the other end of the plastic tubing can then be connected to one of the stems on the rubber stoppers that are supplied, as shown in Figure 1.

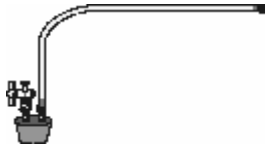


Figure 1

The stopper can then be inserted into a flask or test tube to provide an airtight container to investigate a confined gas, as shown in Figure 2. **Note:** The 2nd valve on the rubber stopper is shown in a closed position.

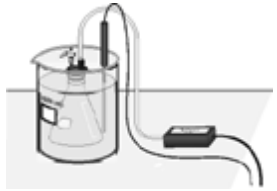


Figure 2

You can also attach the 20 mL plastic syringe included with the Gas Pressure Sensor directly to this stem, as shown here in Figure 3.

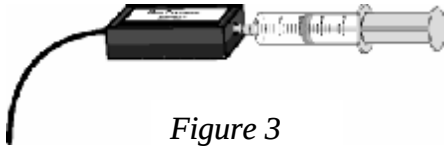


Figure 3

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

Using the Gas Pressure Sensor with a Computer

This sensor can be used with a computer and any of the following lab interfaces: Vernier LabPro®, Go!®Link, Universal Lab Interface, or Serial Box Interface.

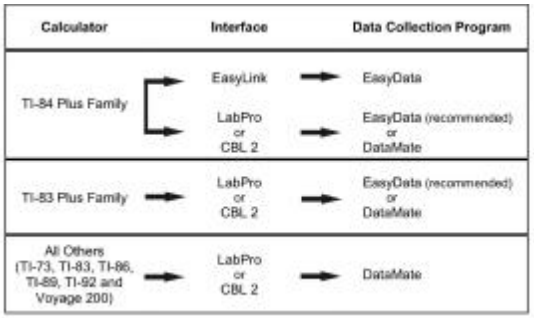
1. Connect the Gas Pressure Sensor, interface, and computer.
2. Start the Logger *Pro*® or Logger Lite® software.
3. The program will automatically identify the Gas Pressure Sensor, and you are ready to collect data.[1]

[1] If your system does not support auto-ID, open an experiment file in Logger *Pro*, and you are ready to collect data.

Using the Gas Pressure Sensor with TI Graphing Calculators

This sensor can be used with a TI graphing calculator and any of the following lab interfaces: LabPro, CBL 2, and Vernier EasyLink. Here is the general procedure to follow when using the Gas Pressure Sensor with a graphing calculator:

1. Connect the data-collection interface to the graphing calculator.
2. Connect the Gas Pressure Sensor to any of the analog ports on the interface or to EasyLink.
3. Start the EasyData or DataMate App—the application you choose to use depends on your calculator and interface. See the chart for more information.



4. The Gas Pressure Sensor will be identified automatically, and you are ready to collect data.

If the data-collection application is not on your calculator, use the following instructions to load it onto the calculator.

- **EasyData App**–This program may already be installed on your calculator. Check to see that it is EasyData version 2.0 or newer. If it is not installed or is an older version, it can be downloaded to your computer from the Vernier web site, www.vernier.com/easy/easydata.html. It can then be transferred from the computer to the calculator using TI-Connect and a TI unit-to-computer cable or TI-GRAPH LINK cable. See the Vernier web site, www.vernier.com/calc/software/index.html for more information on the App and Program Transfer Guidebook.
- **DataMate program**–This program can be transferred directly from LabPro or CBL 2 to the TI graphing calculator. Use the calculator-to-calculator link cable to connect the two devices. Put the calculator into Receive mode, and then press the Transfer button on the interface.

Using the Gas Pressure Sensor with a Palm Powered™ Handheld

1. Connect the Palm Powered handheld, LabPro, and the Gas Pressure Sensor.
2. Start Data Pro.
3. Tap New, or choose New from the Data Pro menu. Tap New again. The Gas Pressure Sensor will be identified automatically.
4. You are now ready to collect data.

This sensor is equipped with circuitry that supports auto-ID. When used with LabPro, Go! Link, 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.

Specifications

- Pressure range: 0 to 210 kPa (0 to 2.1 atm or 0 to 1600 mm Hg)
- Maximum pressure that the sensor can tolerate without permanent damage: 4 atm
- 12-bit resolution (LabPro, Go! Link, ULI II, Serial Box Interface): 0.05 kPa (0.0005 atm or 0.40 mm Hg)
- 10-bit resolution (CBL 2): 0.2 kPa (0.002 atm or 1.6 mm Hg)
- Sensing element: SenSym SDX30A4
- Combined linearity and hysteresis: typical ±0.2% full scale
- Response time: 100 microseconds

How the Gas Pressure Sensor Works

The active sensor in this unit is the SenSym SDX30A4 pressure transducer. It has a membrane which flexes as pressure changes. This sensor is arranged to measure absolute pressure. One side of the membrane is a vacuum, while the other side is open to the atmosphere. The sensor produces an output voltage which varies in a linear way with absolute pressure. It includes special circuitry to minimize errors caused by changes in temperature. We provide an amplifier circuit that conditions the signal from the pressure transducer. With this circuit, the output voltage from the Gas Pressure Sensor will be linear with respect to pressure, with 0.00 volts corresponding to 0 kPa (0 atm) and 4.6 volts corresponding to the sensor's maximum pressure, 210 kPa (2.1 atm).

Pressure Units

Pressure can be measured in many different units. We quote values here in several of the units shown below. Some equivalent values for 1 atmosphere are:

1 atmosphere = 101.325 kPa
= 760 mm Hg
= 29.92 in. of Hg (at 0°C)
= 14.70 psi
= 1013 millibar

Do I Need to Calibrate the Gas Pressure Sensor? "No."

We feel that you should not have to perform a new calibration when using the Gas Pressure Sensor 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:

1. If you ordered the GPS-BTA version of the sensor, and you are using it with a LabPro, Go! Link or CBL 2 interface, then a calibration (in kPa) is automatically loaded when the Gas Pressure Sensor is connected.
2. If you are using Logger *Pro* software (version 2.0 or newer) on a computer, open an experiment file for the Gas Pressure 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 to version 2.2.1 is available on our web site.
3. Any version of the DataMate program (with LabPro or CBL 2) has stored calibrations for this sensor.
4. Any version of DataPro has stored calibrations for this sensor.

Stored Calibration Values for the Gas Pressure Sensor[2]

kPa	slope = 46.48	intercept = 0
atm	slope = 0.4587	intercept = 0
mm Hg	slope = 348.63	intercept = 0

If you would like to perform your own calibrations, follow the steps described here. The standard calibration procedure we use with all of our sensors is a 2-point calibration. For the **first calibration point** perform the following operation:

Allow the sensor to equilibrate to atmospheric pressure. When the voltage reading displayed on the computer or calculator stabilizes, enter the atmospheric pressure, as recorded with a barometer.

For the **second calibration point**, do *one* of the following:

- Use the syringe provided with the Gas Pressure Sensor to produce a pressure very near zero. Before connecting the syringe, push its plunger all the way in to the 0 mL mark. Connect the syringe directly to the Gas Pressure Sensor stem. To produce near-zero pressure, pull the plunger out to the 20 mL position. If your syringe and valve have a tight seal, the pressure will be ~ 0 kPa (0 atm or 0 mm Hg).
- Apply pressure with a pump, measuring it at the same time with a pressure gauge.
- Before connecting the syringe, move the plunger on the syringe so that the syringe volume is set at 10 mL. Connect the syringe to the stem of the Gas Pressure Sensor. Move the syringe plunger so that the voltage reading displayed on the computer or calculator is 3.0 volts. Enter a value of 139.4 kPa as the value (or 1.376 atm, or 1045.9 mm Hg) for this calibration point.[3]

[2] If you want to manually enter the calibration values for a different unit of pressure in Logger *Pro* or DataMate programs, here are some additional calibration values: in. Hg (slope = 13.74, intercept = 0), millibar (slope = 464.7, intercept =0), or psi (slope = 6.743, intercept = 0)

[3] This provides a way to enter other units of pressure. At 3 V, for example, you can also use 41.17 in. Hg, 20.22 psi, or 1394 millibar.

Suggested Experiments

We have a wide variety of experiments already written for use with the Gas Pressure Sensor in our chemistry, biology, and physical science lab books.. Here are some of the experiments you can perform with your Gas Pressure Sensor.

Boyle's Law (Pressure vs. Volume)

Experiment 6, *Chemistry with Computers, Chemistry with Calculators*
Experiment 30, *Physical Science with Computers, Physical Science with Calculators*

Gay-Lussac's Law (Pressure vs. Absolute Temperature)

Experiment 7, *Chemistry with Computers, Chemistry with Calculators*
Experiment 31, *Physical Science with Computers, Physical Science with Calculators*

Vapor Pressure Measurements

Experiment 10, *Chemistry with Computers, Chemistry with Calculators*

Rate of Plant Transpiration

Experiment 10, *Biology with Computers, Biology with Calculators*

Measuring Respiration of Insects

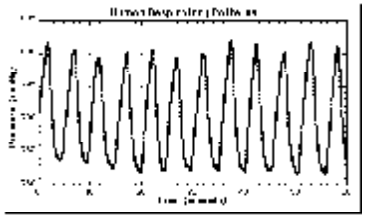
Experiment 23, *Biology with Computers***,** *Biology with Calculators*

Control of Human Respiration

Experiment 26, *Biology with Computers***,** *Biology with Calculators*

Pressure in Liquids: Depth Measurements

If you measure the pressure at the end of a long plastic tube forced underwater, you can indirectly measure depth. Connect the tubing to the stem of the Gas Pressure Sensor and then put the end of the tube under water. The pressure reading will increase 9.775 kPa (0.0965 atm or 73.34 mm Hg) for every meter below the surface of the water.



Note: If you measure depth in this way, the depth you are measuring is to the top of the air, which extends up the tube for a short distance. If this measurement error bothers you, you can simply calibrate your depth measurement system when the end of the tube is at known depths and automatically correct for this.

Additional Pressure Sensor Accessories

In addition to the accessories that ship with the Gas Pressure Sensor, the following accessories are available for purchase separately:

- Pressure Sensor Accessories Kit PS-ACC
- #1 1-Hole Rubber Stopper PS-STOP1
- #5 2-Hole Rubber Stopper PS-STOP5
- Luer Lock Connector PS-LUER
- Plastic 2-Way Valve PS-2WAY
- Plastic Tubing PS-TUBING
- Stopper Stem PS-STEM
- Syringe PS-SYR
- Plastic Tubing Clamps (pkg. of 100) PTC

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.

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