Barometer

(Order Code BAR-BTA)

The Barometer is designed for weather studies. It can also be used as an altimeter if you have a portable interface. Suggested experiments and sample graphs are included at the end of this booklet.

Collecting Data with the Barometer

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 Barometer.

1. Connect the Barometer to the interface.
2. Start the data-collection software.[1]
3. The software will identify the Barometer 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.
- **DataQuest™ Software for TI-Nspire™** This calculator application for the TI-Nspire can be used with the EasyLink or TI-Nspire Lab Cradle.

[1] If you are using Logger *Pro* 2 with either a ULI or SBI, the sensor will not auto-ID. Open an experiment file for the Barometer in the Probes & Sensors folder.

- **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.
- **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.

Specifications

Sensing element:	SenSym SDX15A4
Pressure range (as shipped):	0.8 to 1.05 atm (25 to 31.5 inches of mercury)
Maximum pressure that the sensor can tolerate without permanent damage:	30 psi or 61 in. of Hg
Sensitivity:	436 mV/in. of Hg to 13.06 V/atm.
Resolution	
13-bit (SensorDAQ):	0.0015 in. of Hg
12-bit (LabQuest 2, LabQuest, LabQuest Mini, LabPro, TI-Nspire™ Lab Cradle, Go! Link, ULI II, Serial Box):	0.003 in. of Hg
10-bit, 5 volt A/D converter (CBL 2™):	0.01 in. of Hg
Combined linearity and hysteresis:	typical ±0.1% full scale, maximum ±0.5% full scale
Response time:	100 microseconds
Stored calibration values	
in Hg	
slope:	2.292
intercept:	24.215
atmospheres	
slope:	0.077
intercept:	0.809
mm Hg	
slope:	58.52
intercept:	614.84
millibars	
slope:	78.001
intercept:	819.52

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.

How the Barometer Works

The heart of this circuit is the SenSym SCX15ANC pressure sensor. It has a membrane which flexes as pressure changes. This sensor is set up for absolute pressure measurement, so one side of the membrane is a vacuum. 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.

Pressure Units

Pressure can be measured in many different units. The default unit for the Barometer is kPa. For comparison, some equivalent values for 1 atmosphere are:

1 atmosphere = 760 mm Hg
= 101.325 kPa
= 29.92 in Hg (at 0°C)
= 30.00 in Hg (at 16°C)
= 1.013 bar
= 14.696 psi

The Barometer is fairy durable, but it is designed only for use with non-corrosive gases such as air, helium, nitrogen, etc. Do not get the sensor wet and do not apply too much pressure to it. Note that it is designed only to measure pressures near standard atmospheric pressure.

Calibration Information

You do not need to perform a new calibration on the Barometer. We have set each Barometer to match the stored calibration before shipping it. You can simply use the appropriate calibration file that is stored in your data-collection program from Vernier.

Station Pressure *vs.* Sea-level Pressure

If your Barometer readings do not agree with the local airport or television station, it is because you are looking at two different kinds of readings. "Station pressure" is the true pressure at your site, or station. This is the pressure a mercury barometer would read in your classroom. This is also the pressure that your Vernier Barometer is calibrated to read. "Sea-level pressure" is the pressure after the station pressure has been adjusted to its equivalent at sea level. Airports and television stations usually report the sea-level pressure rather than the station pressure. This is commonly done to take altitude out of the equation for weather forecasters. To determine your station pressure when only sea-level pressure is known, visit http://hyperphysics.phy-astr.gsu.edu/hbase/kinetic/barfor.html#c3

The Barometric Formula is explained along with boxes to input the information from your local television station or airport. Your true station pressure is reported in mm Hg, in Hg, and kPa.

Using the Barometer as a Weather Station

If you want your Vernier Barometer to read sea-level pressure instead of station pressure, you can adjust it one of two ways. You can either adjust the sensor itself or you can do a one-point calibration using our software.

1. There is an offset potentiometer that you can use to adjust the pressure reading up and down.[2] There is a small hole on one end of the Barometer with a small slotted screw inside. A small jeweler's screwdriver can be used to turn this screw. This is a 15-turn potentiometer, so the adjustment can be made very gradually. Simply monitor the readings from the Barometer and adjust the screw until the readings match the airport or television station readings.
2. Perform a one-point calibration.
   You can perform a one-point calibration with our software. (The following describes the general procedure. Be sure to refer to the reference materials of the software for specific instructions.) Plug the Barometer into the interface and start the software. Access the calibration option and choose the one-point calibration option. During the one-point calibration process, you will be asked to enter a single value. Enter the corrected value for your station pressure. Make sure the units for the value you enter match the units in the calibration.

Suggested Experiments

Weather Studies

This sensor was designed to be an accurate, reliable barometer as part of a weather station. It is temperature compensated, so changes in room temperature will not interfere with the data. It has a voltage regulator, so changes in the computer's power supply voltage are not a problem. It is especially interesting to watch pressure changes as a storm moves in. If you have an underutilized computer, why not just connect the Barometer and graph the barometric pressure for several days? You could connect temperature, relative humidity, or light sensors to the same computer. We used a Barometer to produce the graph in Figure 1 during the biggest storm in a decade in Portland, Oregon (December 1995).

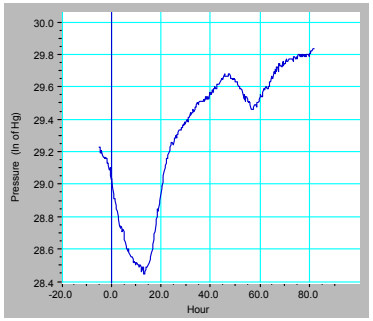


Figure 1

[2] Note that you will need a mercury barometer if you ever wish to change the calibration back to the station pressure.

Altimeter

If you have a portable interface, you can do some interesting studies using this sensor as you drive in a mountainous area. Simply leave the Barometer in the car and take data as you drive. The pressure reading gives you a measure of the altitude. Figure 2 is a graph collected while driving over a pass in the Cascades mountain range. One warning: The Barometer can only read pressures down to about 24 inches of mercury. If you go too high, you will "peg out" the meter at approximately 6000 feet.

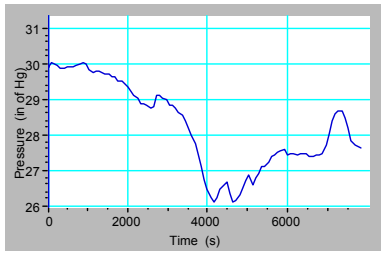
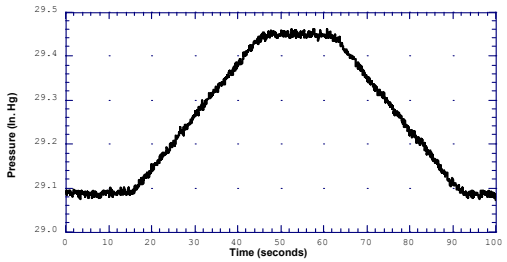


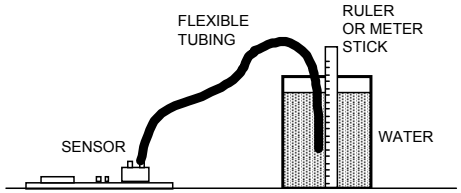
Figure 2

This same approach can be used on an elevator in a tall building. A sample graph is shown here.



Pressure in Liquids

The pressure in a liquid can be investigated using a setup similar to this one:



Connect the tubing to the input port of the Barometer before you put the end of the tube under water. Collect pressure data as a function of depth. Model this data with a linear function.

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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