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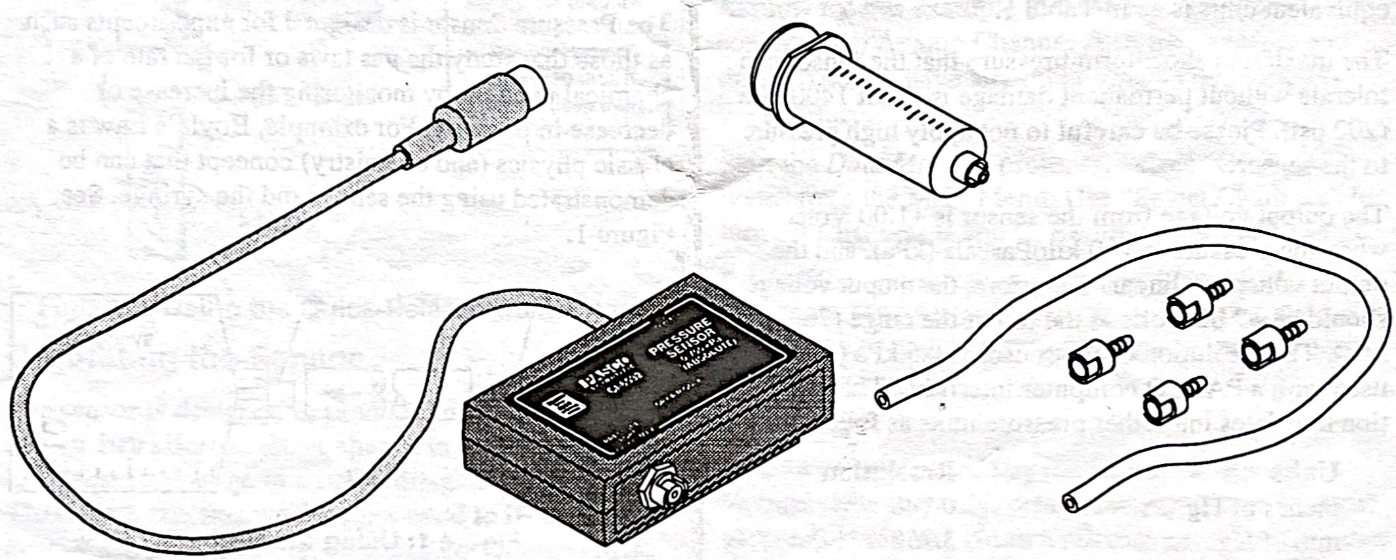
$1.00

Instruction Sheet for the PASCO Model CI-6532

PRESSURE SENSOR - ABSOLUTE (0 TO 700kPa)



Introduction

The PASCO Model CI-6532 is an absolute pressure sensor that is designed to be used with a PASCO computer interface (such as the CI-6500 (IBM), AI-6501 (Apple II), or CI-6550 (Macintosh)). The pressure sensor uses a MPX700 transducer. This type of transducer has two ports, but there is a permanent reference vacuum cell sealed to one port of the transducer. The other port is open to the atmosphere.

The sensor consists of the electronics box with a cable for connecting to the PASCO computer interface. The port that is open to the atmosphere is labeled PRESSURE PORT and it has a "quick-release" style connector. The transducer is durable, but it is designed to be used with non corrosive gases such as air, helium, nitrogen, etc. Do not let the transducer get wet.

The sensor comes with a plastic hypodermic syringe (20 cubic centimeter), a length of plastic (polyurethane) tubing, and several "quick-release" style connectors. Extra parts are available as follows:

Item	Part Number
plastic syringe (20 cc, calibrated)	699-084
polyurethane tubing (0.125")	640-023
quick-release connector	640-021

Range and Resolution

The range of the CI-6532 Absolute Pressure Sensor is between 0 and 700 kiloPascals (or 0 to 6.9 atmospheres). Atmospheric pressure is normally around 101.326 kiloPascals (kPa). Pressure can be measured in many different units (e.g., atmospheres, inches of mercury, millimeters of mercury, kiloPascals, Bar, pounds per square inch). Some equivalent values for pressure are:

1 atmosphere = 30.00 in of Hg (at 16°C)
= 760 millimeters of Hg
= 101.326 kiloPascals (kPa)
= 1.013 Bar = 1013 milliBar
= 14.696 pounds per square inch (psi)

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Table 1: Pressure Range Comparison

kiloPascals	inches of Hg	mm of Hg	Bar	pounds/sq in	atmospheres
700.00	207.25	5250.4	6.999	101.48	6.908
101.32	30.00	760.0	1.013	14.69	1.000

The top of the range of pressure expressed in these equivalent units is as in Table 1.

The maximum short-term pressure that the sensor can tolerate without permanent damage is about 1400 kPa (200 psi). Please be careful to not apply high pressure to the sensor.

The output voltage from the sensor is +1.00 Volts when the pressure is 100 kiloPascals (kPa), and the output voltage is linear. Therefore, the output voltage should be +7.00 Volts at the top of the range (700 kPa). The resolution of the sensor is 0.5 kPa (when used with a PASCO computer interface). This resolution translates into other pressure units as follows:

Units	Resolution
inches of Hg	0.148
mm of Hg	3.750
milliBar	5.088
pounds per square inch (psi)	0.072
atmospheres	0.004

The sensor box contains a precision operational amplifier (op amp) that can drive a heavy capacitive load, such as a six meter extender cable (CI-6515). There is a resistor in parallel with the transducer to compensate the sensor for temperature induced variations. The sensor has a negative temperature coefficient (resistance decreases as temperature increases) and the resistor has a positive temperature coefficient.

Additional Equipment Needed

- Signal Interface such as the CI-6500 (IBM) or AI-6501 (Apple II), or Signal Interface II such as the CI-6550 (Macintosh)

Operation

Connecting and Using the Sensor

Connect the 8-pin DIN plug from the electronics box to Analog Channel A, B, or C on the computer interface box.

The sensor is driven with a constant current and it is temperature compensated. Therefore, changes in room temperature or changes in the computer's power supply will not interfere with the data.

Using the Syringe and Quick-Release Connectors

The Pressure Sensor is designed for experiments such as those that study the gas laws or for the rate of a chemical reaction by monitoring the increase or decrease in pressure. For example, Boyle's Law is a classic physics (and chemistry) concept that can be demonstrated using the sensor and the syringe. See Figure 1.

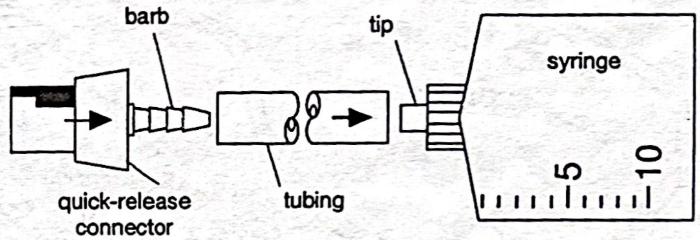


Figure 1: Using the Syringe

To connect the syringe to the sensor, cut a short length of tubing (about one inch). Put the "barb" end of one of the quick-release connectors into one end of the short piece of tubing. Put the other end of the tubing over the tip on the end of the syringe.

> ➧ **NOTE:** You can lubricate the end of the barb to make it easier to put into the short piece of tubing. Put a very small amount of silicon oil or saliva onto the barb and then wipe the barb with a cloth so there is only a thin layer of lubricant on the barb.

Align the quick-release connector with the connector on the PRESSURE PORT of the sensor. Push the connector onto the port, and then turn the connector clockwise until it "clicks" into place (less than one-eighth of a turn). The barb of the quick-release connector is free to rotate even when the connector is firmly attached to the port.

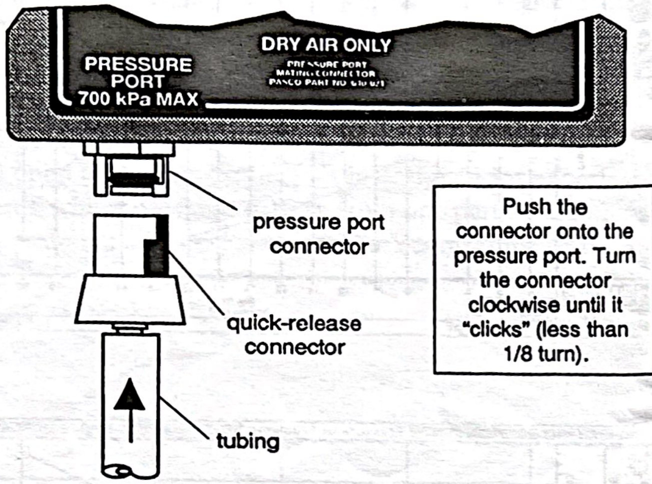


Figure 2: Using the Quick-Release Connectors

Calibrating the Sensor

The sensor is designed to produce one volt at a pressure of 100 kiloPascals. A change in pressure of 100 kPa causes a change in output voltage of one volt. **Therefore, the sensor does not need to be calibrated.** Instead, the output voltage can be converted directly into pressure. For example, an output voltage of two volts equals a pressure of 200 kPa (or approximately 2 atmospheres).

However, you can calibrate the sensor to learn about the process of calibration. You may want to create a calibration file for use with the CI-6500 (or AI-6501) interface. The procedure using the AI-6501 is very similar to the procedure using the CI-6500. You can also include the calibration in a *Science Workshop* document when using the CI-6550 Mac65 interface. You will need to know the local air pressure. If you have an accurate mercury or aneroid barometer available, use it. If not, call a local airport or radio or TV station to get the local air pressure.

Calibration Procedures

One Point Calibration: This method relies on the fact that the output voltage of the sensor changes by one volt for a pressure change of 100 kPa. For the first of the calibration points, leave the PRESSURE PORT open to the atmosphere. Enter the local air pressure reading as the known pressure. For the second point, connect the syringe to the PRESSURE PORT and compress the air in the syringe so the output voltage changes slightly. Record the voltage of this second calibration point. Calculate what the new pressure is by using the equation:

$$\text{pressure (in kPa)} = \text{local air pressure} + \text{voltage change}/1.000\ \text{Volts}/100\ \text{kPa}$$

If you use different pressure units, make the appropriate conversions.

Creating a Calibration File Using *Data Monitor (MS-DOS)* with the CI-6500

Assume for this example that the Pressure Sensor is connected to Analog Channel A of the interface and that you do not have any other sensors connected to the interface.

Start the *Data Monitor* program. Select "Other Options" from the Main Menu. Use "Select Channels" to turn off Channels B and C. Return to the Main Menu.

Select "Calibration" from the Main Menu. Pick "Calibrate Input" from the Calibration Menu. Select "Channel A". Enter "Pressure" as the parameter and "kPa" as the units.

Calibration Point #1: The monitor screen will show the voltage value produced by the sensor. When the voltage value is steady, press <return>. Enter the local air pressure reading (from a reliable barometer or other known source) as the pressure that corresponds to the first voltage value.

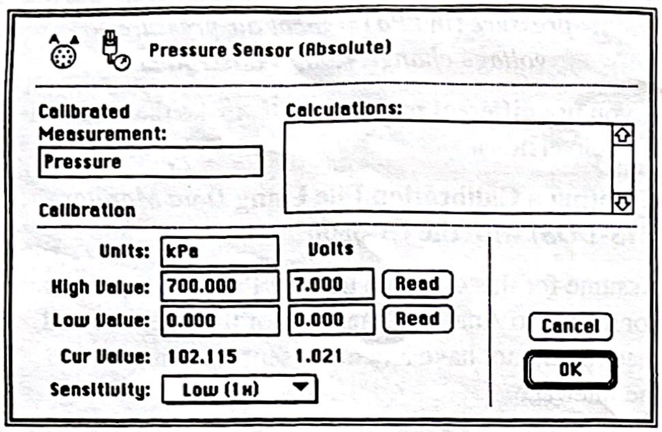
Calibration Point #2: Change the conditions as described in the procedure above. The monitor screen will show the new voltage produced by the sensor. When the voltage value reaches a steady new value, press <return> and enter the pressure reading that corresponds to the second voltage value.

Follow the on-screen instructions to save the calibration file.

Calibrating the Sensor Using *Science Workshop* with the CI-6550

Start the *Science Workshop* program. Click-and-drag the analog sensor plug icon to Analog Channel A. Select "Pressure Sensor (Absolute)" from the list of analog sensors.

Calibration Point #1: In the Experiment Setup window, double-click on the Pressure Sensor icon to open the Analog Sensor Setup dialog box.



The dialog box will show the "Cur Value" of the voltage produced by the Pressure Sensor. Leave the PRESSURE PORT open to the atmosphere. When the voltage value is steady, click on the bottom "Read" button. Enter the local air pressure in the box labeled "Low Value:".

Calibration Point #2: Connect the syringe to the PRESSURE PORT of the sensor. Compress the air in the syringe slightly to raise the air pressure. The "Cur Value" will show the new voltage produced by the sensor. When the voltage value becomes steady, click on the top "Read" button. Enter the pressure in the box labeled "High Value:" as calculated using the equation:

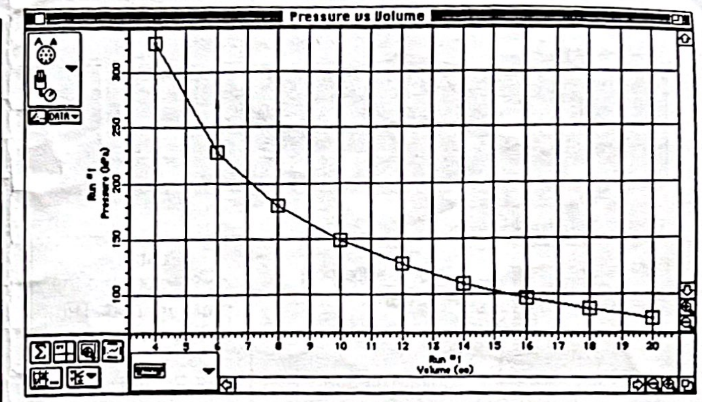
pressure (kPa) = local air pressure + voltage change/1.000 Volts/100 kPa

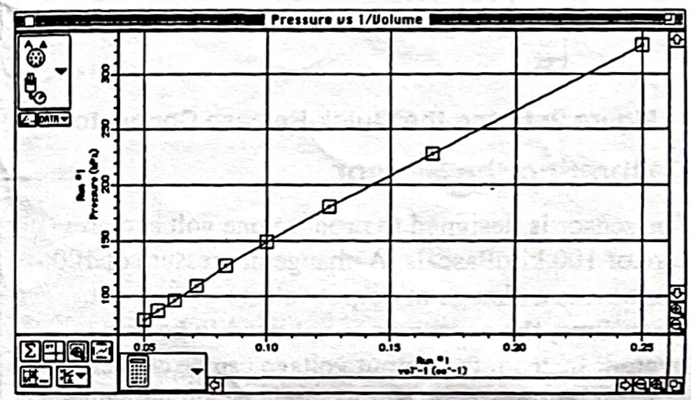
You can save your calibration as part of a *Science Workshop* document by selecting "Save As…" from the File menu.

Suggested Experiments

Boyle's Law (pressure vs volume)

Boyle's Law is a classic experiment in physics (and chemistry) that can be demonstrated using the sensor and the syringe. Set the syringe to a position such as 15 cc. Connect the syringe to the PRESSURE PORT on the sensor. Take data as you change the volume, beginning with a volume that is greater than your beginning volume (e.g., move the syringe to 20 cc). Continue to take data as you decrease the volume to 15 cc and below. The graphs show sample data recorded with *Science Workshop* and the CI-6550 Computer Interface for Macintosh. The first graph is pressure vs volume. The second is pressure vs 1/volume.





Gay-Lussac's Law (pressure vs absolute temperature)

Gay-Lussac's Law states that if the volume remains constant, the pressure of a container of gas is directly proportional to its absolute temperature. Set up a sealed container of air by attaching the longer piece of plastic tubing to a stopper in a 125 mL Erlenmeyer flask. Connect the other end of the tube to the PRESSURE PORT. Place the flask in water baths of different temperatures. Record data on how the pressure changes with the temperature changes.

Pressure in Liquids

Put the end of the longer piece of tubing under water. The pressure reading should increase by 0.0978 kPa (0.02896 in of mercury) per centimeter of depth below the surface. You can also use a "J" shaped tube to study how pressure relates to the difference in heights of the liquid in the two parts of the tube.

Studying Chemical Reactions by Monitoring Pressure

Many chemical reactions produce gases that can cause an increase in pressure in a sealed container. The pressure change can be used to monitor the rate of the reaction.

Other

PASCO scientific also produces a Differential Pressure Sensor (Model CI-6533) and a Barometer (Model CI-6531). The Differential Pressure Sensor is similar to the CI-6532, except that both ports of the transducer are open to the atmosphere. It is designed for experiments where pressure differs from one part of the apparatus to another, such as in a Venturi tube or for a demonstration of Bernoulli's principle. The Barometer has a range from 800 to 1100 milliBar (24 to 32 inches of mercury). It is designed to be a reliable, accurate pressure sensor for weather studies. It is temperature compensated and has a voltage regulator, so changes in temperature or changes in the computer's power supply will not interfere with the data.

Limited Warranty

PASCO scientific warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. PASCO will repair or replace, at its option, any part of the product which is deemed to be defective in material or workmanship. This warranty does not cover damage to the product caused by abuse or improper use. Determination of whether a product failure is the result of a manufacturing defect or improper use by the customer shall be made solely by PASCO scientific. Responsibility for the return of equipment for warranty repair belongs to the customer. Equipment must be properly packed to prevent damage and shipped postage or freight prepaid. (Damage caused by improper packing of the equipment for return shipment will not be covered by the warranty.) Shipping costs for returning the equipment, after repair, will be paid by PASCO scientific.

Equipment Return

Should this product have to be returned to PASCO scientific, for whatever reason, notify PASCO scientific by letter or phone BEFORE returning the product. Upon notification, the return authorization and shipping instructions will be promptly issued.

➧ **NOTE:** NO EQUIPMENT WILL BE ACCEPTED FOR RETURN WITHOUT AN AUTHORIZATION.

When returning equipment for repair, the units must be packed properly. Carriers will not accept responsibility for damage caused by improper packing. To be certain the unit will not be damaged in shipment, observe the following rules:

① The carton must be strong enough for the item shipped.

② Make certain there is at least two inches of packing material between any point on the apparatus and the inside walls of the carton.

③ Make certain that the packing material can not shift in the box, or become compressed, thus letting the instrument come in contact with the edge of the box.