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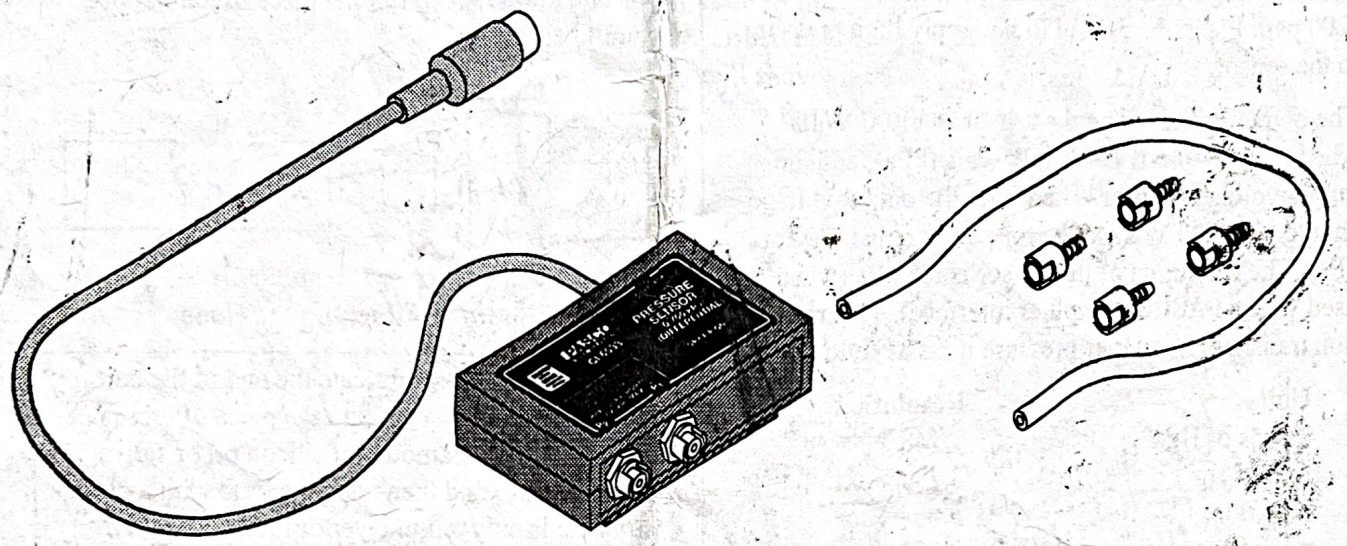
Instruction Sheet for the PASCO Model CI-6533

PRESSURE SENSOR - DIFFERENTIAL (0 TO 700kPa)



Introduction

The PASCO Model CI-6533 is a differential 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, both of which are open to the atmosphere. This type of pressure sensor is sometimes called a "gauge" pressure sensor. The sensor will measure the difference in pressure between its two pressure ports.

The sensor consists of the electronics box with a cable for connecting to the PASCO computer interface. The ports are labeled PRESSURE PORTS P1 and P2.

> **NOTE:** The P1 pressure must be greater than the P2 pressure.

The sensor comes with a length of plastic tubing and four "quick-release" style connectors. 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.

Extra parts are available as follows:

Item	Part Number
polyurethane tubing (0.125")	640-023
quick-release connector	640-021

Range and Resolution

The range of the CI-6533 Differential Pressure Sensor is between 0 and 700 kiloPascals (or 0 to 6.9 atmospheres). When both ports are open to atmospheric pressure, the gauge pressure reading should be very close to zero 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)

This instruction sheet written/edited by: Dave Griffith

10101 Foothills Blvd. • P.O. Box 619011 • Roseville, CA 95678-9011 USA
Phone (916) 786-3800 • FAX (916) 786-8905 • email: techsupp@PASCO.com

Table 1: Pressure Range Comparison

kiloPascals	inches of Hg	mm of Hg	Bar	pounds/sq in	atmospheres
700.00	207.25	5200	6.999	101.48	6.908

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 V 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 is temperature compensated. Therefore, changes in room temperature or changes in the computer's power supply will not interfere with the data.

Using Quick-Release Connectors

To attach the quick-release connector to a piece of tubing, put the "barb" end of one of the quick-release connectors into one end of the piece of tubing. See Figure 1.

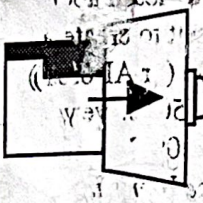


Figure 1: Attaching the Hose

NOTE: You can lubricate the end of the barb to make it easier to put into the 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. See Figure 2.

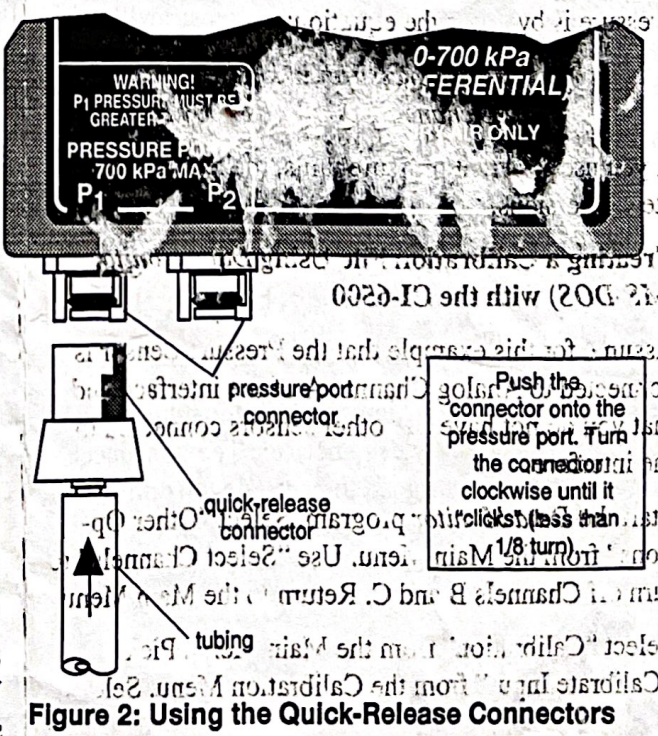


Figure 2: Using the Quick-Release Connectors

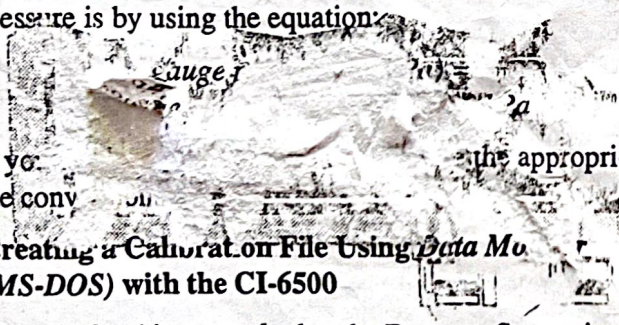
Calibrating the Sensor

The sensor is designed to produce one volt at a gauge pressure of 100 kiloPascals. A change in gauge 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 gauge 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 GI-250 Mac65 interface. You will need a dry air pressure source. If you have a reliable, accurate pressure gauge, use it. You will need to be able to connect the air pressure source to PRESSURE PORT P1.

Calibration Procedures

One Point Calibration: This method relies on the fact that the output voltage of the sensor changes by one volt for a gauge pressure change of 100 kPa. For the first of the calibration points, leave PRESSURE PORT P1 open to the atmosphere. Enter "zero" as the known gauge pressure. For the second point, connect the air pressure source to PRESSURE PORT P1 so the output voltage changes slightly. Record the voltage of this second calibration point. Calculate what the new pressure is by using the equation:



If you [illegible] the appropriate conv[illegible]

Creating a Calibration File Using *Data Mo[illegible]* *(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 [illegible]

[illegible]ion Point #1: The monitor screen will show the [illegible]e value produced by the sensor. When the [illegible]e value is steady, press <return>. Enter "zero" as [illegible]wn gauge pressure that corresponds to the first [illegible]lue.

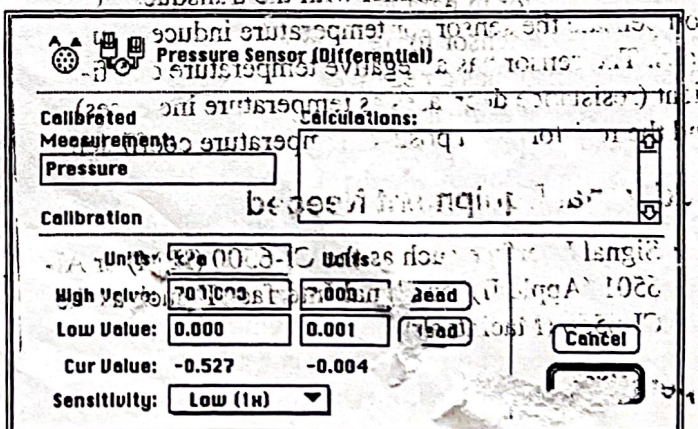
[illegible] Point #2: Change the conditions as described in the procedure above. The monitor screen will show the new voltage produced by the sensor. When the voltage value reaches a steady new value, press <return> and enter the gauge pressure reading that corresponds to the second voltage value.

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 (Differential)" 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.



The dialog box will show the "Cur Value" of the voltage produced by the Pressure Sensor. Leave PRESSURE PORT P1 open to the atmosphere. When the voltage value is steady, click on the [illegible] button. Enter "zero" as the gauge pressure in the box labeled "Low Value".

Calibration Point #2: Connect the air pressure source to PRESSURE PORT P1 of the sensor. 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 gauge pressure in the box labeled "High Value:" as calculated using the equation:

gauge pressure (kPa) =
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.

Other

PASCO scientific also produces an Absolute Pressure Sensor (Model CI-6532) and a Barometer (Model CI-6533). The Absolute Pressure Sensor is similar to the CI-6... except that only one port of the transducer is open to the atmosphere. It measures a range of 0 to 700 kiloPascals absolute pressure and is designed for experiments with the gas laws or for studying the rate of a chemical reaction by monitoring the increase or decrease in pressure. 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 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.