*Instruction Sheet
for the PASCO
Model CI-6558 Rev A*

ACCELERATION SENSOR

interface cable
with 8-pin DIN
connectors

bracket for
attaching to
Dynamics Cart

DIN connector

Acceleration
Sensor

to computer interface
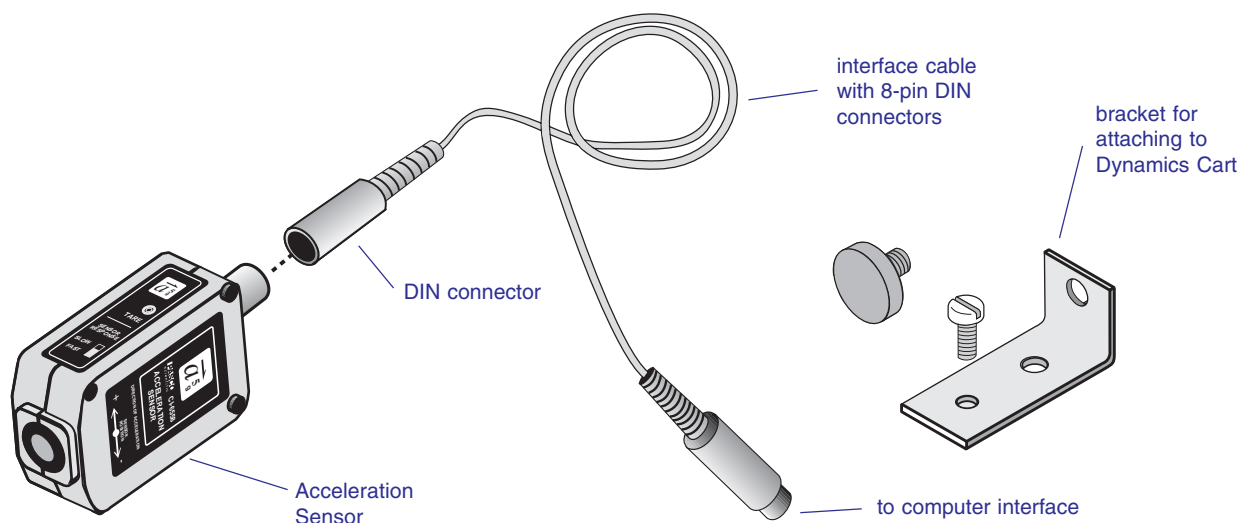
Introduction

The PASCO CI-6558 Rev A Acceleration Sensor is designed for use with any PASCO computer interface and Data Studio to measure accelerations ranging up to 5 times the earth's gravitational field with an accuracy of 0.01 *g* (*g* = acceleration of gravity, 9.8 m/s^2). The sensor produces a bipolar output that may vary from +5 *g* to -5 *g*, depending on the direction of acceleration. The Acceleration Sensor is capable of resolving changes in acceleration on the order of 1 *milli-g* when a gain of 10 is applied in Data Studio.

The Acceleration Sensor has two built-in features for configuring it to a particular application: (1) a tare button, used to set the output of the sensor to 0 regardless of the acceleration being applied (allows the effect of the earth's gravitational field to be nulled); (2) a filter with two settings—"slow" or "fast", setting the frequency response of the Acceleration Sensor to a range suitable for the application.

For experiments such as measuring the acceleration of elevators, roller coasters, and automobiles, select the "slow" setting. The slow filter reduces errors due to high frequency vibrations and noise. For applications involving mechanical systems, such as cart collision experiments, select the fast setting.

The Data Studio software will display the output of the Acceleration Sensor in units of m/s^2, or in terms of *g*.

Very small values of acceleration can be measured by taring the sensor and adding gain in Data Studio.

Equipment

Equipment Included:

- Acceleration Sensor
- 6-foot cable with 8-pin DIN connectors
- bracket, thumbscrew, and bolt for attaching Acceleration Sensor to a Dynamics Cart

Additional Equipment Required:

- Any PASCO Data Studio computer interface (300, 500, 700 or 750 series for Macintosh or Windows)

Additional Equipment Suggested:

- Dynamics Cart (ME-9430 or ME-9454)
- Dynamics Track (ME-9429A or ME-9452)

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
Setup Procedure

Setting Up Data Studio

1 Connect the Acceleration Sensor to any analog channel on the computer interface box with interface cable (Figure 1a),

or

insert the DIN plug of the Acceleration Sensor into the jack of any analog channel on the computer interface box (Figure 1b).

a

Plug into any analog channel.

b

Plug into any analog channel.
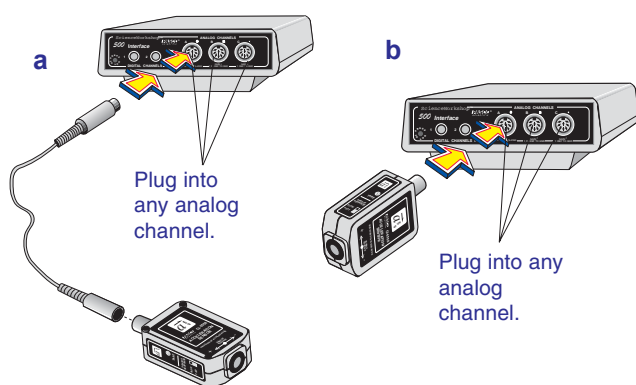
Figure 1. Connecting the Acceleration Sensor to the computer interface.

2 Open the Data Studio program. In the setup window, click and drag the analog plug icon ( ) to the analog channel icon ( ) that corresponds to the port the Acceleration Sensor is plugged into.

3 Select $\overrightarrow{a_g^5}$ **Acceleration Sensor** from the pop-up menu.

4 Open a display window, such as the Graph display, by dragging and dropping the appropriate display icon ( ) to the Acceleration Sensor icon ($\overrightarrow{a_g^5}$).

5 To select units of g or m/s^2 for the display double click the icon ($\overrightarrow{a_g^5}$) and select the Measurements tab.

To select units of g, click the check box next to **Acceleration (g)**.

To select units of m/s^2, click the check box next to **Acceleration, A (m/s/s)** .

➤ *Note: Open additional display windows by following the procedure in steps 4 and 5.*

6 If accelerations of less than 1 g or 10 m/s^2 are to be measured, the sensitivity may be increased to medium (10X gain) as follows:

Double-click on the Acceleration Sensor icon ($\overrightarrow{a_g^5}$) in the setup window to open the **Acceleration Sensor** dialog box. Click on the arrow under the Calibration tab for Sensitivity and select **Med (10x)** in the pop-up menu.

7 The default sampling rate is 10 samples/second. Change the sampling rate, if required, by clicking the General tab and using the - and + buttons to select the desired sampling rate.

Adjusting the Acceleration Sensor

1 Set the filter switch to slow for most applications. Set it to high for collision experiments or similar mechanical experiments (Figure 2).

2 Press the tare button to set the sensor to 0 under the current conditions (Figure 2).

tare button

filter switch: fast or slow

indicator of direction of sensitivity and sensor position
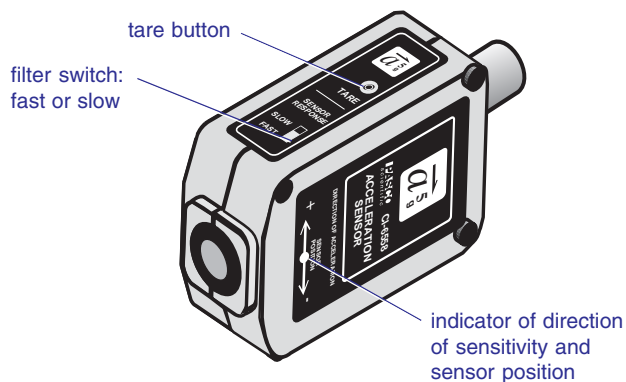
**Figure 2. Sensor setup controls and arrow indicator of the direction of sensitivity.**

Maintaining the Direction of Sensitivity

The sensing unit of the Acceleration Sensor is oriented so that the line of greatest sensitivity follows the arrow indicating the direction of acceleration (Figure 2). Experiments should be conducted with the arrow on the label of the Acceleration Sensor oriented along the same line as the direction of the acceleration to be measured.

Calibrating the Acceleration Sensor

The Acceleration Sensor is factory calibrated and is accurate to about 0.05 *g* or 0.5 m/s². For most experiments, no further calibration is required. However, the following calibration procedure may be performed to maximize the Acceleration Sensor's accuracy.

1 Double click the Acceleration Sensor icon ($\overrightarrow{a}_x^5$) in the setup window of Data Studio then click the Calibration tab.

2 In the **Calibration** dialog, enter 1.000 in the High Value dialog box in the pop-up menu, and -1.000 in the Low Value dialog box.

3 Place the sensor flat on a level surface with the arrow indicating direction of sensitivity parallel to the ground (Figure 3a) and press the tare button.
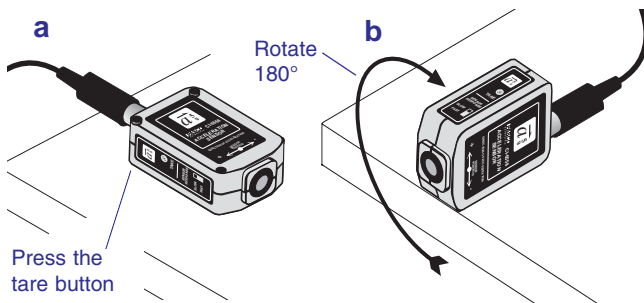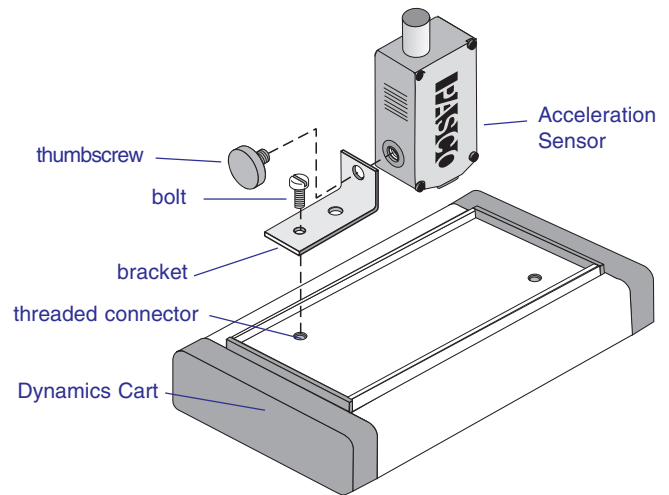

Figure 3. Positions of the Acceleration Sensor during the calibration procedure.

4 Orient the sensor so the + arrow on the label is pointing toward the ground (Figure 3b).

5 Click [Read] beside the High Value dialog box.

6 Rotate the sensor 180° around its major axis so the – arrow points toward the ground (Figure 3b).

7 Click [Read] beside the Low Value dialog box.

8 Click OK. The Acceleration Sensor is now calibrated.

➤ *Note: For a detailed description of the calibration process, access the Data Studio Help menu and click Setup Information, Setting up a sensor.*

Mounting on a Dynamics Cart

Figure 4. Mounting the Acceleration Sensor to the bed of the Dynamics Cart.

Operation Specifications:

- Maximum usable acceleration: ± 5 *g* or 50 m/s²
- Sensor Output: 1 V/*g*
- Accuracy: 0.01 *g* or 0.1 m/s²
- Resolution: 0.001 *g* or 0.01 m/s²
- Alignment error of the acceleration sensing element: ±1° (*Alignment error is defined as the difference between the true and indicated axis of sensitivity.*)
- Absolute maximum acceleration without damaging the sensing element: 1000 *g* for 0.5 ms

DIN Connector Specifications

1: analog output (+), 0 to 10 V
2: analog output (-), signal ground
3: (no connection)
4: + 5 V DC power
5: power ground
6: +12 V DC power
7: -12 V DC power
8: (no connection)
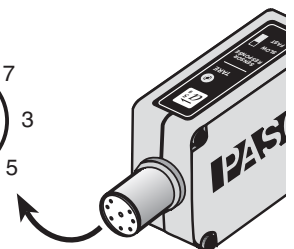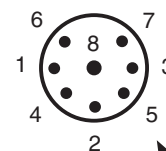
Suggested Experiment

Verify the Acceleration Sensor's Performance in the Earth's Gravitational Field

1 Connect the Acceleration Sensor to the computer interface with the interface cable (see Figure 1a) and set up Data Studio as detailed on page 2. Open a Digital Display and select Acceleration (*g*) from the pop-up menu. Set the filter switch on the sensor to *SLOW*.

2 Place the sensor flat on a level surface with the arrow indicating direction of sensitivity parallel to the ground (Figure 3a) and press the tare button.

3 Orient the sensor so the arrow on the label is perpendicular to the ground (see Figure 3b). Click Monitor Data under the Experiment selection menu in Data Studio.

4 Observe that Data Studio is displaying a value for acceleration of either plus or minus 1 *g*.

5 Rotate the sensor 180° around its major axis so the arrows point in the opposite direction.

6 Observe that Data Studio now displays 1 *g* with the opposite sign as observed before.

7 Can you imagine a way to measure the tilt angle of the sensor? (Hint: tilt angle = $\sin^{-1}$ (acceleration in *g*).
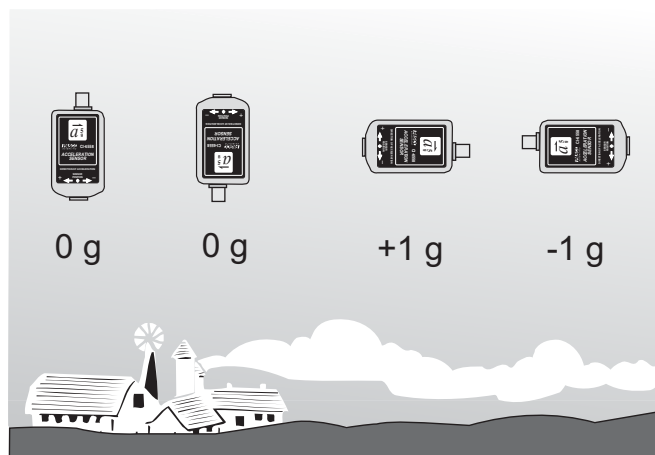
Figure 5. Response of the Acceleration Sensor to the earth's gravitational field.

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Suggested Activities

1 Measure the acceleration of a Dynamics Cart down an inclined Dynamics Track.

2 Measure the acceleration during collision of a Dynamics Cart.

3 Measure the acceleration during free fall.

4 Measure the acceleration of an elevator, automobile, or roller coaster using the remote data logging capability of the 500 series computer interface.

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