

Motion Sensor II

CI-6742A

Included Equipment	Part Number
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Motion Sensor II	CI-6742A
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Additional Equipment Required	
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ScienceWorkshop-compatible Interface	UI-5000, CI-7650, CI-6400, or similar
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Quick Start

1. Connect the Motion Sensor II to your *ScienceWorkshop*-compatible interface (such as the 850 Universal Interface or *ScienceWorkshop* 750 USB Interface).
2. If you are using a computer, connect the PASCO interface to it, turn the interface on, and start the data acquisition software (such as PASCO Capstone).
3. Place an object in front of the sensor at least 15 cm away.
4. Click “Record” or press “Start” to begin recording data.
5. Move the object in a straight line directly away from or toward the sensor.

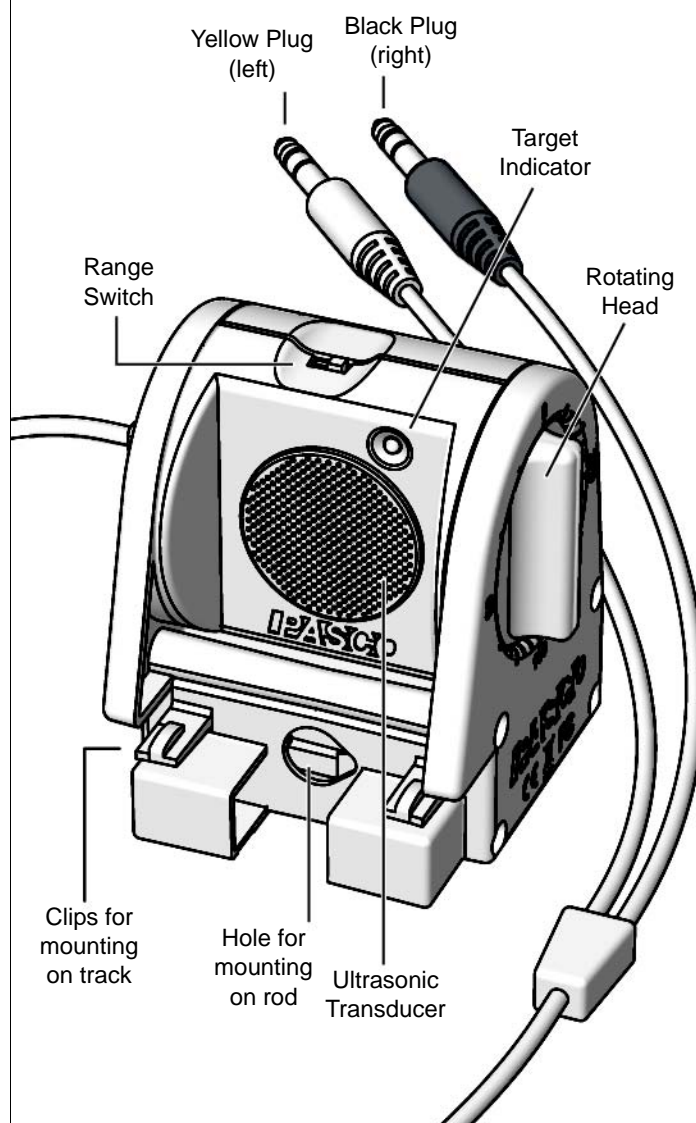
Introduction

The Motion Sensor II works with a *ScienceWorkshop*-compatible interface and PASCO data acquisition software (such as PASCO Capstone) to measure and record motion data. It produces a series of ultrasonic pulses and detects the sound reflecting back from an object in front of it. The interface measures the times between outgoing pulses and returning echoes. From these measurements, the data acquisition software determines the position, velocity, and acceleration of the object.

This instruction sheet includes procedures for setting up the hardware and software, collecting data, changing the sample rate, mounting the sensor on equipment, and troubleshooting.

Theory of operation and specifications are listed at the end of the instruction sheet.

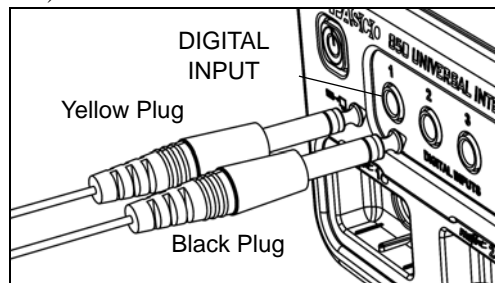
Note: Essential PASCO Capstone tasks are described briefly in this instruction sheet. For more instructions on using Capstone, see the User's Guide or the online help



Set-up

To Connect to a PASCO Interface

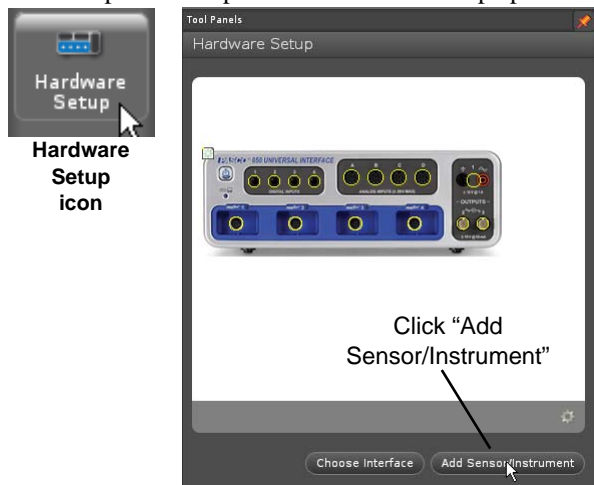
Connect the Motion Sensor's yellow plug to DIGITAL INPUT 1 (or Digital Channel 1) of your *ScienceWorkshop*-compatible interface. Connect the black plug to DIGITAL INPUT 2 (or Digital Channel 2).



NOTE: If you are using a PASPORT-only interface (such as the SPARK Science Learning System), use a PS-2159 Digital Adapter to connect the Motion Sensor to the interface. Put the yellow plug into Input Port 1, and the black plug into Input Port 2. Plug the Digital Adapter into a port on the PASPORT-only interface.

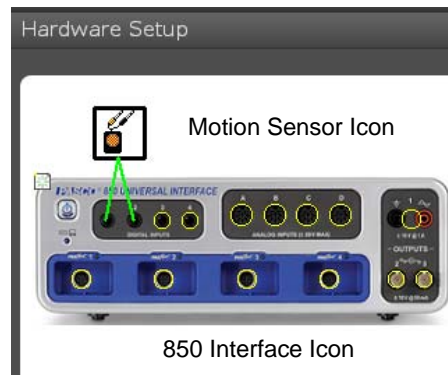
PASCO Capstone Setup

1. Turn on the interface and launch the PASCO data acquisition software, such as PASCO Capstone.
2. In PASCO Capstone, click the “**Hardware Setup**” icon in the Tools palette to open the “Hardware Setup” panel.



3. In the “Hardware Setup” panel, click “**Add Sensor/Instrument**” to open the “Add Sensor or Instrument” window.
4. In the “Add Sensor or Instrument window, click the “**Sensor or Instrument Type**” menu and select “**ScienceWorkshop Digital Sensors**” from the list.
5. Select “**Motion Sensor II**” in the list and then click “**OK**”.

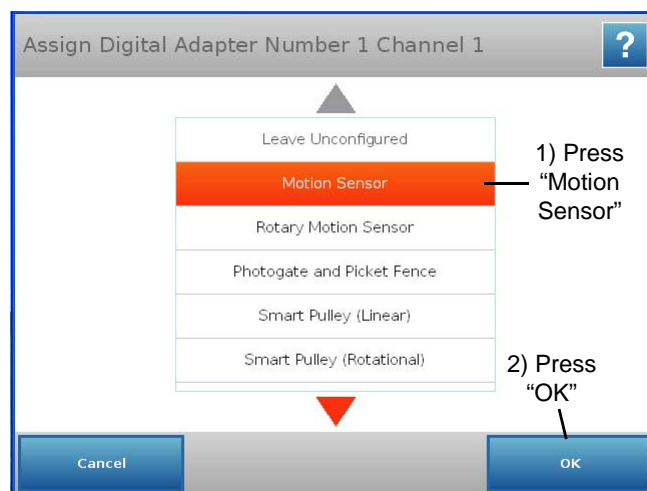
6. Confirm that the “Hardware Setup” panel shows the icon of the Motion Sensor and the icon of the interface.



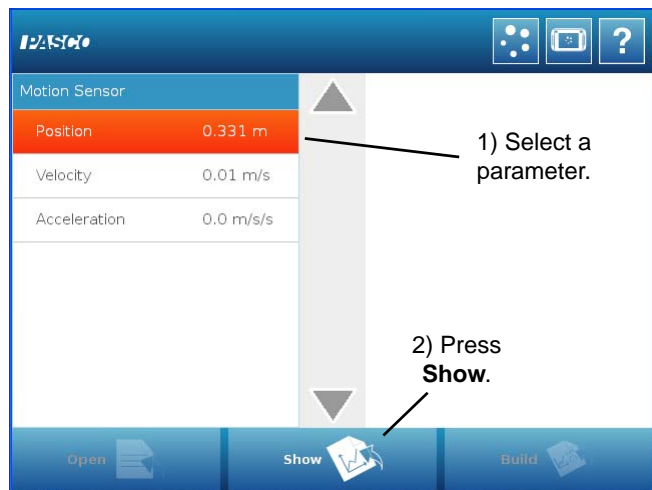
7. Double-click the **Graph** icon in the Displays palette (or other display icon) to create a data display.
8. In a Graph display, click the “**Select Measurement**” menu button on the vertical axis and select position, velocity, or acceleration. Click “**OK**”.

SPARK Science Learning System (SLS) Setup

1. Turn on the interface. Connect the Motion Sensor’s plugs to the input ports on a PS-2159 Digital Adapter, and plug the adapter into the interface.
2. The SPARKvue program recognizes that the Digital Adapter is connected to the interface, and shows a screen with a list of digital sensors. Press “Motion Sensor” and then press “OK”.







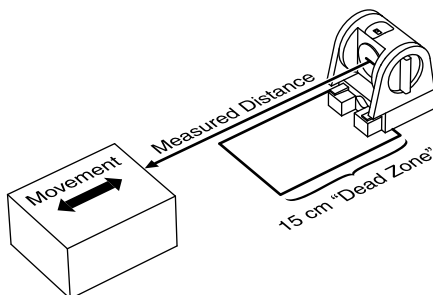
- Press “OK” in the Edit Sensor Properties screen, and then press to select “Position”, “Velocity”, or “Acceleration” in the next screen.



- Press “Show” to create a Graph screen. The Graph shows the parameter you selected on the vertical axis, and time on the horizontal axis.

To Aim the Motion Sensor at an Object

- Set the range switch to short range () or long range () setting.
 - Select  for measuring a cart on a track.
 - Select  for measuring most other objects.
- Arrange the Motion Sensor and object so that the Motion Sensor's transducer faces the object.
 - The object should be at least 15 cm from the transducer.
 - If the object will move, it should move directly toward or away from the Motion Sensor.
 - Aim the motion sensor slightly up to avoid detecting the tabletop.



- Remove objects that may interfere with the measurement. These include objects between the sensor and target object, either directly in front of the sensor or to the sides.

Data Collection

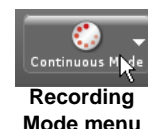
To Record Data

- In PASCO Capstone, click **Record**. In SPARKvue, press **Start**.
 - The Motion Sensor starts clicking. If a target is in range, the target indicator flashes with each click. The data acquisition software starts collecting and displaying data.
- Click **Stop** to stop data collection.

To Display Data without Recording

PASCO Capstone

Click the **Recording Mode** menu and select **Fast Monitor Mode**. The **Record** icon changes to a **Monitor** icon. Click **Monitor** to display live data without recording it.

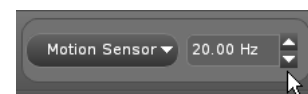


Sensor Configuration

To Change the Sample Rate

PASCO Capstone

Click the up or down button next to the **Sample Rate** setting.



SPARKvue

Sample Rate setting

In the Graph display screen, press the **Sampling Options** icon. Select the **Sampling Mode**, **Sample Rate**, and **Sample Rate Unit** in the **Sampling Options** screen, and then press **OK**.

The normal range of sampling rates is between 1 Hz and 50 Hz. At the default rate, the Motion Sensor can measure distance up to 8 m. The maximum distance decreases with increasing sample rate. At very high sample rates (between 50 Hz and 250 Hz), the maximum distance is less than 2 m.

Equipment Mounting

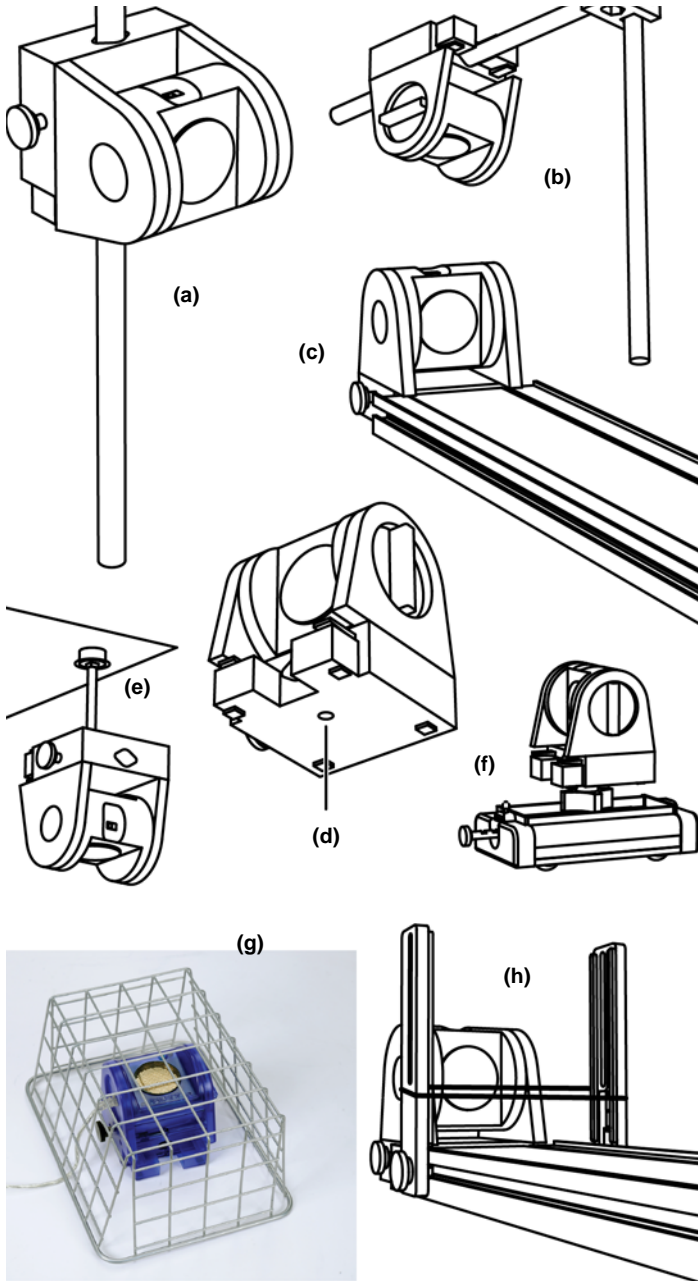
Mount the Motion Sensor as illustrated on a vertical rod (a) or a horizontal rod (b).

Integrated clips allow it to be attached to the end of a dynamics track (c).

A threaded hole in the bottom of the unit (d) is provided for attachment to the PS-2546 Magnetic Bracket (e), the ME-6743

Cart Adapter (f), and other 1/4-20 threaded mounting devices such as a camera tripod.

To protect the Motion Sensor from being hit by an object, use a device such as the SE-7256 Motion Sensor Guard (g) or ME-9806 bracket with a rubber band (h). The Motion Sensor can “see through” a wire screen or rubber band placed close to the transducer.



Troubleshooting

If the Motion Sensor fails to perform satisfactorily, try these steps:

- Ensure that the target object is no closer than 15 cm.
- Switch the range switch to the other setting.
- Adjust the aim left, right, up, or down. In some cases the Motion Sensor works best when it is aimed slightly to the side or above the target in order to exclude interfering objects.
- Improve the target by adding a larger or harder surface to reflect ultrasound. A small object can be a better reflector than large object if it has a harder surface.
- Remove interfering objects near the target object or sensor.
- Increase or decrease the sample rate.

Theory of Operation

The Motion Sensor uses an electrostatic transducer as both a speaker and a microphone. When triggered by the interface, the transducer transmits a burst of 16 ultrasonic pulses with a frequency of about 49 kHz. This burst of pulses can be heard as a single click. The ultrasonic pulses reflect off an object and return to the sensor. The target indicator on the sensor flashes when transducer detects an echo.

Sound intensity decreases with distance; to compensate, the sensor increases the gain of the receiver amplifier as it waits for the echo. The increased gain allows the sensor to detect an object up to 8 m away. The lower gain at the beginning of the cycle reduces the circuit's sensitivity to echoes from false targets.

The interface measures the time between trigger rising edge and the echo rising edge. The data acquisition software uses this time and the speed of sound to calculate the distance to the object. To determine velocity, the software uses consecutive position measurements to calculate the rate of change of position. Similarly, it determines acceleration using consecutive velocity measurements.

Specifications

Minimum Range	15 cm
Maximum Range	8 m
Transducer Rotation	360°
Range Settings	<p>Short Range: for distance measurement up to 2 m with improved rejection of false target signals and air-track noise</p> <p>Long Range: for distance measurement up to 8 m</p>
Mounting Options	<p>On rod up to 12.7 mm diameter</p> <p>Directly to PASCO dynamics tracks</p> <p>On table top</p>
Connector	<p>Dual stereo phone plug for <i>ScienceWorkshop</i>-compatible interfaces</p>

Technical Support

For assistance with any PASCO product, contact PASCO at:

Address: PASCO scientific
10101 Foothills Blvd.
Roseville, CA 95747-7100

Phone: 916-786-3800 (worldwide)
800-772-8700 (U.S.)

Web: www.pasco.com

Email: support@pasco.com

Limited Warranty For a description of the product warranty, see the PASCO catalog.

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The European Union WEEE (Waste Electronic and Electrical Equipment) symbol (to the right) and on the product or its packaging indicates that this product **must not** be disposed of in a standard waste container.

