Visual Accelerometer

PS-2128

"AA" Batteries

Thumbscrews
(M5 x ,8 x 40 mm)

PASPORT Sensor
Extension Cable

Red LEDs

Green LEDs

Visual Accelerometer

.

Included Items
Visual Accelerometer
PASPORT Sensor Extension Cable PS-2500
"AA" Battery (3) PI-6601 (4-pack)
Thumbscrew (2) M5 x .8 x 40 mm

Recommended Items*
PASCO Track and Cart
PASCO Interface
PASCO Data Acquisition Software

See the PASCO catalog or the PASCO web site at www.pasco.com for more information.

| Other Items* |
| --- |
| Visual Accelerometer Accessory Set PS-2516 |

Introduction

The PS-2128 Visual Accelerometer is a special type of sensor that is designed for visual demonstration of acceleration. For example, the Visual Accelerometer can be attached to the top of any PASCO Cart (such as a PAScar, GOcar, or Dynamics Cart), or it can be used by itself for acceleration studies. Green and red light-emitting diodes (LEDs) on one side of the Accelerometer light up to indicate the magnitude and direction of acceleration. The sensor measures acceleration along its long axis as indicated by the arrows on the side of the sensor.

The sensor can also be used with a PASPORT-compatible interface (such as the UI-5100 850 Universal Interface) and PASCO data acquisition software (such as PASCO Capstone). With the data acquisition software, the sensor can be used to measure acceleration changes.

The sensor comes with a PASPORT Sensor Extension Cable for connecting to an interface, two thumbscrews for attaching the sensor to a PASCO Cart, and three "AA" batteries.

Installing or Replacing the Batteries

- Remove the thumbscrews on the underside of the sensor. Remove the bottom enclosure of the sensor.
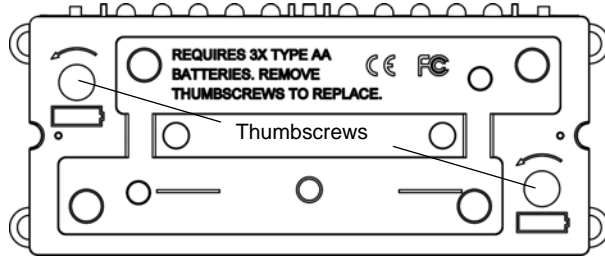
- Place the "AA" batteries into the compartment in the orientation shown.
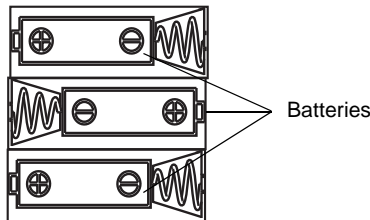
- NOTE: The Accelerometer turns itself on when the last battery is installed and the red and green LEDs will flash once.

- Replace the bottom enclosure of the sensor and replace the thumbscrews.

Operating Procedures

Power Requirements

The Accelerometer requires three "AA" alkaline batteries (included) or power from a PASPORT-compatible interface.

- To connect the sensor to a PASPORT-compatible interface, plug the PASPORT Sensor Extension Cable into the mini-DIN connector on the top of the Accelerometer.
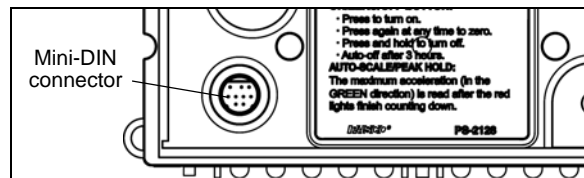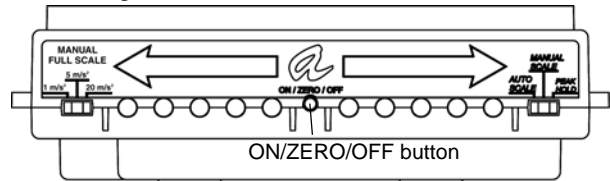

- Plug the cable into a PASPORT input port on the interface.
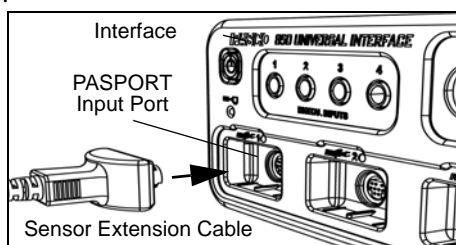
Turning the Accelerometer On and Off

The Accelerometer has an "ON/ZERO/OFF" button between the red and green LEDs.


- *Push* in and then *release* the "ON/ZERO/OFF" button.

- When you release the button, the green and red LEDs will flash once to indicate that the batteries are working.

- NOTE: If the Accelerometer is connected to an interface, the green and red LEDs will not flash.

Turning the Accelerometer Off

- *Push* and *hold* the "ON /ZERO/OFF" button until the two red LEDs and two green LEDs next to the button light up.
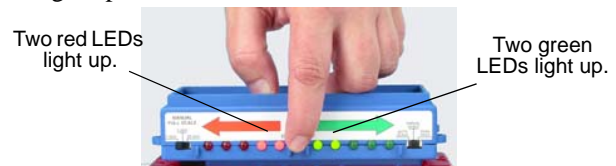
- When you release the button, the sensor turns off.

- NOTE: If the sensor fails to turn on or off using the push button, open the case and remove any battery for a few seconds, then reinstall.

Battery Life and Power

- With battery-powered operation, a battery test occurs each time you turn on the Accelerometer. If the battery test is good, first the green LEDs and then the red LEDS flash on for a moment. *If the green and red LEDs continue to alternately flash for several seconds, then the battery condition is low.*

- The sensor has a built-in timer that will automatically power off after three hours, even if the sensor is being used at the time. To resume, press the "ON/ZERO/OFF" button.

- When the sensor is connected to a PASPORT-compatible interface, it cannot be turned off and the three hour automatic-off feature does not function. When the sen-

sor is disconnected from the interface, the "ON/ZERO/OFF" button and the automatic off function operate normally.

• When the sensor is turned off, it draws only a fraction of a milliampere from the batteries. When used intermittently, battery life is six to nine months. If the sensor will not be used for several weeks, always remove the batteries. This increases battery life and reduces the risk of damage from leaky batteries.
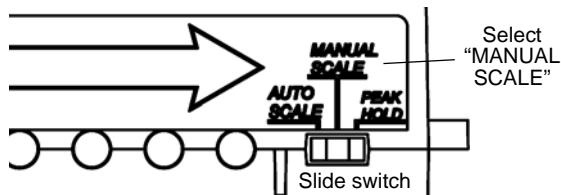
Zeroing the Visual Accelerometer

The Visual Accelerometer is factory calibrated, but you should always zero the Accelerometer in the same position that it will be used during an experiment.

• Place the sensor in a resting position in the same orientation that it will be used during the experiment.

• *Push* in and then *release* the "ON/ZERO/OFF" button. The sensor takes about one second to complete the zeroing function, so try not to move the sensor during this operation.

• If the sensor is connected to an interface, the data acquisition software can be used to confirm that the sensor is zeroed.

Using the Visual Accelerometer

1. **a) For standalone use:** Make sure that the batteries are installed.
   b) For use with data acquisition software: Connect the PASPORT Sensor Extension Cable to the mini-DIN connector on the top of the sensor. Connect the cable to a PASPORT-compatible interface.

2. *Push* in and *release* the "ON/ZERO/OFF" button to turn on the Visual Accelerometer.

3. At the slide switch at the right end of the sensor, move the switch to "MANUAL SCALE".

4. At the slide switch at the left end of the sensor, select a full scale value (1, 5, or 20 m/s^2).
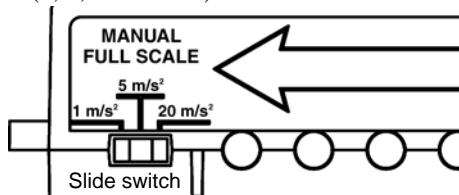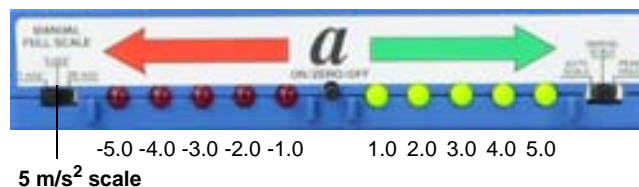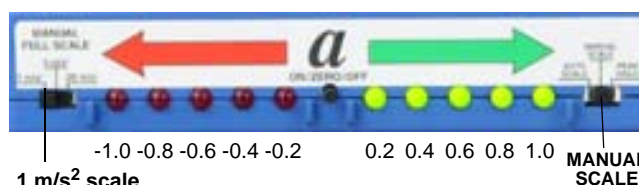

5. Use the provided thumbscrews to attach the Visual Accelerometer to the top of a PASCO Cart.

6. Place the Visual Accelerometer in the desired orientation for the experiment and *push* in and *release* the "ON/ZERO/OFF" button to zero the sensor.

7. Move the cart and watch the LEDs illuminate as you accelerate the cart back and forth.

The Visual Acceleration Scale

The green and red LEDs on the side of the sensor indicate the amount of acceleration along the long axis of the sensor. The green LEDs indicate acceleration in the positive direction and the red LEDs indicate acceleration in the negative direction.

MANUAL SCALE and MANUAL FULL SCALE

When MANUAL SCALE is selected, each of the LEDs represent one-fifth (1/5) of the MANUAL FULL SCALE that is selected (1 m/s^2, 5 m/s^2, or 20 m/s^2).

-1.0 -0.8 -0.6 -0.4 -0.2   0.2 0.4 0.6 0.8 1.0 **MANUAL SCALE**

1 m/s^2 scale

-5.0 -4.0 -3.0 -2.0 -1.0   1.0 2.0 3.0 4.0 5.0

5 m/s^2 scale

-20 -16 -12 -8 -4   4 8 12 16 20

20 m/s^2 scale

AUTO SCALE

When AUTO SCALE is selected, the Visual Accelerometer automatically determines the maximum reading for the scale from the largest *positive* recorded acceleration before the acceleration changes direction.

After the maximum acceleration is measured, the first four green LEDs represent 1/5, 2/5, 3/5, and 4/5 of the maximum reading. The red LEDs represent -1/5, -2/5, -3/5, and -4/5 of the maximum reading. NOTE: Use the data acquisition software to determine the *measurement* of the maximum reading.

AUTO SCALE only works in the positive (green LED) direction.

PEAK HOLD

When PEAK HOLD is selected, the Accelerometer searches for the peak acceleration and holds the maximum value. PEAK HOLD operates only in the positive direction. The PEAK HOLD applies the maximum acceleration before the direction changes. Before switching to PEAK HOLD, set the MANUAL FULL SCALE to the desired range. To reset to a new PEAK HOLD, push and release the "ON/ZERO/OFF" button. To stop PEAK HOLD, move the switch to MANUAL SCALE or AUTO SCALE.

Using the Visual Accelerometer with PASCO Capstone

Use the PASPORT Sensor Extension Cable to connect the sensor to a PASCO interface. Start the PASCO Capstone software. Turn on the Accelerometer.

• Click the "Hardware Setup" icon in the Tools palette to open the "Hardware Setup" panel. Confirm that the Visual Accelerometer icon appears with the interface's icon.

• Click one of the display templates in the workbook page, or double-click an icon in the "Displays" palette to open a specific data display.

Changing Units

PASCO Capstone can display measurements from the Visual Accelerometer in m/s^2. g, ft/s^2, or cm/s^2.

• Click the "Data Summary" icon in the Tools palette to open the "Data Summary" panel.

• In the Sensor Data Summary under "Visual Accelerometer", click "Acceleration" to highlight the measurement, and then click the "Properties" icon (that looks like a gear) to open the "Properties" panel.

• Click "Names and Symbols" and then select the desired units from the "Default Units" list. Click 'OK' to close the panel.
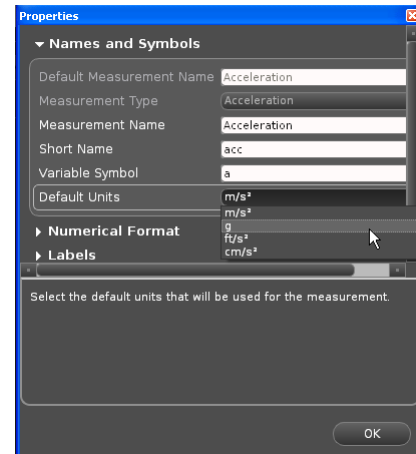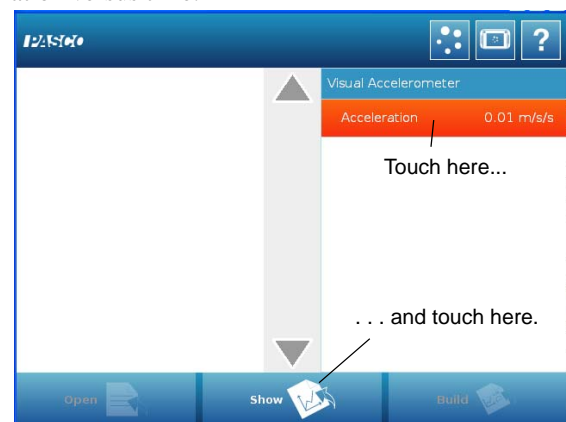

Using the Visual Accelerometer with SPARKvue

Use the PASPORT Sensor Extension Cable to connect the sensor to a SPARK Science device. Start SPARKvue and turn on the Accelerometer.

• Check that the SPARKvue screen lists the Visual Accelerometer and its measurement, "Acceleration".
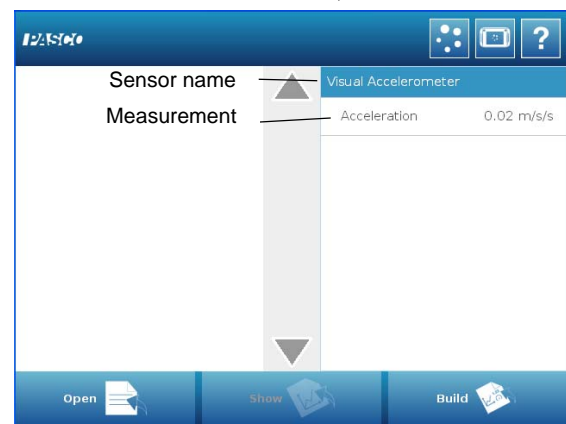
• Touch "Acceleration" to highlight it, and then touch "Show" to open a screen with a graph display of acceleration versus time.

Changing Units

SPARKvue can display measurements from the Visual Accelerometer in m/s/s and g.

- In the graph screen, touch the Experiment Tools icon to open the Experiment Tools screen. Touch "Data Properties" to open the Data Properties screen.

- Touch the button next to "Measurement", touch "Acceleration", and then touch the button next to "Units". Touch 'g'. Touch "OK" to close the screen.
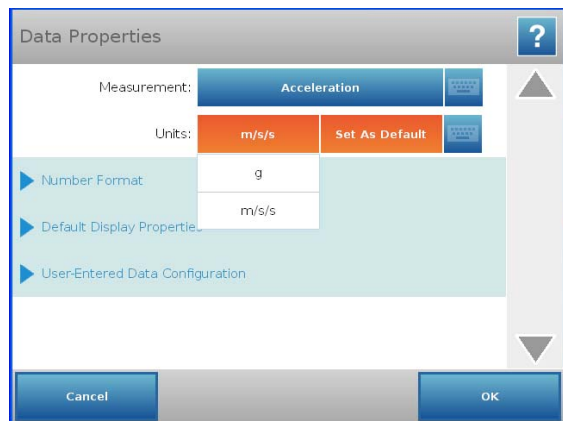
Using the Visual Accelerometer with the Xplorer GLX Datalogger

Turn on the Xplorer GLX and use the PASPORT Sensor Extension Cable to connect the sensor to a port on the top of the Xplorer GLX.

- The Xplorer GLX automatically shows a graph display of acceleration (m/s/s) versus time.

- NOTE: The Xplorer GLX can display measurements from the Visual Accelerometer in m/s/s and g. Refer to the User Guide for information about changing units.

Data

- Click "Record" (   ), touch the 'Start' button (   ), or press the "Record" button (   ) to begin recording data.

- Click "Stop" (   ), touch the 'Stop' button (   ) or press the "Record" button (   ) again to end recording data.

Setup Options

The Visual Accelerometer can be mounted in various ways for studies of linear, rotary, and centripetal acceleration, elastic and inelastic collisions, friction, free fall, etc. The follow-

ing paragraphs and photographs describe some sample experiment setup options.

If you plan to use the Visual Accelerometer in various orientations, consider purchasing a Visual Accelerometer Accessory Kit (PS-2516).
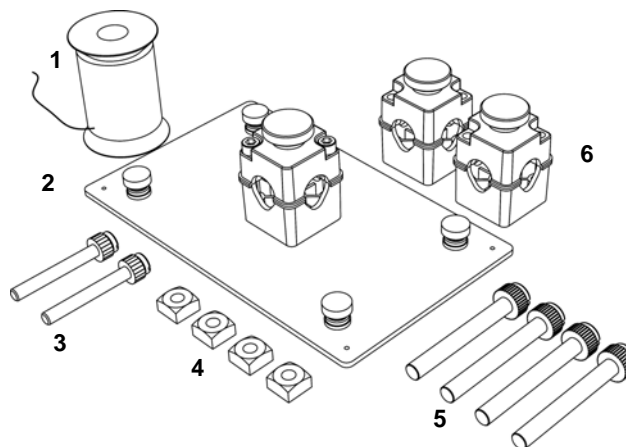

The Visual Accelerometer Accessory Kit includes the following:

Item	Item
1. Nylon thread, 1 spool	4. Square nut, 1/4-20 (4)
2. Pendulum Platform Plate	5. 1/4-20 x 2.0" thumbscrew (4)
3. M5 x .8 x 40 mm thumbscrew (2)	6. Rod Clamp (2)

1. Visual Accelerometer on an Inclined Track

Use the Visual Accelerometer on an inclined PASCO Track to study acceleration changes. Attach the Accelerometer to the top of a PASCO Cart. Set the inclined track at a shallow angle so that there is more time to observe the change in motion. Zero the Accelerometer when it is at the top of the incline.
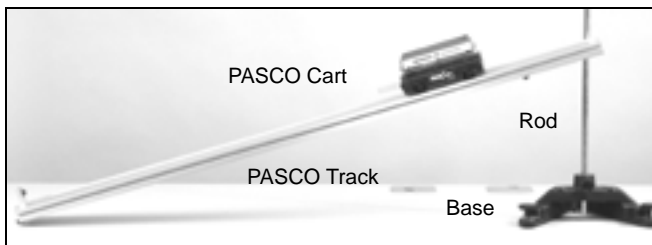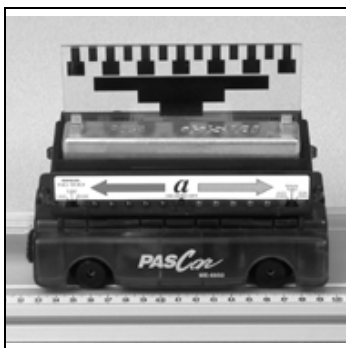

Additional Equipment: 1.2 m or 2.2 m PASCO Track*, PASCO Cart*, Large Rod Base (ME-8735), 45 cm Stainless Steel Rod (ME-8738).

*(*See the PASCO catalog or web site at www.pasco.com)*

2. Visual Accelerometer with Mass Bars and Picket Fence (Photogate Studies)

The Visual Accelerometer can be used with a picket fence (flag) for photogate studies. A mass bar can be placed on the top of the Accelerometer to study the affect of mass on acceleration. Use the provided thumbscrews to attach the Visual Accelerometer to a PASCO Cart. The picket fence inserts directly into the side of the accessory tray on the top of a PASCO Cart.

Additional equipment: 1.2 m or 2.2 m PASCO Track*, PASCO Cart*, Cart Picket Fence (ME-9804), Photogate Head (ME-9498A).

(*See the PASCO catalog or web site at www.pasco.com)

3. Visual Accelerometer and Force Sensor (Newton's Law Studies)

When studying Newton's laws with a Force Sensor on a cart, add the Visual Accelerometer to the top of the sensor. The Visual Accelerometer attaches to the Force Sensor with thumbscrews through holes in the top of the sensor (just like you would attach to a PASCO Cart).

Additional equipment: 1.2 m or 2.2 m PASCO Track*, PACO Cart*, Force Sensor[1] (CI-6537).

(*See the PASCO catalog or web site at www.pasco.com)

[1] *Note: The CI-6537 Force Sensor may require an Analog Adapter (PS-2158).*

4. Visual Accelerometer with Fan Accessory (and Time Pulse)

The Visual Accelerometer can be used with the ME-9491 Fan Accessory for motion and constant acceleration experiments. Use the provided thumbscrews to attach the Visual Accelerometer to a PAScar or Dynamics Cart. The Fan Accessory clips onto the side rails of the Visual Accelerometer the same as it does to a PASCO Cart. The Time Pulse Accessory allows the fan to turn on and off, hands free. Set the time pulse for about 1 second. This will give a short acceleration, and then show a constant speed as it coasts the rest of the way down the track.
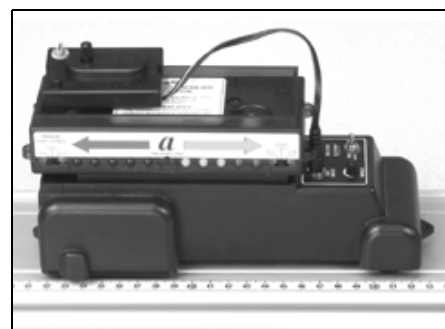
Additional equipment: 1.2 m or 2.2 m PASCO Track*, PASCO Cart*, Fan Accessory (ME-9491), Time Pulse Accessory (ME-9496.)

(*See the PASCO catalog or web site at www.pasco.com)

5. Visual Accelerometer on Motorized Cart (with Time Pulse)

The Visual Accelerometer can be used with the ME-9781 Motorized Cart for motion and constant velocity experiments. The Visual Accelerometer attaches to the Motorized Cart with thumbscrews through holes in the top of the cart (the same way you attach it to a PASCO Cart.) The Time Pulse Accessory allows the cart to turn on and off, hands free. Set the Time Pulse for about 2 seconds. This will give a very short acceleration (as it turns on), and then show a constant speed for the two seconds. Watch for the very short deceleration as it turns off.

Additional equipment: 1.2 m or 2.2 m PASCO Track*, PASCO Cart*, Motorized Cart (ME-9781), and Time Pulse Accessory (ME-9496).

(*See the PASCO catalog or web site at www.pasco.com)

PASCO®

6. Visual Accelerometer with Friction Accessory

To study the effect of friction on acceleration, the Visual Accelerometer has a recess in the bottom that allows use of the Friction Pad (available for the PAScar and GOcar). The friction pad inserts through a hole in the bottom of the PAScar or GOcar. Make sure you adjust the amount of friction you want before you attach the Visual Accelerometer to the top of the PAScar or GOcar.

Friction Pad

Additional equipment: 1.2 m or 2.2 m PASCO Track*, PAScar (ME-6950) or GOcar (ME-6951, PAScar/GOcar Friction Accessories (ME-6952)

(*See the PASCO catalog or web site at www.pasco.com)

7. Visual Accelerometers on Colliding Carts (Collision Studies)

The Visual Accelerometer can be used in setups for either elastic or inelastic collisions between carts on a track. With the thumbscrews provided, attach a Visual Accelerometer to each cart and place both on the track. You can have both Accelerometers facing the same direction for better visibility during a demonstration, but to use the PEAK HOLD feature, the Accelerometers must face opposite directions, with the red arrows pointing towards each other. Switch to PEAK HOLD on both units at the same time. As the red lights count down, launch the carts. The carts must collide after the red lights have finished counting down. To repeat, leave the PEAK HOLD switch as it is, and record data again. It will reset and start the red light countdown. You can use a Plunger Cart or carts with magnetic end caps. Add mass bars to change the conditions.

Additional equipment: A second Visual Accelerometer (PS-2128), 1.2 m or 2.2 m PASCO Track*, PASCO Carts*.

(*See the PASCO catalog or web site at www.pasco.com)

8. Visual Accelerometer and Spring Oscillations

For oscillation or Newton's Law studies, place the Visual Accelerometer attached to a PASCO Cart on a PASCO Track. Connect springs from the cart to the end stops on the track.


Additional equipment: 1.2 m or 2.2 m PASCO Track*, PASCO Cart*.

(*See the PASCO catalog or web site at www.pasco.com)

9. Visual Accelerometer and Pendulum (Horizontal Orientation)

This setup uses a pendulum clamp and thread to allow the Visual Accelerometer to oscillate as a pendulum. Because the Visual Accelerometer tips as it oscillates, the results may be surprising. Compare the results of this setup to the Parallel Pendulum setup.
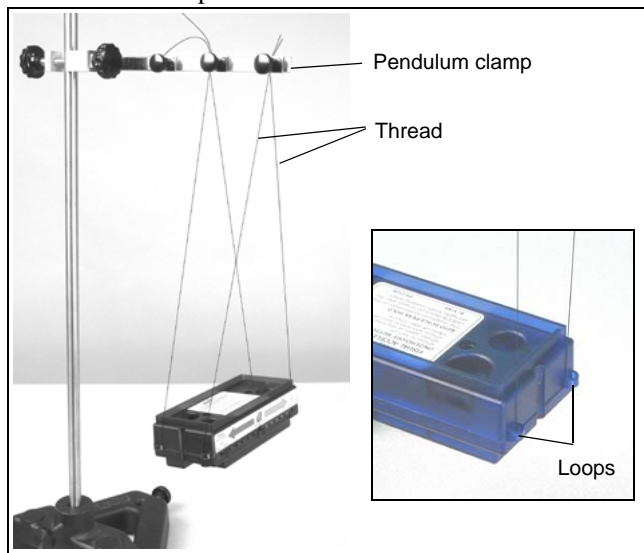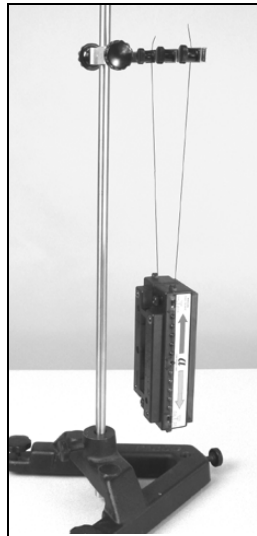

It is easier to adjust for level if you don't tie the thread to the Visual Accelerometer. Run the thread from the pendulum clamp through the loops on the ends of the sensor and then back up to the clamp. Zero the Accelerometer when it is at rest at the bottom of its swing.

Additional equipment: Pendulum Clamp (ME-9506)

Additional equipment recommended: Large Rod Base (ME-8735) and 90 cm Stainless Steel Rod (ME-8738)

10. Visual Accelerometer and Pendulum (Vertical Orientation)

This setup uses a pendulum clamp and thread to allow the Visual Accelerometer to hang vertically. As the Visual Accelerometer oscillates, it measures the centripetal acceleration, the acceleration parallel to the string. It is easier to adjust for level if you don't tie the thread to the Visual Accelerometer. Run the thread from the pendulum clamp through the loops on the Visual Accelerometer and then back up to the clamp. Zero the Accelerometer (in its vertical orientation) when it is at rest at the bottom of its swing. Because the Visual Accelerometer tips as it oscillates, the results might be surprising. Compare the results of this setup to the Parallel Pendulum setup. A more clear demonstration of centripetal acceleration is described in the rotation setup on page 18, using the Rotating Platform.

Additional Equipment: Pendulum Clamp (\ME-9506)

Additional equipment recommended: Large Rod Base (ME-8735) and 90 cm Stainless Steel Rod (ME-8738).

10. Visual Accelerometer Parallel to Pendulum

This setup keeps the Visual Accelerometer level as it oscillates by using the special four string pendulum plate from the Visual Accelerometer Accessory Kit. The Accelerometer correctly shows the horizontal acceleration as it oscillates. It is easier to adjust for level if you don't tie the thread to the Visual Accelerometer. Run the thread from the pendulum plate down through the loops on the end of the Visual Accelerometer and then back up to the plate. Zero the Accelerometer when it is at rest at the bottom of its swing.

Additional equipment: Visual Accelerometer Accessory Kit (PS-2516).

Additional equipment recommended: Large Rod Base (ME-8735), Double Rod Clamp (ME-9873), 45 cm Stainless Steel Rod (ME-8736), and 90 cm Stainless Steel Rod (ME-8738).

Pendulum Plate

Thread

Loops
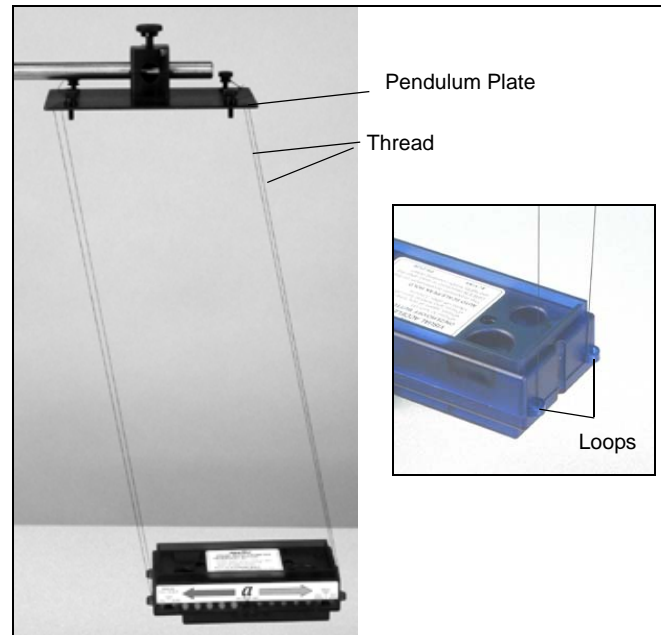
12. Visual Accelerometer Clamped to a Rod Stand

To use the Visual Accelerometer inside another moving reference, such as an elevator, best results are obtained if the sensor is mounted to a stand. Use the two plastic rod clamps from the Visual Accelerometer Accessory. Insert two of the 1/4-20 x 2.0 inch plastic thumbscrews through the top of the Accelerometer case, and securely fasten the clamps to the underside of the sensor.

There is a ridge on the bottom of the case to help align the clamps square to the case. Zero the Accelerometer when it is mounted on a rod in its vertical orientation.
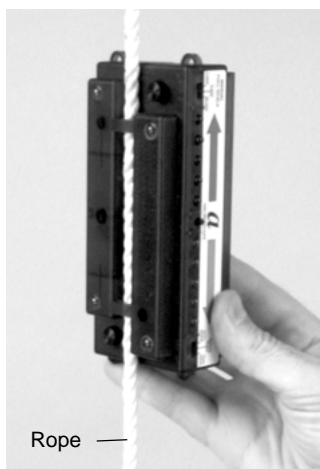
Additional equipment: Visual Accelerometer Accessory Kit (PS-2516).

Additional equipment recommended: Small Tripod Base and Rod (SE-9451).

13. Visual Accelerometer Sliding on a Rope (Free Fall)

For free fall studies, the underside of the Visual Accelerometer has a channel that accepts a cord or a small rope. By running the rope through a foam cushion at the bottom, you can allow the Accelerometer to free fall. Zero the Accelerometer in its vertical orientation.

Additional equipment recommended: No bounce pad (SE-7347)

Rope —

14. Visual Accelerometer on Rotating Platform

The Visual Accelerometer attaches to the Rotating Platform for centripetal acceleration studies. Use two 1/4-20 x 2.0 inch plastic thumbscrews and two square nuts from the Visual Accelerometer Accessory Kit. The square nuts fit into the T-slot in the platform. You can use either the slot in the top or slot in the side. For the exact center point of the sensor, see the Specifications.

Additional equipment: Rotating Platform (ME-8951).

Specifications (PS-2128)

Item	Value
Range:	±1, ±5, ±20 m/s^2
Maximum measurement:	±20 m/s^2
Maximum acceleration without damage	1,000 g (10,000 m/s^2)
Accuracy	±0.2 m/s^2
Resolution	LEDs; 20% of full scale Data acquisition software: 0.01 m/s^2
Default sampling rate	50 samples/sec
Maximum sampling rate	100 samples/sec
Frequency response:	0 to 10 Hz
Power required:	3 "AA" alkaline cells

The center of the sensor is indicated by the red dot on the top label of the Visual Accelerometer.

Technical Support

For assistance with any PASCO product, contact PASCO at:

Address:	PASCO scientific 10101 Foothills Blvd. Roseville, CA 95747-7100
Phone:	+1 916-786-3800 (worldwide) 800-772-8700 (U.S.)
E-mail:	support@pasco.com
Web	www.pasco.com

For the latest information about the Visual Accelerometer Sensor, visit the PASCO web site at www.pasco.com and enter "PS-2128" in the Search window.

Troubleshooting

Problem	Possible Cause(s)	Possible Solution(s)
One or more LEDs flicker, regardless of the direction of movement.	The Accelerometer is in an unstable position or you have a low battery condition.	Prior to using the Visual Accelerometer, use the thumbscrews to mount it to a cart or a steady base. Replace the batteries.
One red and one green LED alternately flash at turn on.	Batteries are low.	Open the bottom casing and replace the batteries.
Accelerometer does not turn on.	Low batteries or incorrect turn on.	Replace the batteries. Check battery orientation. Check turn on procedure.
Accelerometer does not turn off.	Accelerometer is connected to a PASCO interface. Accelerometer is locked up.	Disconnect the Accelerometer from the interface. Remove one battery for a few seconds and then replace it.
Accelerometer does not respond to acceleration or changing switch positions.	Weak batteries or electrostatic discharge cause the Accelerometer to lock up.	If the batteries are good, remove one battery for a few seconds and then replace it.
Positive and negative LED scales appear to work in reverse of the direction of acceleration.	Improper zeroing or unit malfunction.	Zero the Accelerometer when it is in the same orientation in which it will be used. Check the zeroing procedure.
Auto scale reading is erased.	Moving the scale switch back and forth.	To retain the auto scale reading, turn the unit off while in auto scale, then turn the unit back on.

Product End of Life Disposal Instructions:

This electronic product is subject to disposal and recycling regulations that vary by country and region. It is your responsibility to recycle your electronic equipment per your local environmental laws and regulations to ensure that it will be recycled in a manner that protects human health and the environment. To find out where you can drop off your waste equipment for recycling, please contact your local waste recycle/disposal service, or the place where you purchased the product.

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

Battery Disposal Information

Batteries contain chemicals that, if released, may affect the environment and human health. Batteries should be collected separately for recycling, and recycled at a local hazardous material disposal location adhering to your country and local government regulations. To find out where you can drop off your waste battery for recycling, please contact your local waste disposal service, or the product representative.