PASPort

3-Axis Acceleration-Altimeter

PS-2136

Sensor Specifications:	Procedure:
Sensor ranges:	Acceleration: -10 to +10 g Altitude*: 0 to 7000 meters
Accuracy:	Acceleration: 1% Altitude*: 1 meter for changes not exceeding 100 meters
Default sample rate:	20 samples/per second
Maximum sample rate:	20 samples/per second

* The altitude is the *height relative to sea level* (in meters). Altitude readings will vary with local variations in barometric pressure. The sensor will resolve better than 0.3 meters.

Acceleration Quick Start

The PS-2136 3-Axis Acceleration Altimeter measures acceleration (in m/s/s or g) along three axes (x,y, and z) and altitude (in feet or meters).

Additional Equipment Needed

- PASPORT™ interface (USB Link, PowerLink, etc.) with USB-compatible computer or a PS-2000 Xplorer
- EZscreen or DataStudio® software (version 1.8.5 or later)

Equipment Setup

1. Connect the PASPORT interface to a USB port on your computer or to a USB hub.
2. Connect the sensor to a PASPORT interface. (If using an Xplorer in the classroom, connect the Xplorer cable to your computer.)
3. The software launches when it detects a PASPORT sensor. Select a point of entry.


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Zeroing the Acceleration/Altimeter

The 3-Axis Acceleration Altimeter automatically zeroes when students click the **Start** button in DataStudio (version 1.8.5 or later). The DataStudio PASPORT Setup window provides additional zeroing options, as outlined in the table below.

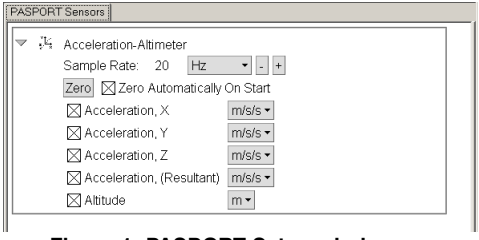


Figure 1: PASPORT Setup window

DataStudio Task	Procedure
Automatically zero the sensor	In DataStudio, click the **Start** button. The zero feature affects all axes (x, y, and z)* and the altitude.
Disable automatic zeroing	In the PASPORT Setup window, scroll to the Acceleration box and deselect the box next to "Zero Automatically on Start."
Manually zero the sensor	Place the sensor in a stationary and proper orientation for the experiment. In the PASPORT Setup window, click the **Zero** button.
Reverse the effect of zeroing the sensor	Exit the current experiment and start a new experiment (i.e. From the File menu, select "New Experiment.")

* The resultant acceleration is the magnitude of the vector sum for the x, y, and z accelerations.

Collecting Data with the 3-Axis Acceleration Altimeter in the Classroom

1. Plug the 3-Axis Acceleration Altimeter into a PASPORT interface.
2. Connect the PASPORT interface to a USB port (or USB hub) connected to a USB-compatible computer.
3. Orient the sensor for the experiment.
4. In DataStudio, click the **Start** button to begin recording data. To end data collection, click the **Stop** button.

Classroom Activity with the 3-Axis Acceleration Altimeter

1. Using the PASPORT extension cable, plug the 3-Axis Acceleration Altimeter into a PASPORT interface (USB Link, Xplorer, etc.).
2. Mount the 3-Axis Acceleration Altimeter to a Dynamics Cart, PAScar, or GOcar, using the included bracket.
3. Place the car on a Dynamics Track that has been inclined at some height and angle.
4. In EZscreen or DataStudio, click the **Start** button and allow the car to roll down the track.
5. When the car approaches the end of the track, click the **Stop** button. Have a lab partner at the end of the track ready to catch the car.
6. Repeat steps 3-5 two more times.
7. Looking at the acceleration-time graph, describe the acceleration of the car as it rolls down the track.
8. Average the acceleration values from the data runs and compare to the theoretical value for the height/angle you chose.
9. (Optional): Change the height/angle of the track and repeat the experiment to determine the effect of height/angle on the acceleration of the car.

Measurements with the 3-Axis Acceleration Altimeter

PASCO's 3-Axis Acceleration Altimeter features five simultaneous measurements, as follows, for use in a wide variety of exciting activities:

- Acceleration (x-axis)
- Acceleration (y-axis)
- Acceleration (z-axis)
- Acceleration (magnitude of the resultant)
- Altitude (calculated from pressure measurements)

Using the 3-Axis Acceleration Altimeter in the Field

To use the PS-2136 3-Axis Acceleration Altimeter in the field, you will also need an Xplorer datalogger (PS-2000) and an Xplorer Vest (PS-2520).

When used in the field, approximately four minutes of data can be stored in Xplorer's memory at the default sampling rate (20 Hz). You can change the sampling rate to increase or decrease the recording time.

Figure 2

Collecting Data with the 3-Axis Acceleration Altimeter in the Field

Procedure:

1. Plug the Acceleration Altimeter into an Xplorer.
2. Open the pocket on the Xplorer Vest and slide in the Xplorer and sensor. Be sure the display of the Xplorer is facing the clear window.
3. Stretch the elastic over the sensor to hold the sensor in place.
4. Close the pocket. Slip the vest over the head and onto the chest.
5. Connect the four buckles and adjust the straps until the vest fits snugly.
6. Press the **Power** button on the Xplorer. (Note: If more than two minutes passes before beginning data collection, the Xplorer will automatically power off.)
7. Enter the ride or get ready to start the desired activity.
8. To begin data collection, press and hold the **Start/Stop** button on the Xplorer for three seconds.*
9. Experience the ride or activity.
10. To stop data collection, press and hold the Start/Stop button for three seconds.*
11. Plug the Xplorer datalogger into the USB port of your computer. Data from the Xplorer will automatically download into DataStudio. (Note: You do not need to remove the Xplorer from the vest, as the pocket has a button hole for plugging in a USB cable.)

*Holding the **Start/Stop** button on the Xplorer prevents accidental starting and stopping of data collection during the ride or activity.

Suggested Activities

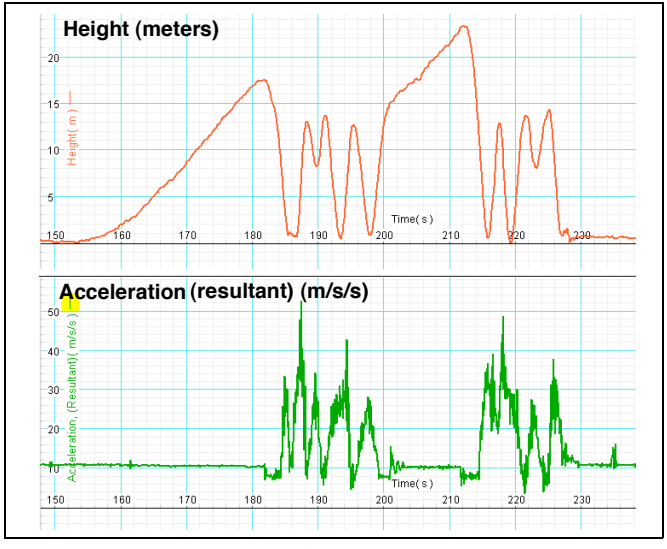
Acceleration measurements can be used to help students better understand velocity changes that occur with and without changes in altitude.

- **Amusement park rides:** Use the 3-Axis Acceleration Altimeter to help students see clear, visual clues about where they experience various acceleration changes on a ride, such as a roller coaster.
- **Skydiving:** Use the 3-Axis Acceleration Altimeter to measure changes in altitude during the acceleration and terminal velocity portions of the jump.
- **Snow skiing:** Measure accelerations experienced from turning snow skiis and the changes in altitude experienced throughout a ski run.
- **Ball toss:** Place the sensor inside a foam ball and toss through the air. The resultant acceleration and altitude data can be used to determine that acceleration is constant throughout the flight, even at the highest point.

Note: Altitude data is based on measurements from a pressure sensor. The calculation for altitude assumes standard pressure at sea level as a reference. If your ambient pressure conditions differ from reference, the absolute altitude reading may be incorrect or even negative. However, the changes in altitude will be accurate within one meter.

Sample Data

The data below was collected from an amusement park ride.



Note: The resultant acceleration and altitude data can be placed in the same graph window. This allows students to determine at which point on the ride they experienced a particular acceleration. Acceleration data in the x, y, and z axes is also available and can be displayed separately for further analysis.