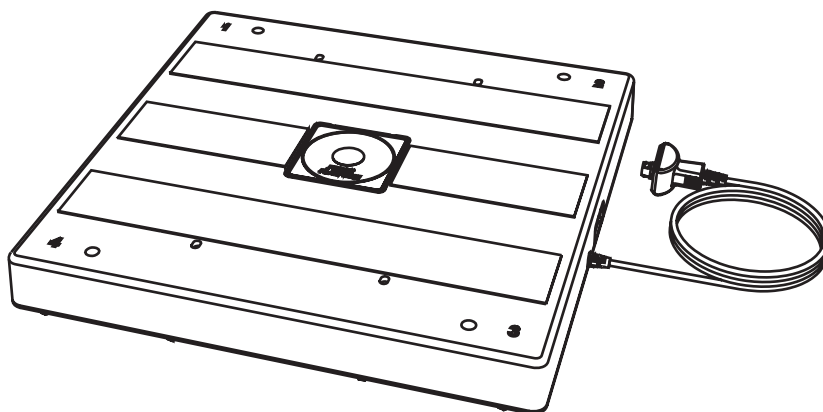


2-Axis Force Platform

PS-2142



Included Equipment

Part Number

2-Axis Force Platform

PS-2142

Required Equipment

PASPORT Interface¹

See PASCO catalog or www.pasco.com

Optional Equipment

Handle Set

PS-2548

¹Compatible PASPORT interfaces include the Powerlink (PS-2001), Xplorer GLX (PS-2002), USB Link (PS-2100), and others. See the PASCO catalog, visit www.pasco.com, or contact PASCO tech support for more information. Xplorer (PS-2000) with firmware version 1.14 or earlier is compatible in computer-based (non-logging) mode.

Introduction

The PASPORT Force Platform, used with a PASPORT interface, continuously measures force applied to it in two separate directions: normal to its surface (up to 4400 N) and along an axis parallel to its surface (up to 1100 N). You can use the 2-Axis Force Platform to measure the static forces of a person standing or leaning on it, or the dynamic vertical forces involved in moving and jumping. It has the measurement range and strength to accommodate people of all sizes and the sensitivity to measure smaller forces such as the weight of a ball. Put the platform horizontally on the floor or a tabletop, or mount it vertically on a wall. With the optional handle set, you can use the platform to measure both “pulling” and “pushing” force.

How It Works

When an object is placed on the platform, it applies a force normal to the platform's surface; this force is the object's weight. Because the platform does not move (much), the force applied by the floor to the platform's feet increases by an amount equal to the object's weight. Each of the four feet is connected to a beam with a strain gauge, through which the platform's electronics measure the force. The platform calculates and outputs the sum of these four forces. Force is measured in this way even if it is not constant, for instance, the force applied by a bouncing ball or jumping person.

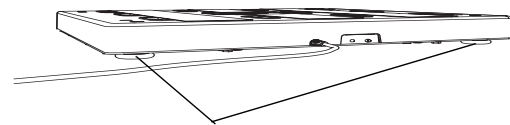
As well as the sum of the normal forces applied to the four beams, the platform can be set to output the separate normal force measured by *each* beam. See below for instructions on making these measurements visible.

Parallel force is measured by a fifth beam attached to the top plate of the platform. Note the arrow printed on the platform indicating the direction of the parallel axis.

Hardware Setup

On the floor

Place the 2-Axis Force Platform on the floor. It works best on a hard floor such as tile or wood, rather than carpet, which would allow the platform to move slightly when you step on it. If the floor is not perfectly level, adjust the platform's feet by turning them to make the platform level and stable. The platform should have all four feet on the floor with nothing touching the flat bottom surface.

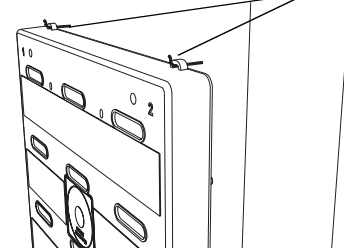


Turn feet to level Force Platform

On a Wall

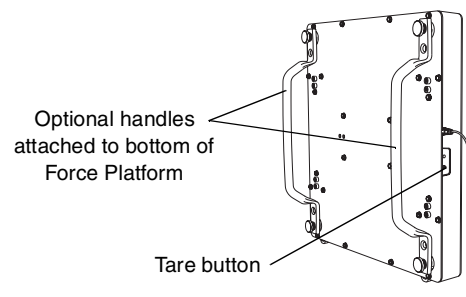
Use the tabs on the side of the platform to hang it from a pair of bolts or hooks on a wall. Make sure that all four feet are in stable contact with the wall.

Hang the Force Platform using side tabs



With the Optional Handle Set

Fasten the handles to the threaded brass inserts on the top of the platform, or remove the feet and fasten the handles to the bottom of the platform. With the handles, you can hold the platform against a wall to measure horizontal pushing force. If you have two platforms with handles (attached to the bottom), you can demonstrate Newton's third law by pushing the platforms together.



Note that the handles do not connect to the top plate when fastened to the top of the platform; therefore, parallel force applied to the handles will not be measured. To measure parallel force using the handles, attach them to the bottom of the platform. Hold the handles and press the top plate against a surface.



Interface and Software Setup

Connect the platform's cable to a PASPORT interface. A green LED on the side of the platform lights to indicate that the unit is powered and ready to take data. Press the tare button to set the output to zero.

Using the 2-Axis Force Platform with DataStudio

If you are using a computer, start DataStudio. Click the Start button to begin data collection. By default, the platform collects data at 10 samples per second and displays it in units of newtons (N). You can change these settings in the Experiment Setup window. (Click the Setup button to open the window.) In the Setup window you can also make the separate force measurement of each beam visible. For more instructions on using DataStudio, press F1 to open DataStudio's on-line help.

Using the 2-Axis Force Platform with the Xplorer GLX

If you are using an Xplorer GLX without a computer, press  to start data collection. By default, the platform collects data at 10 samples per second and displays it in units of newtons (N). You can change these settings in the Sensors screen. (From the Home screen, press  to open the Sensors screen.) In the Sensors screen you can also make the separate force measurement of each beam visible. For more instructions on using the Xplorer GLX, refer to the GLX Users' Guide.

Safety



Teachers: *The 2-Axis Force Platform is designed for use by students under the supervision of a teacher. Ensure that all users understand and follow these guidelines when jumping or stepping on the platform.*

- Do not stand on or jump off tables, chairs, or other inappropriate objects.
- Before you jump or step on the platform, be certain that it will not skid or move and that you will land with your foot or feet entirely on the platform, not hanging over the edge.
- Use the platform away from objects that may interfere with your movements or injure you if you fall.
- Follow all other safety rules and guidelines that apply to you.

Suggested Activities

Walking

Place the platform on the floor. Starting several paces away, walk toward the platform and step on it as you continue to walk forward. Study the vertical and horizontal forces applied by your foot. In what direction does your foot apply force to the platform in order to move you forward? In what direction does the platform apply force to your foot? Repeat the exercise at different walking speeds. How does walking faster affect the magnitudes of the horizontal and vertical forces?

Vertical Jumping

Stand on the platform and jump vertically. Look at a graph of force versus time to determine your “hang time,” or how much time you spend in the air. Is your hang time related to how high you jump? What other factors affect hang time? (For more precise time measurements, use a higher sampling rate.) Do you apply any horizontal force to the platform when jumping (and landing) vertically?

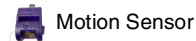
Leaning

Place the platform on the floor near a wall. Stand on the platform while observing horizontal and vertical force. Lean against the wall with slowly increasing force. How do the measured vertical and horizontal forces change?

Horizontal Jumping

Jump forward off of the platform. Turn around (while standing in the same spot where you landed) and jump back onto the platform. Compare the horizontal and vertical forces of jumping off and jumping back on.

Vertical Impulse



Use a motion sensor (PS-2103) to measure the position and velocity of the top of your head as you jump vertically on the platform. What is your measured vertical velocity at the moment your feet leave the platform? If you assume that you are a point mass, does this velocity correspond with your measured hang time? Why not?

Stand on the platform and press the tare button. Bend your knees and jump with one smooth motion. The area under the force versus time plot is the impulse. How does the impulse of jumping compare to the impulse of landing? Using the measured impulse, calculate your launch velocity.

Compare the velocity measured by a motion sensor to the velocity calculated from the impulse. Why are they not necessarily equal?



Horizontal Impulse

Hang the platform on a wall. Press the tare button. Sit on a rolling chair, a kinesthetics cart (SE-8747), or a hovercraft (ME-9838) and push off against the platform. Measure the impulse, or the area under a plot of force versus time. How is the impulse related to your momentum immediately after pushing off?

Use a motion sensor (PS-2103) to measure your velocity as you push off. Use this velocity to calculate your momentum and compare it to the impulse. (Remember to take into account the mass of the person *and* the chair, cart, or hovercraft.)

Force Distribution (With a Single Platform)

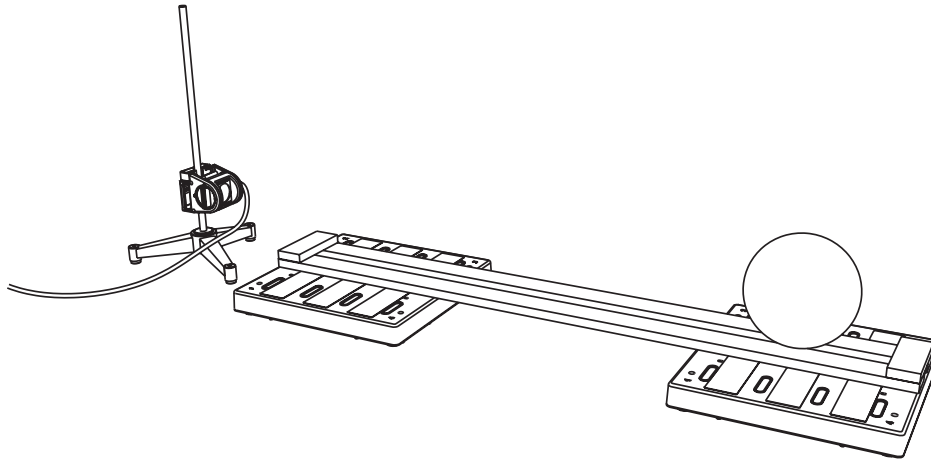
On a graph, display the separate force measurements of each of the platform's four beams. Stand on the platform and slowly shift your weight from your left foot to your right foot. Slowly shift your weight from your heels to your toes. What happens to the forces measured at the four corners of the platform? What happens to the sum of these forces?

Force Distribution (With Two Platforms)

Place two 2-Axis Force Platforms on the floor, and place two parallel boards (as pictured) to act as a bridge. Press the tare buttons. Place a heavy ball on the boards. Set up a motion sensor (PS-2103) to measure the position of the ball. While collecting data, give the ball a push so that it rolls along the boards.

What is the relationship between the position of the ball and the force measured by each platform? How does the sum of the forces change?

Calculate the changing torques applied to the boards by each platform and the ball as the ball rolls. How does the sum of the torques change?



Specifications

Range	Normal direction: -1100 N to +4400 N (-250 pounds to +1000 pounds) Parallel direction: -1100 N to +1100 N (-250 pounds to +250 pounds)
Resolution	0.1 N
Maximum Sampling Rate	2000 Hz with Xplorer GLX, 1000 Hz with other PASPORT interfaces
Zero (Tare) Function	Push Button
Platform Size	37 cm × 37 cm
Mass	6.4 kg
Force Overload Protection	Up to 6600 N (1500 pounds in the normal direction) 1700 N (375 pounds) per beam

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.)

Fax: (916) 786-3292

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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