PASPort™

GPS Position Sensor

PS-2175

Contents

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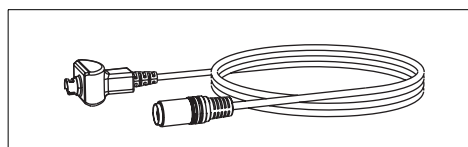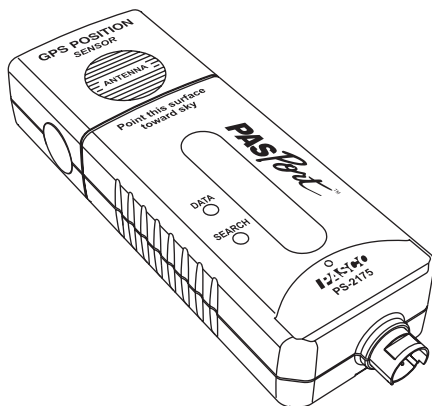| Included Equipment	Part Number
GPS Position Sensor	PS-2175
PASPORT Extension Cable	PS-2500
Required Equipment	
Xplorer GLX or other PASPORT Interface[1]	See PASCO catalog or www.pasco.com
Recommended Equipment	
USB Flash Drive[2]	PS-2551 or similar
My World GIS software	See PASCO catalog or www.pasco.com/myworld/

[1]*PASPORT interfaces include the Xplorer GLX (PS-2002), Xplorer (PS-2000), AirLink (PS-2005), PowerLink (PS-2001), and USB Link (PS-2100)*

[2]*For transferring data from Xplorer GLX to My World GIS software.*

Introduction

The PASPORT GPS Position Sensor uses signals received from the Global Positioning System to determine its latitude, longitude, altitude and horizontal velocity anywhere on earth. Use it alone or in conjunction with other sensors for outdoor experiments in environmental science, physics, and other subjects.

Data from the GPS Position Sensor is relayed to a PASPORT interface such as the Xplorer GLX. You can view and analyze the data on the GLX, or transfer it to a computer running DataStudio or *My World GIS*.

The Position Sensor is compatible with all PASPORT interfaces, but is most easily used with the Xplorer GLX. The instructions in this manual assume that you are using an Xplorer GLX. See page 10 for additional information on using other interfaces.

Theory of Operation

GPS stands for Global Positioning System. This system is maintained by the U.S. government for use by people anywhere on earth. The system consists of more than 24 satellites orbiting at an altitude of about 20 000 km. The satellites broadcast ranging signals and necessary data for the Position Sensor to determine its own position and velocity. The Position Sensor only receives data from the satellites; it does not transmit any signal.

To determine its position, the sensor must receive data from at least three satellites. When the sensor is first powered on, it searches the sky for available satellites. This process typically takes between 30 seconds and 2 minutes. Once satellites have been identified, the sensor actively tracks them and acquires new satellites as they come into view.

The Position Sensor performs best outdoors with a clear view of the sky.
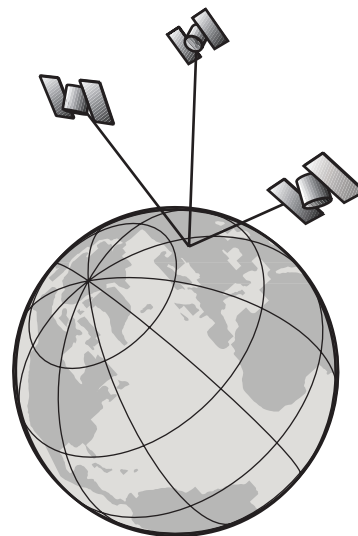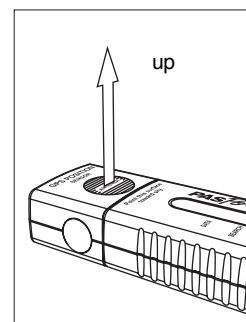
Sensor Set-up

Orientation and Positioning

It is important to orient the sensor properly to receive signals from satellites overhead, especially during *initial search* mode (when the red **SEARCH** indicator is blinking). The antenna detects signals through the labeled side of the sensor. Hold the sensor with the labeled side approximately horizontal and facing the sky. Do no cover the marked antenna area.

If the sensor is connected directly to the Xplorer GLX (without a cable), connect it to channel 1 or 2 (not 3 or 4) and hold the GLX horizontally.

A 1/4-20 threaded insert is provided for attachment of a mounting rod or thumbscrew as illustrated.

Orientation for *initial search* mode

Interface set-up

The Position Sensor works best with GLX firmware version 1.40 or later. Visit www.pasco.com/glx to download the newest firmware.

Before taking the GLX outdoors, leave it connected to AC power for several hours to ensure that the battery is fully charged.

1. Plug the Position Sensor directly into channel 1 or 2 of the Xplorer GLX, or use the included cable to connect it to any channel.

2. Press and hold the power button to turn on the GLX. The GLX automatically detects the sensor and opens the Digits display showing Latitude and Longitude measurements.

3. (Optional) Press ⟨F4⟩ to see all eight of the sensor's primary measurements.

If you plan to use other sensors to collect data alongside GPS data, connect them to other ports of the GLX.
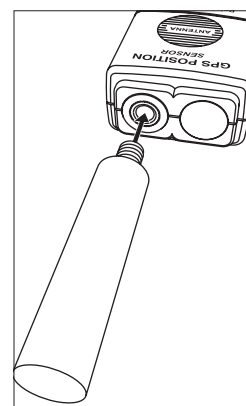
Optional mounting rod attachment

Modes

LED indicator lights in the GPS Position Sensor tell you whether or not the sensor is ready to make measurements. If you see the green **DATA** indicator, the sensor is ready. If you see the red **SEARCH** indicator (or both green and red), the sensor is not ready.

At initial power on, the sensor enters *initial search* mode, in which it searches the sky for available satellites. *Initial search* mode typically lasts between 30 seconds and 2 minutes. In *initial search* mode, the red **SEARCH** indicator flashes.

When the sensor is actively tracking three or more satellites, it switches to *GPS valid* mode. In this mode, the sensor continuously updates its position and velocity measurements. In *GPS valid* mode, the green **DATA** indicator glows steadily.

If the sensor cannot track at least three satellites, it enters *GPS lost* mode. In this mode it continues to report its most recent position measurements. Use this "stale" data with caution; it is incorrect if the sensor has moved since its last valid measurement. In *GPS lost* mode, both indicators flash.
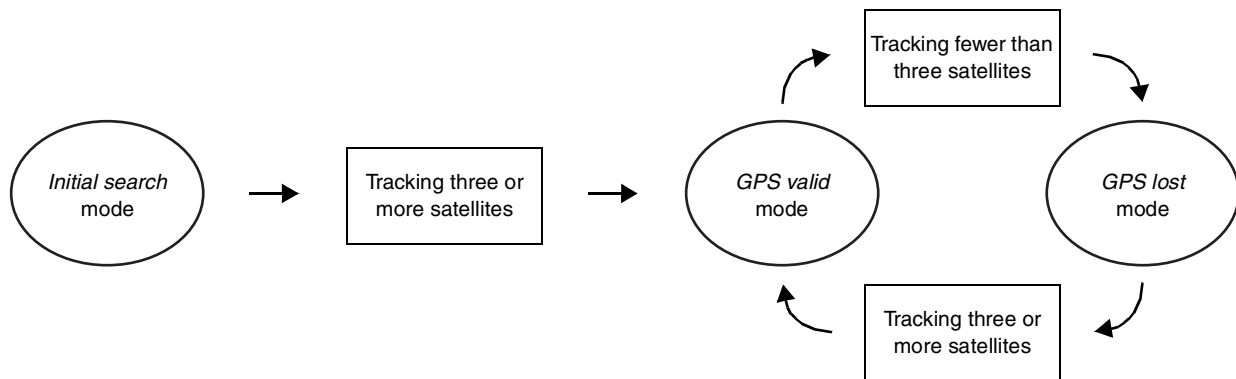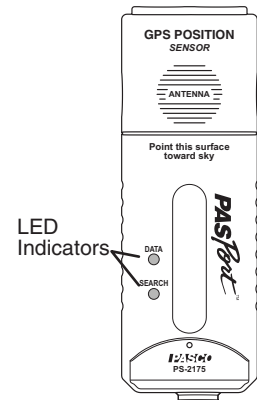
Table 1: Modes

Mode	LED Indicators	Reported Data	Satellite count	Note
Initial search	Data: off Search: flashing (red)	Latitude: 0.0 Longitude: 0.0	0	No position available
GPS valid	Data: on (green) Search: off	Latitude: valid Longitude: valid	≥ 3	Good positions available
GPS lost	Data: flashing (green) Search: flashing (red)	Latitude: last valid report Longitude: last valid report	0	Stale positions available, use with caution

Sensor Data

The sensor simultaneously reports several different measurements. When the GLX records data, it records all of these measurements, even if they are not displayed. The measurements are described in Table 2.

Table 2: Measurements

Measurement[1]	Range	Resolution	Notes	Example[2]
Latitude	±90.000000°	0.000001° (~2 m)	Global position appropriate for *My World* and other mapping applications	38.803772°
Longitude	±180.000000°	0.000001° (~2 m)		-121.316544°
Altitude	0 to 18000 m	1 m		34 m
Horizontal speed	0 to 515.00 m/s	0.01 m/s		1.07 m/s
Course over ground	0 to 360°	0.01°	North: 0° East: 90° South: 180° West: 270° Reliable when the Position Sensor is moving	24.74°
Satellite Count	0 to 20	1	Number of satellites that the Position Sensor is actively tracking	5
Latitude Relative	±10000 m	~0.2 m	Relative displacement from location at the start of data recording; origin is reset each time a new data run starts	2.3
Longitude Relative	±10000 m	~0.2 m		1.8
Latitude Minutes	0 to 60.0000'	0.0001' (~0.2 m)	Minutes within the current degree	48.2271'
Longitude Minutes	0 to 60.0000'	0.0001' (~0.2 m)		-18.9935'

[1]*See specifications on page 11 for accuracy information.*

[2]*Example data acquired at 38° 48.2271´ north latitude, 121° 18.9935´ west longitude, walking north-northeast.*

Data Collection

Whenever it is powered on, the Position Sensor continuously receives (or attempts to receive) data from GPS satellites, even if data is not being recorded by the GLX. The sensor uses the satellite data to calculate latitude, longitude, and the other quantities listed in Table 2. These measurements are reported to the GLX.

If the sensor is not actively tracking satellites, it still reports data to the GLX. Use this data with caution. In *initial search mode* (flashing red), it reports latitude and longitude values of zero. In *GPS lost mode* (flashing red and green), it reports the last valid measurements.

To record data:

1.   Press ⊙ on the GLX. By default, the GLX records data at its maximum rate of once per second and displays Latitude and Longitude (in decimal degrees) in the Digits display.

2.   To stop recording, press ⊙ again.

To record another run of data, repeat steps 1 and 2.

If you want to observe your current position without recording data, the steps above are not necessary. The Digits display always displays a live reading.

Typical GLX Procedures

For complete instructions on using the GLX to collect, display, and analyze data, refer to the Xplorer GLX Users' Guide.

Display Relative Displacement in a Graph

The **Latitude Relative** and **Longitude Relative** measurements are the north-south and east-west displacements (in meters) from your starting point. The starting point is reset every time you start data recording. Follow these steps to plot **Latitude Relative** versus **Longitude Relative**.

1. Press (⌂) , (F1) to open the Graph display.

    By default, the Graph appears with Latitude versus time.

2. Press (✓).

    The Graph's active areas light up with **Latitude** highlighted.

3. Press (✓) to open the data source menu. Use the arrow keys to highlight **Latitude Relative**. Press (✓).

4. Press (✓) to light up the Graph's active areas again.

5. Press the down arrow key to highlight **time**.

6. Press (✓) to open the data source menu. Use the arrow keys to highlight **Longitude Relative**. Press (✓).
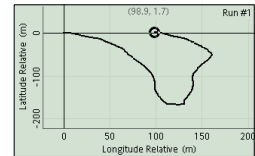
Relative displacement graph

Display Data in Degrees and Minutes

Follow these steps to display Latitude and Longitude in degrees and minutes with "N" or "S" to indicate north or south of the equator and "E" or "W" to indicate east or west of the prime meridian.

1. In the Digits display, press (✓) to light up the active areas.

2. Use the arrow keys to highlight **Latitude**.

3. Press (✓) to open the data source menu. Use the arrow keys to highlight **Data Properties**. Press (✓).

    The Data Properties box opens.

4. Use the down arrow key to highlight **Numeric Style**.

5. Press (✓) to open the menu. Use the arrow keys to highlight **NSEW 000°00.000**. Press (✓).

6. Press (F1) (OK).

7. Repeat steps 1 through 6 for **Longitude**.

Position displayed in default style (top) and in degrees and minutes (bottom)

Change the Sampling Rate

By default, the GLX records data from the Position Sensor once every second. Follow these steps to select a longer time between samples.

1. Press ⌂ , F4 to open the Sensors screen.

2. Use the left and right arrow keys to select the GPS Position Sensor icon at the top of the screen.

3. Press the down arrow key to highlight **Sample Rate Unit**. For sample rates faster than once every 60 s, leave this setting on **seconds**. Otherwise, press ✓ to open the menu, use the arrow keys to highlight **minutes** or **hours**, and press ✓.

4. Press the down arrow key to highlight **Sample Rate**. Press ＋ and − to set the time between samples (ranging from 1 s to 4 hours).

Collect Data in Manual Sampling Mode

In manual sampling mode, you trigger the recording of each data point by pressing a key. This mode is useful for making a series of "spot measurements" instead of a continuous recording.

1. Press ⌂ , F4 to open the Sensors screen.

2. Press F1 to open the Mode menu. Use the down arrow key to highlight **Manual**. Press ✓. The Data Properties window opens.

3. Press F2 (No Data). (This step configures the GLX to acquire sensor data without prompting you to enter keyboard data.)

4. Open a Graph, Table, or other display of your choice.

5. Press ▶ to start the data run.

6. Go to the location where you will record a data point.

7. Press �F to record a single data point from the Position Sensor (and any other connected sensors).

8. Repeat steps 6 and 7 to record more data points.

9. After you have recorded every data point, press ▶ to end the data run.

Transfer Data to DataStudio

Follow these steps to transfer recorded data to DataStudio for display and analysis on your computer.

1. After collecting data, use the cable included with the GLX to connect the GLX to the USB port of a computer with DataStudio installed. DataStudio will launch automatically and open the File Manager window. You will find the data that you just collected in the RAM folder under the filename "untitled" or "untitled (2)", "untitled (3)", etc.

2. Click this data file once to select it; then click **OK** to transfer the file to DataStudio and open it.

Plot Data in *My World GIS* (example)

Once you have collected data on the GLX with the GPS Position Sensor and other sensors, you can import it into *My World* software to be plotted on a map or aerial photograph and combined with other datasets. This procedure requires a USB flash drive and a computer with *My World* installed.

In this example you will use the temperature probe included with the Xplorer GLX to record temperature alongside GPS data. You can use a similar procedure to record and plot measurements from other sensors such as humidity, pH, or light intensity.

I. Acquire Data

1. Connect the Position Sensor to the GLX.

2. Connect a temperature probe to temperature port 1 or 2 on the left side of the GLX.

3. Turn on the GLX (if it is not already on).

4. Take the GLX outdoors.

5. Wait for the sensor to enter *GLX valid* mode (green **DATA** indicator glowing).

6. Press ▶ to start recording data.

7. Go for a short walk. Remember to hold the Position Sensor with the label facing the sky. Walk through a variety of areas where the temperature is likely to vary due to proximity to buildings, vegetation, or bodies of water.

8. Press ▶ to stop recording.

II. Transfer Data to *My World*

1. Connect a USB flash drive to the USB port on the right side of the GLX.

USB Flash Drive

2. Press ⌂ , F2 to open the Table display.

3. Press F4 to open the Tables menu. Use the arrow keys to highlight **Export All Data**. Press ✓. The *Export All Data* box opens.

4. Press F4 (Add All).

5. Note the Export File Name. (You can edit it if you wish.)

6. Press F1 (OK). A tab-delimited text file containing your data is saved on the USB flash drive. The message "Data export is complete" appears on the GLX.

7. Remove the flash drive from the GLX.

8. Connect the flash drive to your computer.

9. Launch *My World*.

10. In *My World*, open the **File** menu and select **Import Layer from File**. Navigate to the USB flash drive and open the file that you saved in step 6.
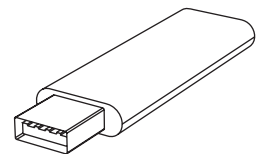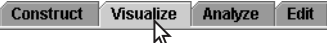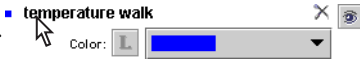
The *Import Text Data* window appears.

11. Change the **Begin Importing on Line** setting to **2**.

12. Click **OK**. The *Save Imported Data As* window appears.

13. Type the filename *Temperature Walk.tsv*. Click **Save**. This new dataset, *Temperature Walk*, appears in the Data Library on the left side of your screen.

III. Plot Data

1. Drag *Temperature Walk* from the Data Library to the Layer List.

2. Click the **Visualize** tab.

3. In the Layer List, click *Temperature Walk* to select that dataset.

4. In the Map section, click the Zoom button to zoom in on the data plot.

   A plot of the route that you walked appears in the Map section.

5. In the Layer List, open the Color Field menu (see right) and select **Temperature**.
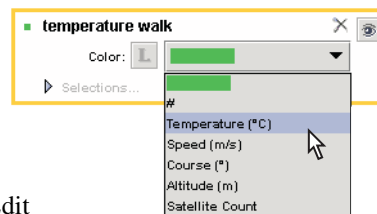
The plotted points are now color-coded to indicate the temperature measured at each point.

• To change the color coding and other appearance properties, click the Edit Appearance button.

• To combine your data plot with a map, aerial photograph, or other datasets, return to the **Construct** tab and drag the desired dataset from the Data Library to the Data List.

• For more instructions on using *My World*, visit www.pasco.com/myworld/

Using the Position Sensor with Other Interfaces

Xplorer (PS-2000)   Connect the Position Sensor the Xplorer either directly or using the included cable. Ensure that there are fresh batteries in the Xplorer. Press and hold the power button to turn on the Xplorer. Press ▶ to start recording data. Press ▶ again to stop. After you have collect at least one data run, connect the Xplorer to a computer running DataStudio to display and analyze the data.

Computer-based PASPORT Interfaces   Computer-based interfaces include the AirLink (PS-2005), PowerLink (PS-2001), and USB Link (PS-2100). You can also use the Xpolorer and Xplorer GLX in computer-based mode.

Connect the PASPORT interface to your computer (see instructions included with your interface). Connect the Position Sensor to interface either directly or using the included cable. Start DataStudio. Click **Start** to start recording data. Click **Stop** to stop recording.

Specifications

Position accuracy	10 m, 2D RMS 5 m, 2D RMS with WAAS enabled
Velocity accuracy	0.1 m/s
Maximum sample rate	1 Hz
Time to first fix (average)	42 s, cold start 38 s, warm start 1 s, hot start
Channels	20

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) 786-7565

Web: www.pasco.com

Email: support@pasco.com

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