PASPort™

Temperature/Sound Level/Light Sensor

PS-2140

The PS-2140 Temperature/Sound Level/Light Sensor simultaneously measures temperature (in °C, °F, or K), sound (in decibels), and light intensity (in lux).

Additional Equipment Needed

- PASPORT™ interface (USB Link, PowerLink, Xplorer, etc.) with USB-compatible computer
- 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 Temperature/Sound Level/Light Sensor to the 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 choice from the PASPORTAL window.


Sensor Specifications:	
Temperature (ambient)* Range: -10 to 50 °C Accuracy: ±2 °C Resolution: 0.01 °C	**Light** Range: 0 to 5249 Lux Accuracy: ±2 dB Resolution: 0.1 Lux
Temperature (probe)** Range:-35 to 135°C Accuracy: ±0.5 °C Resolution:0.01°C	**Sound Level** Range: 40 to 90 dBA Accuracy: ±3 dB Resolution: 0.1 dB

Note: You can record two separate temperature measurements with this sensor.

*Ambient temperature (in °C or °F) is automatically recorded and does not require a probe.

**This refers to the probe temperature (in °C, °F, or K) for any probe connected to the side temperature port. The range, accuracy, and resolution of the probe temperature vary with the type of probe connected to the sensor.

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Sample Data: Temperature, Sound Level, and Light Intensity Changes inside a Refrigerator
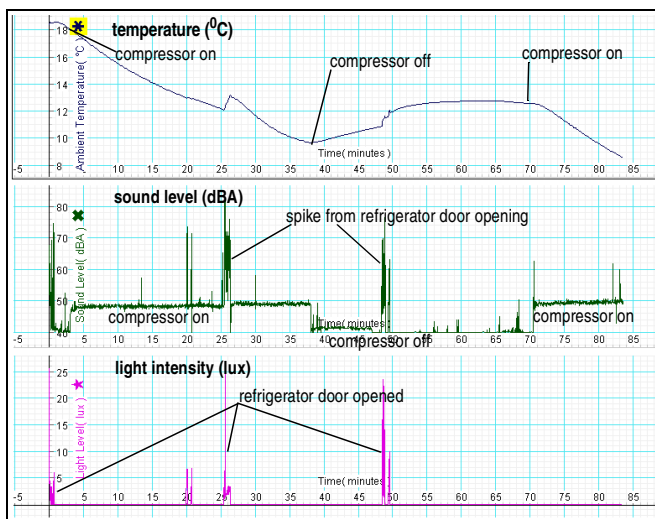
Equipment required: PS-2140 Temperature/Sound Level/Light Sensor, PASPORT Xplorer, DataStudio software (ver. 1.8.5 or later), refrigerator
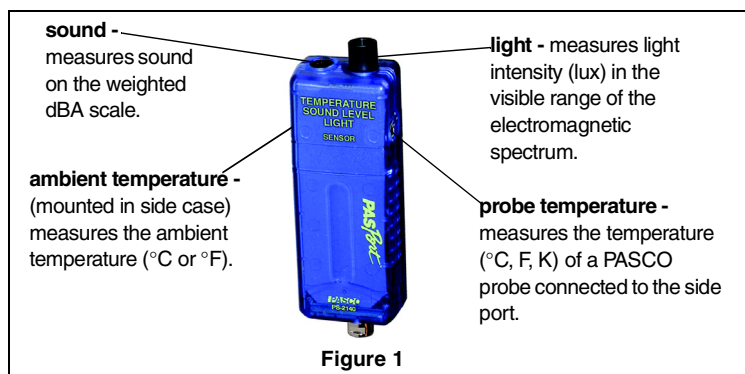
Note: Ensure the Xplorer has new or fresh batteries. Check Xplorer's battery level before beginning the experiment. If the batteries are at 75% capacity or less, replace the batteries or use a low sampling rate (1 to 2 samples/minute).

⚠ **CAUTION:** To avoid permanently damaging the sensor, do not place the Temperature/Sound Level/Light Sensor in liquids, a freezer or oven, or near fire.
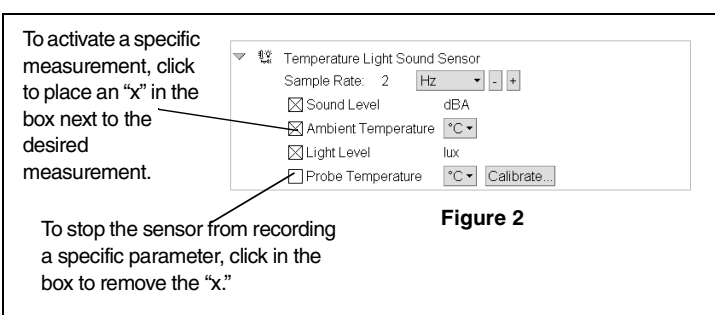
1. Plug the PS-2140 Temperature/Sound Level/Light Sensor into a PASPORT **Xplorer**.
2. (Optional): Connect a Fast Response Temperature Probe (PS-2135) to the side port and simultaneously measure the temperature in the freezer.
3. Place the Temp/Sound Level/Light Sensor into a refrigerator (on a shelf near the light source), and press the **Start/Stop** button. Close the door to the refrigerator. On a piece of paper, record the time you put the sensor into the refrigerator.
4. Monitor the temperature, sound, and light for approximately 30 minutes to one hour (or enough time for the compressor to turn on and off).
5. At 10 minute intervals, open the refrigerator door, check to see that the sensor is functioning properly, and close the door.
6. After 30 minutes to one hour, open the refrigerator door, press the **Start/Stop** button to end data collection, and remove the sensor.
7. Connect the Xplorer cable to your computer and open DataStudio. At the DataStudio prompt, click the **Retrieve Now** button to display the data.
8. Describe the changes in temperature, light, and sound during the time that the sensor was in the refrigerator. What light and sound did the sensor detect? What caused the temperature change? Explain your conclusions.
9. **Optional activity:** Place the Temp/Sound Level/Light Sensor next to a computer screen or television. Monitor the temperature, light intensity, and sound level as you change the light intensity and sound volume controls.

DataStudio/DS Lite Tasks:	Procedure:
View the temperature, light and sound in graphs:	From the Data list, drag the temperature, sound, and light icons each to a Graph display.
Change measurements:	Click on the **Setup** button to open the PASPORT Setup window. Scroll to the Temp/Sound/Light box. Click to place a check next to the desired measurement(s).
Scale to fit the data:	Click the **Scale-to-Fit** button.
View data statistics:	On the main toolbar, click the **Statistics** button.

Temperature/Sound Level/Light Sensor Measurements and Operation

Figure 1

sound - measures sound on the weighted dBA scale.

light - measures light intensity (lux) in the visible range of the electromagnetic spectrum.

ambient temperature - (mounted in side case) measures the ambient temperature (°C or °F).

probe temperature - measures the temperature (°C, F, K) of a PASCO probe connected to the side port.

Note: By default, the sound, ambient temperature, and light measurements display when you first plug in the sensor. At any time, you may activate or deactivate the display of any of the four measurements through DataStudio's PASPORT Setup window (Figure 2).

To activate a specific measurement, click to place an "x" in the box next to the desired measurement.

Figure 2

To stop the sensor from recording a specific parameter, click in the box to remove the "x."

Calibration Procedure

Calibration of the Temperature/Sound Level/Light Sensor is not generally required. If you plan to take measurements with an external temperature probe, you may calibrate the temperature probe with DataStudio. The ambient temperature, light, and sound parameters *are not set up for* calibration.

To calibrate the probe temperature (in DataStudio):
1. Plug the Temperature/Sound Level/Light Sensor into a PASPORT interface.
2. Plug the temperature probe into the external side port of the sensor.
3. In DataStudio, click the **Setup** button to open the PASPORT Setup window.
4. In the PASPORT Setup window, scroll to the Temperature/Sound Level/Light box and click the **Calibrate** button.

⚠ **WARNING:** Do not place any part of the Temperature/Sound Level/Light box in water or other liquids. Placing the sensor box in liquids will permanently damage the sensor.

5. Place the *temperature probe* in the 0°C water (or your first point). (NOTE: The software is set to use 0°C and 100°C as the two points for calibration. You may choose to enter your own values and use a thermometer as a reference.) In the Calibration window, click the **Set** button.
6. Repeat steps 5-6 for the 100°C water (or your second point).
7. Click **OK** to save the calibration values.

Collecting Data

1. Plug the Temperature/Sound Level/Light Sensor into a PASPORT interface. Connect the PASPORT interface to a USB-compatible computer.
2. Place the sensor in the experimental setting or condition.
3. In DataStudio, open a Graph display and click the **Start** button to begin recording data (See "DataStudio tasks" on Card 1B).
4. To end data collection, click the **Stop** button.

Sensor Usage Tips

⚠ **CAUTION:** To avoid damaging the sensor, do not place the sensor in liquids, freezers, ovens, or fire. When placing the sensor near electrical appliances, follow standard electrical safety precautions in the classroom. PASCO does not cover the costs of sensor replacements due to negligent or destructive use in the classroom.

• The sensor can be used with most PASPORT temperature probes (i.e. PS-2131, PS-2135, PS-2153).
• DataStudio software, version 1.8.5, contains workbook activities for use with the Temperature/Sound Level/Light Sensor. When you plug the sensor into a USB Link or PowerLink interface, a list of the workbook activities appears in the PASPORTAL window.
• When using the Temperature/Sound Level/Light Sensor with an **Xplorer** for prolonged monitoring (greater than 55 minutes), ensure that the Xplorer contains new or charged batteries. To maximize battery life, connect the Xplorer to a computer or Xplorer Power Adapter (PS-2530).
• Do not point the sensor directly at the sun for more than a few minutes.
• If connecting two or more Temperature/Sound Level/Light sensors to a PowerLink, use channels 1 and 3 on the PowerLink. Placing the sensors too close together may block either sensor's external temperature port.

Suggested Applications

• Studying general physical laws and concepts in science, such as light absorption, sound acoustics, radiation, conduction, and convection
• Single parameter studies: comparing the light intensity emitted from the sun at different times of the day; comparing the sound level emitted from various sources (car horn, radio, voice, etc.); comparing the temperature of different appliances, skin temperature of animals, etc.
• General physics studies exploring how sound, light, and heat relate to energy
• Environmental, greenhouse, and ecological studies
• Comparing environmental conditions among various species of plants, animals, or other microorganisms
• Comparing temperature, light, and sound from different electrical appliances