

PAR Sensor

(Order Code PAR-BTA)



The PAR (Photosynthetically Active Radiation) Sensor measures photosynthetic light levels in both air and water. The sensor responds to visible light in the spectral range that is used by plants in photosynthesis (375–630 nm). It features a waterproof sensor head and connector and reports the Photosynthetic Photon Flux Density (PPFD), which is measured in $\mu\text{mol m}^{-2} \text{s}^{-1}$ (micromoles of photons per meter squared per second). The sensor is calibrated for use in sunlight, but can also be used to measure PPFD from electric light sources. This sensor is ideal for experiments that investigate photosynthesis and primary productivity and can also be used in many agricultural and environmental science applications.

Note: Vernier products are designed for educational use. Our products are not designed nor are they recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

What's Included

- PAR Sensor
- Cover for the lens of the PAR sensor

Compatible Software

See www.vernier.com/manuals/par-bta for a list of software compatible with the PAR Sensor.

Getting Started

1. Connect the sensor to the interface (LabQuest Mini, LabQuest 3, etc.).
2. Start the appropriate data-collection software (Logger Pro[®], LabQuest[®] App, or Vernier Graphical Analysis[®]) if not already running, and choose New from File menu. The software will identify the sensor and load a default data-collection setup. You are now ready to collect data.

If you are collecting data using a Chromebook[™], mobile device such as iPad[®] or Android[™] tablet, or a Vernier wireless interface, please see the following link for up-to-date connection information:

www.vernier.com/start/par-bta

Using the Product

Sensor Orientation

Sensor orientation is important for getting the best results from the PAR Sensor. When measuring PAR outdoors, the sensor head should be level, with the white lens pointing straight up toward the sky and with the cord pointing toward the north (in the Northern Hemisphere) or toward the south (in the Southern Hemisphere).

When measuring PAR from an artificial light source, the sensor head should be placed with the lens of the sensor facing the center of the light path.

Mounting the PAR Sensor

The PAR Sensor can be permanently mounted to a surface for continuous outdoor use. The sensor head and connector are waterproof and the black electronics box is weatherproof. Care should be taken to keep the electronics box as dry as possible. For best results, the sensor head should be leveled during mounting. The nylon 10–32" × 3/8" mounting screw found on the bottom of the sensor head can be used for attaching the PAR Sensor to a solid object.

The sensor should also be mounted such that obstructions do not shade the sensor (e.g., trees, weather station, cell phone tower). Once mounted, the protective cap should be removed from the sensor. The protective cap can still be used as a covering for the sensor when it is not in use.

Calibrating the Sensor

The Vernier PAR Sensor is calibrated before shipping and should not need user calibration.

Optional Calibration Check

The Vernier PAR Sensor should not need to be calibrated, but you can verify the calibration using the Clear Sky Calculator (www.clearskycalculator.com). The Clear Sky Calculator for Quantum Sensors reports the theoretical PPFD at any time of day at any location in the world on a cloudless day. The application is most accurate at solar noon in the spring and summer.

Adjusting the Calibration Equation for Other Light Sources

The Vernier PAR Sensor is calibrated for use in sunlight and for broadband artificial light sources. The calibration equation can be adjusted to measure PAR from different light sources, such as LED grow lights and to make the sensor more accurate when used under water. For steps on adjusting the calibration equation please see www.vernier.com/til/3102

Specifications

PAR range	0 to 2500 $\mu\text{mol m}^{-2} \text{s}^{-1}$ (in full sun)
Absolute accuracy	$\pm 5\%$ (full scale)
Repeatability	$\pm 1\%$
Long-term drift	Less than 2% per year
Cosine response	45° zenith angle: $\pm 2\%$ 75° zenith angle: $\pm 5\%$
Wavelength range	370–650 nm
Resolution	1 $\mu\text{mol m}^{-2} \text{s}^{-1}$

Sensor dimensions	diameter: 2.4 cm height: 3.3 cm cable length: 5 m
Materials	Anodized aluminum with cast acrylic lens
Operating environment	-10 to 60°C 0–100% relative humidity Sensor head and cable can be submerged in water to electronics box
Stored calibration values	slope: 500 $\mu\text{mol m}^{-2} \text{s}^{-1}/\text{V}$ intercept: 0

Care and Maintenance

Do not wrap the cable tightly around the sensor for storage. Repeatedly doing so can irreparably damage the wires and is not covered under warranty.

Cleaning the PAR Sensor

Debris on the PAR Sensor lens will partially block the optical path and will lead to low readings. Dust and other organic deposits are best removed using water or window cleaner. Never use an abrasive cleaner on the lens. Salt deposits can also accumulate on the sensor lens over time due to evaporation from sea spray, sprinkler irrigation water, or wave splash. Salt deposits should be dissolved with vinegar and then removed using soft cloth or cotton swabs.

PAR Sensor Head Connector

The head of the Vernier PAR Sensor is attached to the main cable using a P68-rated stainless-steel marine grade (M8) connector. This connector is located 25 cm from the sensor head. The connector is used for removing the sensor head during routine calibration, replacement, or maintenance by the manufacturer. Please do not remove the sensor head from the main cable. For the connector to be waterproof, confirm that the cables are firmly connected and the threaded connectors are finger tight.

PAR Terminology

Radiation that drives photosynthesis is called photosynthetically active radiation (PAR) and is defined as the total amount of radiation across a spectral range of 400 to 700 nm. This means that an ideal PAR sensor would respond equally to all wavelengths of light between 400–700 nm. The summed amount of light across this range is called the photosynthetic photon flux density (PPFD) and is measured in units of micromoles per square meter per second ($\mu\text{mol m}^{-2} \text{s}^{-1}$). The term PPFD is often shortened to PPF (photosynthetic photon flux) by plant physiologists. The two terms (PPFD and PPF) are interchangeable.

Plant physiologists also refer to sensors that measure PPFD as quantum sensors. A quantum, in this case, refers to the minimum quantity of light (one photon) that is

available for absorption by the photosynthetic pigments of plants. In other words, one photon is a single quantum of light that can be used by plants for photosynthesis. Based on this definition, the Vernier PAR Sensor is a quantum sensor.

How the Sensor Works

The Vernier PAR Sensor consists of a waterproof Apogee Instruments SQ series quantum sensor connected to a 5 m cable. The end of the cable is attached to a voltage amplifier located inside a black electronics box. A cable from the electronics box is then connected to the data-collection interface. The sensor head consists of an acrylic lens, filter, photodiode, and signal processing circuitry that is mounted in a waterproof aluminum housing that can be used for continuous PPFD measurements. The sensor head is cosine corrected. This allows the sensor to maintain accuracy when light hits the sensor head at different angles. Light hitting the lens of the sensor head produces an analog voltage that is amplified by the electronics box. This amplified voltage is then converted to PPFD by the data-collection software.

Troubleshooting

For troubleshooting and FAQs, see www.vernier.com/til/3113

Related Products

Item	Order Code
Go Direct Optical Dissolved Oxygen	GDX-ODO
Go Direct CO ₂ Carbon Dioxide Gas	GDX-CO2
Extra-Long Temperature Probe	TPL-BTA
Go Direct Tris-Compatible Flat pH	GDX-FPH
Go Direct Conductivity	GDX-CON
Salinity Sensor	SAL-BTA
Water Quality Bottles (8)	WQ-BTA

Warranty

Warranty information for this product can be found on the Support tab at www.vernier.com/par-bta

General warranty information can be found at www.vernier.com/warranty



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Rev. 6/20/2023

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