UNDERWATER PAR MEASUREMENT

LI-COR, Inc. Toll Free: 1-800-447-3576 (U.S. & Canada) • Phone: 402-467-3576 • FAX: 402-467-2819 • E-mail: envsales@env.licor.com • Internet: http://www.licor.com

LI-192SA UNDERWATER QUANTUM SENSOR

Underwater or Atmospheric PPFD Measurement

Underwater or atmospheric *Photosynthetic Photon Flux Density* (PPFD) can be accurately measured using the LI-192SA Underwater Quantum Sensor. The LI-192SA is cosine corrected and features corrosion resistant, rugged construction for use in freshwater or saltwater and pressures up to 800 psi (5500kPa, 560 meters depth).

LI-192SA SPECIFICATIONS

Absolute Calibration: ± 5% in air traceable to NBS.

Sensitivity: Typically 4 µA per 1000 µmol s^{-1} m^{-2} in water.

Linearity: Maximum deviation of 1% up to 10,000 µmol s^{-1} m^{-2}.

Stability: < ± 2% change over a 1 year period.

Response Time: 10 µs.

Temperature Dependence: ± 0.15% per °C maximum.

Cosine Correction: Optimized for both underwater and atmospheric use.

Azimuth: < ± 1% error over 360° at 45° elevation.

Detector: High stability silicon photovoltaic detector (blue enhanced).

Sensor Housing: Corrosion resistant metal with acrylic diffuser for both saltwater and freshwater applications. Waterproof to withstand 800 psi (5500kPa) (560 meters).

Size: 3.18 Dia. × 4.62 cm H (1.25" × 1.81").

Weight: 227 g (0.50 lbs).

Mounting: Three 6-32 holes are tapped into the base for use with the 2009S Lowering Frame or other mounting devices.

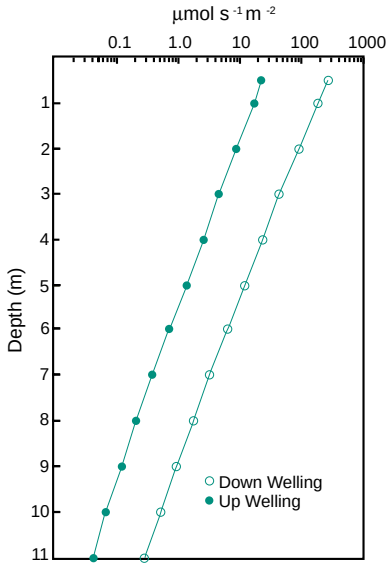
Cable: Requires 2222UWB Underwater Cable.

UNDERWATER PAR MEASUREMENT

Accurate measurements of *Photosynthetically Active Radiation* (PAR, 400-700 nm) in aquatic environments is accomplished using either the LI-192SA Underwater Quantum Sensor or the LI-193SA Spherical Quantum Sensor. These sensors have been utilized extensively by limnologists, oceanographers and biologists conducting aquatic productivity studies and vertical profiling.

For extremely turbid conditions, radiation levels with resolution down to 0.01 µmol s^{-1} m^{-2} can be measured when either the LI-192SA or LI-193SA quantum sensors are used with the LI-1400 DataLogger.

Both the LI-192SA and the LI-193SA utilize computer-tailored filter glass to achieve the desired quantum response. Calibration is traceable to NIST.



Typical semi-logarithmic plot of downwelling and upwelling quantum irradiance collected with two LI-192SA Quantum Sensors.

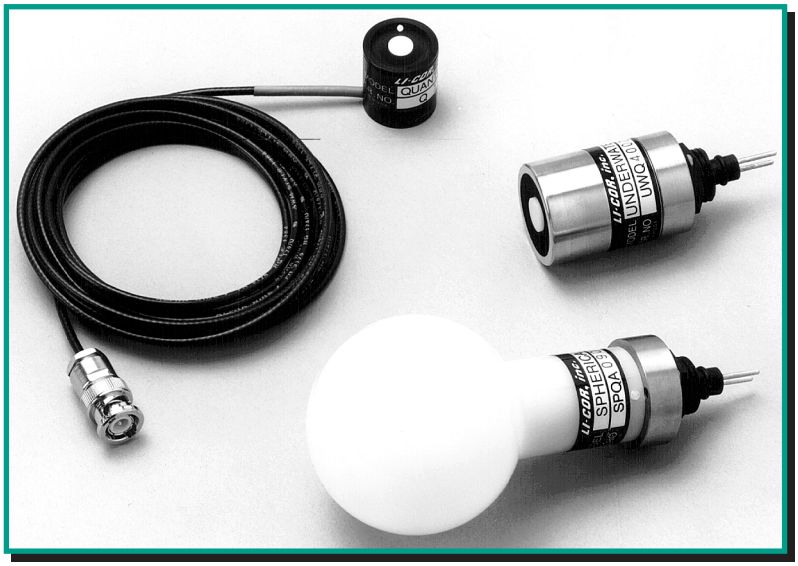
LI-193SA SPHERICAL QUANTUM SENSOR

Underwater PAR From All Directions

The LI-193SA Underwater Spherical Quantum Sensor gives an added dimension to underwater PAR measurements as it measures photon flux from all directions.

This measurement is referred to as *Photosynthetic Photon Flux Fluence Rate* (PPFFR) or *Quantum Scalar Irradiance*. This is important, for example, when studying phytoplankton which utilize radiation from all directions for photosynthesis.

The LI-193SA features a high sensitivity optical design and compact, rugged construction (3400 kPa, 350 meters depth).



Clockwise: LI-190SA Quantum Sensor, LI-192SA Underwater Quantum Sensor, LI-193SA Spherical Quantum Sensor

LI-193SA Specifications

Absolute Calibration: ± 5% in air traceable to NBS.

Sensitivity: Typically 7 µA per 1000 µmol s^{-1} m^{-2} in water.

Linearity: Maximum deviation of 1% up to 10,000 µmol s^{-1} m^{-2}.

Stability: < ± 2% change over a 1 year period.

Response Time: 10 µS.

Temperature Dependence: ± 0.15% per °C maximum.

Angular Response: < ± 4% error up to ± 90° from normal axis (see Figure 3).

Azimuth: < ± 3% error over 360° at 90° from normal axis.

Detector: High stability silicon photovoltaic detector (blue enhanced).

Sensor Housing: Corrosion resistant metal for both saltwater and freshwater applications with an injection molded, impact resistant, acrylic diffuser. Units have been tested to 500 psi (3400 kPa)(350 meters) with no failures.

Size
Globe: 6.1 cm Dia. (2.4").
Housing: 3.18 cm Dia. (1.25").
Overall Height: 10.7 cm (4.2").

Weight: 142 g (0.31 lbs.).

Mounting: Three 6-32 mounting holes are tapped into the base for use with the 2009S Lowering Frame or other mounting devices.

Cable: Requires 2222UWB Underwater Cable.

2009S Lowering Frame

The 2009S Lowering Frame provides for the placement of two underwater cosine sensors, one each for downwelling or upwelling radiation (shown right), or a single LI-193SA Spherical Quantum Sensor. The 2009S provides stability for proper orientation of the sensor(s), minimizes shading effects, and features a lower mounting ring for stabilizing weight attachment if necessary.

Construction: Anodized aluminum.

Size: 51.4 L (20.3") × 35.6 cm W (14.0").

Weight: 327 g (0.72 lbs.).

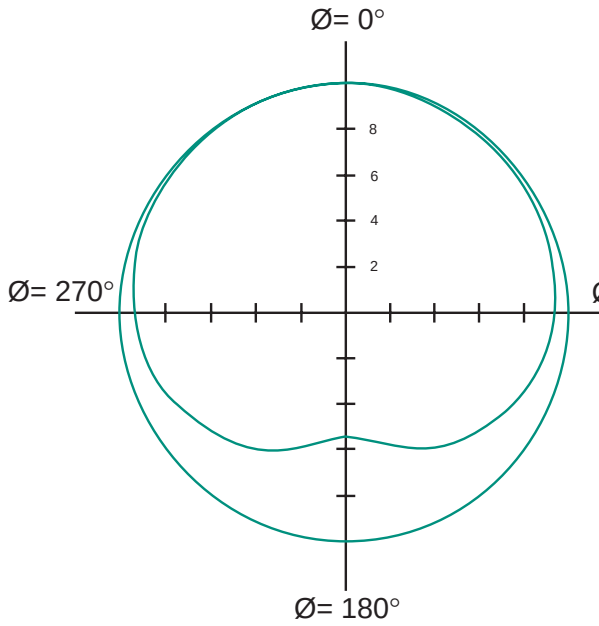


Figure 3.

Typical Angular Response of the LI-193SA Spherical Quantum Sensor. The low response on the bottom of the sensor is due to light blockage by the detector housing. The error due to this low response is not significant in most cases because of the small portion of upwelling radiation compared to the total radiation.

2009S Lowering Frame

2222UWB Underwater Cable

This 2-wire shielded cable is used with underwater sensors and has a waterproof connector on the sensor end. The other end of the cable is fitted with a BNC connector for attaching the cable directly to the readout instrument for type "SA" sensors (also attaches to the calconnector of "SB" type sensors). Standard cable lengths are 3, 10, 30, 50, 75, and 100 meters. Custom lengths over 100 meters can also be ordered.

Underwater Sensors require 2222UWB Underwater Cable.

Ordering Information

The Underwater Sensors can be purchased with several accessories. Please see accessory sheet for more details.

LI-192SA Underwater Quantum Sensor
LI-193SA Spherical Quantum Sensor
2009S Lowering Frame
2291 Millivolt Adapter (1210 ohm)
2222UWB-3 Underwater Cable, 3 meters
2222UWB-10 Underwater Cable, 10 meters
2222UWB-30 Underwater Cable, 30 meters
2222UWB-50 Underwater Cable, 50 meters
2222UWB-75 Underwater Cable, 75 meters
2222UWB-100 Underwater Cable, 100 meters
100L Lubricant

LI-COR®
ENVIRONMENTAL DIVISION
4421 Superior Street • Lincoln, NE 68504.
Toll Free: 1-800-447-3576 (U.S. & Canada)
Phone: 402-467-3576 • FAX: 402-467-2819
E-mail: envsales@env.licor.com
Internet: http://www.licor.com