# PUV-2500 Ultraviolet Radiometer

Biospherical Instruments Inc. PUV-2500 is a submersible, multichannel, profiling, ultra-violet radiometer designed to make measurements of UV and PAR (Photosynthetically Active Radiation -- 400-700 nm) irradiance to depths of 350 meters. The instrument combines UV optimized irradiance optics with a high-speed data acquisition system and advanced electronics in a compact, rugged design.

The standard PUV-2500 measures downwelling cosine irradiance at 7 wavebands, upwelling chlorophyll natural fluorescence, pressure/depth, and water temperature. The optical configuration uses 7 highly stable, solid-state filter-photodetectors with center wavelengths at 305, 313, 320, 340, 380, 395 nm, and PAR for measurements of downwelling irradiance and a single radiance photodetector for measurements natural fluorescence. Optionally, the PUV-2500 can be ordered featuring 8 wavebands of downwelling irradiance alone, without upwelling radiance capability.

The PUV-2500 utilizes our Windows®-based, PROFILER operating and data-acquisition software. This custom software offers full-color graphical display with multiple, user-selected channels and allows a high degree of interaction and customization. This software stores collected data in a Microsoft Access® database format, which simplifies export to other applications.
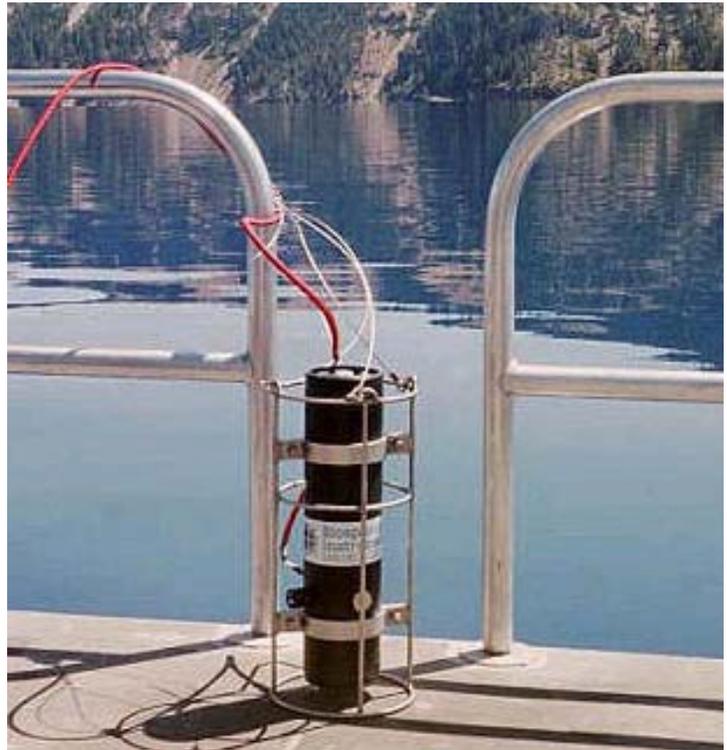


# Key Features

**Measures 7 (optionally 8) wavebands of downwelling irradiance and 1 upwelling radiance channel**

**Includes sensors for measurement of pressure/depth (350 m maximum) and water temperature**

**Uses specialized, highly stable, solid-state sensors with optimized UV interference filter/photodetectors**

**PUV-2510 radiometrically matching surface instrument is also available**

**Compact design is battery-powered and ideal for hand deployment from a small craft and other vessels**

## Features

Highly versatile because of its small size and lightweight design, the PUV-2500 can be used in traditional vertical profiling mode (surrounded by a protective lowering frame and supported by its own cable) or, by employing our new free-fall design option, in free-descent mode. The optional free-fall system allows the researcher to "kite" the instrument away from the vessel, thereby avoiding problems caused by ship shadow.

The instrument is shipped with a rechargeable battery-powered deckbox, AC adapter/charger, and Windows®-based software. Accessories—including a stainless-steel lowering frame, free-fall deployment system and underwater cables—must be ordered separately.

## PUV-2510 Surface Radiometer

A typical PUV-2500 system often includes a PUV-2510 reference radiometer. The PUV-2510 is a downwelling surface irradiance sensor designed to radiometrically match the underwater instrument, but optimized for use in air. Operating together, the two instruments may be compared to monitor PUV performance for interference from shadows cast by boats or clouds and to assist in the development of atmospheric corrections. This instrument is not temperature regulated, however it may deployed separately for short-term measurement of UV-PAR surface irradiance.

## Calibration

Optical calibrations are performed in our darkroom in accordance with the methods outlined by the National Institute of Standards and Technology (NIST), National Bureau of Standards (U.S.) Technical Note 594-13 and NBS Special Publication 250-20. In the case of the 305 nm channel, an additional procedure is followed that references the sensor to solar irradiance using a high-resolution scanning spectrophotometer.

*Supported by the telemetry cable, the PUV-2500 may be deployed by hand or using a winch*

*The PUV-2510 may be used as a surface reference for the PUV-2500 or as a stand-alone UV-PAR surface instrument*

*Specifications subject to change without notice*

## PUV System Electronics Specifications

**Microcontroller:** High performance PIC17C756 CMOS microcontroller

Featuring 8bit, 18.432MHz frequency, internal 16K non-volatile EEPROM

**Data Acquisition:** A high accuracy 16 bit ADC with a PGA input yielding a 10 VFS and 1.3 µV LSB

The microprocessor enables auto zero and gain corrections for the A/D and PGA

A set of internal voltage references are also used in calibrations

32 channel multiplexer selects analog signals from up to 8 photodetectors, temperature, pressure and tilt/yaw sensors

Real time data averaging can be selected from 17Hz to 1 hour

**Photodetector Preamps**: Each detector is individually amplified by an electrometer grade FET Op Amp with variable gain. The available gains (100,000 V/A, $30^6$ V/A and $10^{10}$ V/A) cover 10 decades of light levels with minimum detectable signals of less than 10 femtoAmps.

**System Data Rate:** user adjustable with maximum rate of 20 Hz and 57600 Baud

**Channel Sampling Time:** scan time is typically 15msec when reading including additional processing time, all heads are synchronized to start scans within 500 µsec ±175 nsec

**Optional Sensors:** dual-axis instrument inclinometer

## PUV-2500 Optical Specifications
### Irradiance Array

**Standard Wavelengths:** 305, 313, 320**,** 340, 380, 395nm, PAR (400-700nm), natural fluorescence

**Optional Wavelengths:** *Consult factory for current availability.*

**Bandwidth:** 10 nm FWHM standard except 305 (controlled by atmospheric ozone cutoff)

**Filter Photodetectors:** 7 Ed wavelengths standard; 1 Lu natural fluorescence standard

**Filter Type:** Custom low-fluorescence design , 5 cavity interference filters

**Cosine Collector:** Teflon®-covered quartz optimized for use in water

**Angular Response:** ±2% from 0° to 65°; ±10% from 65° to 85°

**Out-of-band Rejection:** $1x10^{-6}$

**Typical Saturation:** $10^5$ µW.cm$^{-2}$.m$^{-1}$

**Noise Equivalent Irradiance:** $10^{-5}$ µW.cm$^{-2}$.nm$^{-1}$

**PAR Typical Saturation:** 0.4 µE.cm$^{-2}$ s$^{-1}$

**PAR Noise Equiv. Irradiance:** $4 \times 10^{-10}$ µE.cm$^{-2}$.s$^{-1}$

## Radiance Detector

**Filter Photodetectors:** 1 wavelength standard

**Detectors:** Custom 13 mm$^2$ silicon photodiodes

**Filter Type:** Custom low-fluorescence interference

**Out-of-band Rejection:** $1x10^{-6}$

**Typical Saturation:** $10^3$ µW.cm$^{-2}$.nm$^{-1}$.sr$^{-1}$

**Noise Equiv. Radiance:** $10^{-6}$ µW.cm$^{-2}$.nm$^{-1}$.sr$^{-1}$

## PUV-2500 Physical

**Diameter:** 10.2 cm  **Length:** 40.5 cm

**Depth Range:** 350 m (recommended max. operating)

**Materials:** PET plastic housing; stainless steel lowering frame

**Weight:** 3.2 kg in air, near neutral in water

**Temperature Rating:** 0C to 50C

## PUV Deckbox

**Microprocessor:** A separate PIC17C756 CMOS microcontroller is used to translate the high level PC program commands to individual head commands, buffer the high volume of data transmitted from the heads and provide exact timing of data collection between heads

**Battery Power:** Rechargeable 12-V gel cell battery; LED indicator light for low battery voltage

**AC Adapter/Charger:** 90-240 VAC, 50-60 Hz

**Output:** Single COM port supporting both instruments alone or in combination (PUV-2500 and PUV-2510)

## Cables

**Deckbox:** (Supplied) RS-232 serial interface

**Instruments:** (order separately) Custom 6-conductor, shielded cable with internal Kevlar® strength members. This cable is rated at 225kg and may be ordered in custom lengths to 300 meters.

## PUV-2510 Surface Reference (order separately)

**Optical and electrical specifications** match the PUV-2500 except cosine collector geometry which is optimized for use in air.

**Diameter:** 10.2 cm   **Length:** 35.6 cm

**Materials:** Aluminum housing

**Weight:** 3.4 kg in air

**Temperature Rating:** -10C to 50C

## Software

The PUV-2500 utilizes our Windows®-based, PROFILER operating and data-acquisition software. PROFILER is fully compatible with Windows 7, VISTA or XP, allowing the host PC to acquire and display data in real time. This custom software offers full-color graphical display with multiple, user-selected channels and affords a high degree of interaction and customization. Software includes user-specified configurations for sampling speed, averaging, and profile setup. When profiling, the user can view three plots (Time, Profile, and Spectral Plots), as well as a live-channel display and a large, easy-to-read instrument depth, inclination, and record number display. The software allows the user to annotate plots, such as to mark the beginning or end of an upcast or downcast or to define dark segments, facilitating dark corrections.

**BSI's PROFILER software allows the user to select and process different regions of the dataset. Using interactive zooming, you can select minimum data limits to avoid cluttered displays.**
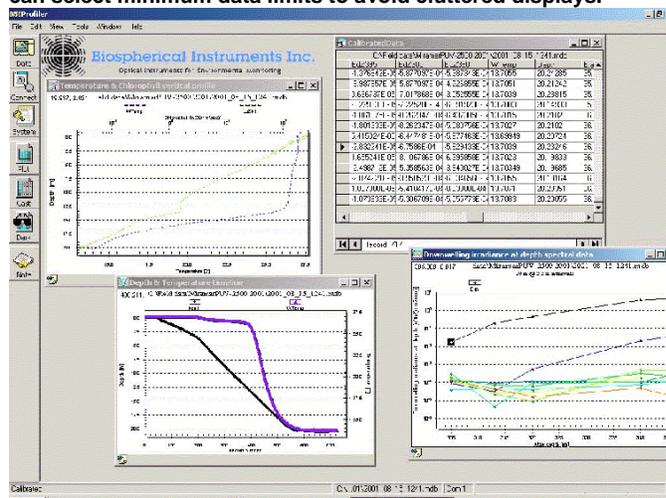


**Data are stored in Microsoft Access® data tables for compatibility with a wide variety of software and ease of post-processing.**

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