Aquation’s **Shutter Fluorometer** measures both the effective ($\Phi_{II}$) and maximal quantum yield ($F_v/F_m$) of PSII photochemistry. Its unique shutter mechanism alternately exposes the sample to full sunlight or darkness, enabling full quenching analysis at any time without user intervention. Flexible software enables yield measurements, dark acclimations, light curves and user-defined actinic light treatments to be made at any time of the day or night.

**Features**

- Self-closing shutter for automated dark acclimation
- Measures $\Phi_{II}$, $F_v/F_m$ (using shutter), PAR and temperature
- Shutter enables automated RLCs and $F_0'$ determination for NPQ relaxation
- Autogain and autozero functions automatically establish correct settings in the field
- Logger can operate multiple sensors simultaneously
- Simple switch initiates program underwater
- Fully waterproof to 50 m; rugged design for diving
- Larger housing and battery pack available for extended deployments
- Select programs provided or define your own program using easy-to-use software
- Autonomous operation for up to 72 h depending on program
- Shutter sensor can be operated direct from PC for pre-field tests

The quantum yield of PSII photochemistry is widely used as a measure of photosynthetic performance and stress. Combined with ambient light intensity and two constants, electron transport rate can be calculated representing the flow of electrons into the photosystem at any time during the day.

The Shutter Fluorometer enables these and other measurements to be made 24/7 both on-land and underwater for extended periods.

The Shutter Sensor is designed as part of a fully submersible fluorometer system for use in both marine and freshwater environments.

When multiple Shutter Sensors are combined with a Submersible Datalogger, the “Multichannel Shutter Fluorometer” will conduct multi-day deployments where regular replicated measurements of plant photosynthetic performance are required without the need for operator intervention.

*See over for further detail.*
Shutter Fluorometer

Specifications:
- Multiple turnover saturating pulse modulated fluorometer (PAM)
- Excitation light 470 nm
- Actinic & saturating lights – white LED
- Far-red light for PSI excitation 735 nm
- PAR sensor: cosine corrected 2π sensor 400-700 nm
- Temperature sensor: resolution ± 0.1 °C, range -5 to +40 °C
- Operating temperature: 0 °C to 45 °C
- Storage temperature: -5 °C to 60 °C
- Submersible to 50 m depth
- Power: 16.8V 4.5Ah rechargeable NiMH battery pack

Field Applications of the Shutter Fluorometer

Continuous monitoring of the same sample over 24 hour periods with the Shutter Fluorometer provides both the baseline pre-dawn fluorescence values of Fo and Fm, daytime values of dark-acclimated F0’, and enables calculation of non-photochemical quenching and direct measurement of ambient PAR throughout the day. Regular application of the far-red LED and shutter enables one to regularly determine Fo’ without user intervention. Until now, automated measurement of Fo’ in the field has not been possible yet has been identified as an important measurement in field fluorescence studies (Maxwell and Johnson 2000).

This value is necessary for distinguishing the relative proportion of the components of non-photochemical quenching, in particular down-regulation and photo-inactivation (Kornyeyev and Holaday 2008). At the simplest level, these processes are related to a plant’s natural ability to cope with excess light and the extent to which the plant is stressed (Runcie et al. 2009). Determining and characterising plant stress is particularly relevant for field environmental studies.

The Shutter Fluorometer is also well suited to the direct measurement of electron transport rate (ETR), where the simultaneous measurement of ambient PAR is used with fluorescence measurements and other plant-specific values to obtain ETR estimates (Beer et al. 1998, Longstaff et al. 2002).

While the Shutter Fluorometer was originally designed to operate underwater, it can also be used in terrestrial studies.

Relevant references