



MULTI-COLOR-PAM Multiple Excitation Wavelength Chlorophyll Fluorescence Analyzer

DESCRIPTION

The MULTI-COLOR-PAM fluorometer provides an unprecedented color range of measuring and actinic light including white and far-red light sources. The various colors enable researchers to tailor conditions of fluorescence measurements exactly to the spectral properties of their sample.

Therefore, the MULTI-COLOR-PAM fluorometer opens the way to study many wavelength-dependent aspects of photosynthesis that so-far have not been commonly accessible. The MULTI-COLOR-PAM fluorometer is optimized for highly sensitive assessment of photosynthesis in dilute suspensions of algae, cyanobacteria and chloroplasts. In addition, the measuring system can be configured to study leaf photosynthesis and epidermal UV-A screening.

Data analysis by the MULTI-COLOR-PAM fluorometer includes the option to determine the wavelength-dependent functional PS II absorption cross-section, $\Sigma\sigma(II)\lambda$, and absolute PS II turnover rates, $ETR(II)\lambda$. In addition, the MULTI-COLOR-PAM software provides standard saturation pulse quenching analysis and methods for analysis of fast fluorescence changes including polyphasic rise kinetics and dark relaxation of fluorescence with a time resolution of 10 μ s.



MULTI-COLOR-PAM

General Features

- The MULTI-COLOR-PAM provides 6 colors of pulse-modulated measuring light (400, 440, 480, 540, 590 and 625 nm) and 5 colors of actinic light (440, 480, 540, 590, 625). In addition, white (420-640 nm) and far-red light (730 nm) light sources are built in.
- By employing state-of-the-art LED light sources in combination with elaborated chip-on-board technology, strong actinic photon fluxes are achieved while keeping the emitter unit highly compact. Each measuring light color can be freely combined with one of the available actinic light sources.
- The MULTI-COLOR-PAM detects fluorescence by a highly sensitive photodiode attached to either an optical unit for suspensions or for leaves. A spherical or flat cosine-corrected sensor feeds its signal directly to the MULTI-COLOR-PAM control unit so that accurate PAR measurements can be obtained in suspension or at leaf surfaces. A special routine is provided to measure PAR-lists for all colors automatically.
- The MULTI-COLOR-PAM detects effective PS II quantum yield, $Y(II)$, with outstanding accuracy and, thus, enables highly reliable calculations of relative electron transport rates (rel. ETRmax) even with extremely stressed samples. The MULTI-COLOR-PAM fluorometer can be configured for suspensions (cyanobacteria, algae or chloroplasts) or for flat objects like leaves. Both configurations require the same three components: the MCP-C Power-and-Control-Unit, the MCP-E Multi-Color Emitter Head and MCP-D Detector Head.

ACCESSORIES

MULTI-COLOR-PAM / Suspension Configuration

- **Temperature Control
Block ED-101US/T**
- **Spherical Micro
Quantum Sensor, US-
SQS/WB**
- **Temperature Control
Unit US-T**
- **Miniature Magnetic
Stirrer, PHYTO-MS**

Configurations

- For measurements of suspensions, the measuring heads MCP-E and MCP-D are attached to an optical unit (ED-101US/MD) which holds in the center a 1 x 1 x 4.5 cm quartz cuvette. The optical unit guides light efficiently to the sample by a Perspex rod. Similarly, a Perspex rod forms a path with negligible light loss between sample and detector.
- The equipment for measurement of suspension is completed by a number of accessories. The software-controlled stirrer PHYTO-MS prevents settling of particles during measurements. The spherical quantum sensor US-SQS/WB measures light intensity within the suspension and it is a must for measurements of light response curves or functional PS II absorption cross-section. Temperature control can be exercised using the temperature block ED-101/T connected to a thermostated water bath and mounted on top of the ED-101US/MD optical unit. Alternatively, the US-T unit can control cuvette temperature by a heat-transfer rod dipped into the suspension.
- For leaf studies, an optical unit equipped with a leaf clip is used (MCP-BK). Similarly as in the optical unit for suspensions, Perspex rods provide efficient optical pathways between measuring heads and sample where the rod between emitter head and sample is conically shaped to optimize optical efficiency of the unit. For the leaf configuration, the recommended accessory is a cosine-response quantum sensor (US-MQS/WB) which is positioned in a special port of the leaf clip of the optical unit.

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Application

- Analysis of the fast fluorescence rise kinetics in saturating light allows determination of the wavelength- and sample-specific functional absorption cross-section of PS II, $\Sigma\sigma(II)\lambda$.
- Vastly different light response curves for electron transport rates (rel. ETR) of Chlorella are obtained with light of different colors (440 and 625 nm) when the usual PAR-scale is used
- Calculating $Y(II)/Y(II)_{max}$ where the $Y(II)$ and $Y(II)_{max}$ are the PS II quantum yields in the light-exposed and the dark state, respectively.
- Quantifying the absolute rate of electron transport in optically thin suspensions of unicellular algae and cyanobacteria.

This Instrument is manufactured by our principle company

WALZ - Germany