PHYTO-PAM-II

Multiple Excitation Wavelength Phytoplankton & Photosynthesis Analyzer

Differential Analysis of Mixed Algae Samples

WALZ

PHYTO-PAM-II COMPACT VERSION

One instrument – one compact housing

PHYTO-PAM-II instruments facilitate measurements of mixed algae populations for analysis of chlorophyll content and photosynthetic performance of variously pigmented phytoplankton. Deconvolution of the fluorescence responses of these phytoplankton groups is based on differences upon excitation with multiple measuring light wavelengths.

Due to its innovative optoelectronical design with 60 LED power-chips on 10 x 10 mm active COB-area (metal core Chip-on-Board) PHYTO-PAM-II features five wavelengths of fluorescence excitation and actinic illumination (440, 480, 540, 590 and 625 nm). In addition, also white light for actinic illumination and far-red light for preferential excitation of photosystem I is provided.

In contrast to the MULTI-COLOR-PAM fluorometer, where one of five measuring light colors can be applied at the time, with PHYTO-PAM devices different excitation wavelengths are applied quasi-simultaneously in form of µsec measuring light pulses with rapidly alternating colors.

The obtained fluorescence signals are deconvoluted on bases of algae specific reference spectra providing differentiated information on the photosynthetic state of the mixed algae sample.

Unlike references of the first generation PHYTO-PAM instruments, PHYTO-PAM-II reference spectra are universal and can be shared among users.

PHYTO-PAM-II provides determination of the wavelength-dependent light-saturation characteristics, transient fluorescence recordings and determination of the wavelength-dependent absorption cross-section of photosystem II, $\sigma_{II}(\lambda)$. $\sigma_{II}(\lambda)$ varies considerably between different types of phytoplankton and knowledge of $\sigma_{II}(\lambda)$ is essential for estimation of electron transport rates from fluorescence parameters.

In the COMPACT Version of the PHYTO-PAM-II all components including the measuring chamber are contained in a single compact housing. Hence, except for the USB-cable for communication with the PC, normal operation does not involve connection of external cables, so that this device is particularly suited for on-deck and field applications.

The 15 mm (outer Φ) round cuvette is illuminated from the bottom, with fluorescence being detected at right angle. In this way, the whole sample is illuminated homogenously and a representative part of the sample is monitored.

The Spherical Micro Quantum Sensor US-SQS/WB is included in the COMPACT Version´s scope of delivery.

FEATURES

Five measuring light wavelengths for the deconvolution of up to four algae groups

Six actinic light colors

Far red LED for Fo‘ determination

Universal reference spectra

Comprehensive Sat-Pulse analysis, Ft recordings

Fast kinetics mode for the determination of the wavelength-dependent absorption cross-section of Photosystem II, $\sigma_{II}(\lambda)$

Automation by script file operation

Spherical Micro Quantum Sensor US-SQS/WB included

ACCESSORIES

Stirring Device WATER-S
To prevent settling of particles, a battery driven stirring motor can be mounted on top of the cuvette. Stirring of the suspension occurs by a replaceable Perspex rod.

Optional Stirring Device WATER-S

PHYTO-PAM-II MODULAR VERSION

Modular setup – more options

PHYTO-PAM-II MODULAR Version provides PHYTO-PAM-II features known from the COMPACT Version in a more flexible and extendable system.
In the MODULAR Version the multi-color-emitter and photomultiplier-detector units are separated from the control unit, mounted to a central optical unit holding a 10 x 10 x 45 mm cuvette.

The modular setup features flexibility in the choice of detector filters and constitutes an open optical system, providing two additional optical ports for connection of alternative light sources or detectors.
Furthermore this setup allows to connect a miniature magnetic stirrer below the cuvette. The software triggered stirring process hinders sample sedimentation. For temperature control of the investigated suspension a Peltier temperature control "finger" can be mounted at the cuvette top.

The MODULAR Version can be recommended primarily for basic research on photosynthesis of algae and cyanobacteria in dilute suspensions and/or natural phytoplankton samples. Generally the MODULAR Version is mainly designed for laboratory applications but as the Power-and-Control-Unit PHYTO-II-C is equipped with a battery, this PHYTO-PAM-II system may also be used in on-deck and field applications.

The MODULAR Version basic system consists of following components:

Power-and-Control-Unit PHYTO-II-C
Battery driven central component providing all neccessary ports and stirrer speed control

Multi-Color Emitter Unit PHYTO-II-E
featuring Chip-On-Board (COB) LED arrays for pulse-modulated fluorescence excitation at 440, 480, 540, 590 and 625 nm, as well as actinic illumination (440, 480, 540, 590, 625 nm and white) in form of continuous light and Single- or Multiple Turnover light pulses; with far-red light source (740 nm) for selective excitation of PS I

Photomultiplier-Detector PHYTO-II-D
featuring an automatic overload switch and special detector filter combination

Optical Unit ED-101US/MP
with a 10 x 10 x 45 mm quartz-cuvette to be mounted on the delivered stand

Spherical Micro Quantum Sensor US-MQS/WB
for calibration of the PAR lists of variously colored actinic lights, measuring lights, single and multiple turnover pulses

ACCESSORIES

Miniature Magnetic Stirrer PHYTO-MS
Settling of particles is prevented by using a miniature magnetic stirrer (PHYTO-MS). The stirrer is mounted directly beneath the sample cuvette. A rotating magnetic field created by the stirrer tip moves a miniature magnetic stir bar in the cuvette. The stirrer is connected to the PHYTO-PAM-II control unit (PHYTO-II-C). Stirring can be switched on and off software controlled.

Temperature Control Unit US-T
The US-T unit employs a heat-transfer head with a cooling/heating Peltier element and a separate power-and-control unit. The heat-transfer head is mounted on top of the optical unit so that the tip of the rod is in touch with the suspension investigated. The achievable temperature spread in suspensions is about 30 K; absolute temperatures depend on ambient temperature.

Miniature Magnetic Stirrer PHYTO-MS

Temperature Control Unit US-T

PHYTOWIN-3 SOFTWARE

Programmable software for data aquisition and processing

PhytoWin-3 Software operates PHYTO-PAM-II instruments in conjunction with a Windows PC.

PhytoWin-3 software features nine different windows for analysis and display of measured and calculated data. Script file operation provides automation of experimental protocols.

Channels
Original, unbiased fluorescence information at 5 different excitation wavelengths

Settings
Controls for instrument settings, like measuring pulse frequency, actinic intensity, saturation pulse width and intensity, clock interval, etc.

Algae
Deconvoluted fluorescence information for differently pigmented algae groups based on the applied reference excitation spectra; user surface for Chl determination

Slow Kinetics
Graphic display of slow kinetics recorded in the SP-Analysis mode

Light Curve
Graphic display of light response curves; effective quantum yield and relative electron transport rate (ETR) as a function of PAR, curve fitting on the basis of a modified Eilers & Peeters model (1988) or Platt (1980)

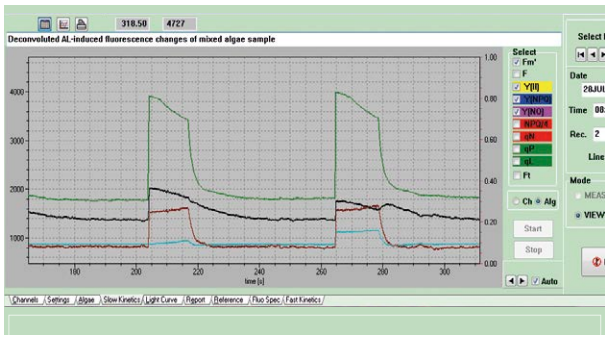
Report
Stores all measured data and instrument settings. The Report file can be edited by the user and exported into other programs

Reference
Recording and display of reference excitation spectra of cyanobacteria, green algae, diatoms/dinoflagellates and phycoerythrin-containing organisms

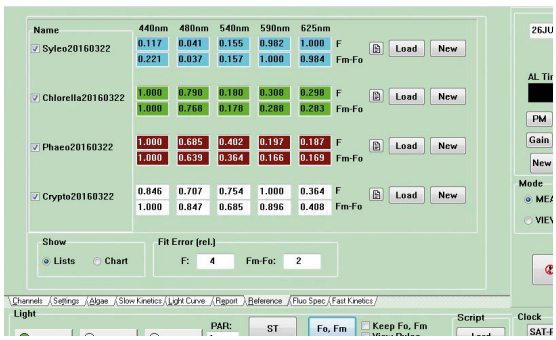
Fluo Spec
Display of measuring light spectral characteristics and non-normalized reference excitation spectra

Fast Kinetics
Control and graphical display of fast kinetics analysis providing information on the wavelength-dependent absorption cross-section of PS II, $\sigma_{II}(\lambda)$

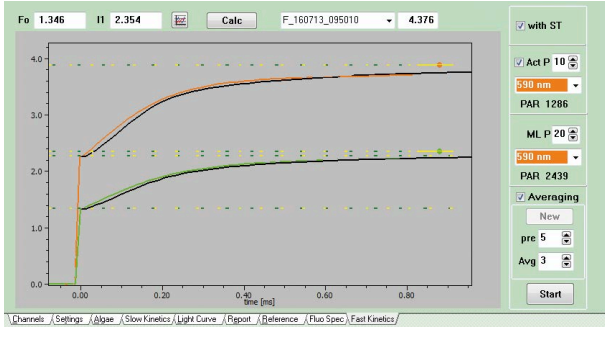
Free software updates will keep the instrument always up-to-date on latest developments.



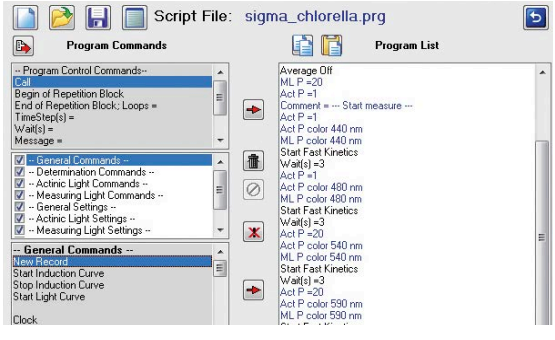
Slow Kinetics, deconvoluted real-time recording of fluorescence responses



Reference Spectra are universally valid and can be exchanged between users



Fast Kinetic recordings and determination of the functional absorption cross section σ_{PSII}



Script files allows automatic execution of all commands that can be carried out manually

TECHNICAL SPECIFICATIONS PHYTO-PAM-II

COMPACT VERSION

PHYTO-PAM-II/ED

General design: Metal housing for PHYTO-PAM-II Power-and-Control-Unit incorporating all opto-electronic components as well as the measuring chamber for 15 mm Ø quartz cuvette WATER-K

Chip-on-board multi-wavelength measuring light LED emitter: 440, 480, 540, 590, and 625 nm for pulse-modulated measuring light; 2 intensity settings; 8 settings of pulse frequency and 3 settings of auto MF-high pulse frequency

Chip-on-board multi-wavelength actinic LED array: 440, 480, 540, 590, 625 and 420-640 nm (white) for continuous actinic illumination, up to 1500 µmol m^{-2} s^{-1} PAR; fast kinetic flashes up to 7000 µmol m^{-2} s^{-1} PAR; saturation pulse up to 5000 µmol m^{-2} s^{-1} PAR

Far-Red LED: emission peak at 725 nm

Signal detection: Photomultiplier detector based on Photosensor Module H-10720

Standard detector filter: long-pass > 650 nm

Sockets: charge socket for Battery Charger MINI-PAM/L, input socket for US-SQS/WB Spherical Micro Quantum Sensor, USB socket

Communication: USB 1.1, USB 2.0 and USB 3.0 compatible

User interface: Windows computer with PhytoWin-3 software

Power supply: Rechargeable sealed lead-acid battery 12 V/2 Ah; Battery Charger MINI-PAM/L (100 to 240 V AC)

Dimensions: 29 cm x 30 cm x 20.5 cm (l x w x h), aluminum housing with carrying handle and cuvette cover

Power consumption: Basic operation 1.5 W, ML +AL at maximum output 4.5 W Saturation Pulse at maximum intensity, 7 W

Weight: 4.8 kg (including battery)

Operating temperature: -5 to +40 °C

BATTERY CHARGER MINI-PAM/L

Input: 90 to 264 V AC, 47 to 63 Hz
Output: 19 V DC, 3.7 A
Operating temperature: 0 to 40 °C
Dimensions: 15 cm x 6 cm x 3 cm (l x w x h)
Weight: 300 g

SPHERICAL MICRO QUANTUM SENSOR US-SQS/WB

Design: 3.7 mm diffusing Plexiglas sphere coupled to integrated PAR-sensor via 2 mm fiber, compact amplifier unit and special holder for mounting on sample cuvette

Connects to: PHYTO-PAM-II LIGHT SENSOR connector

Cable length: 3 m + 0.5 m

Size: Sensor: diameter 1 cm, length: 11 cm; 15.2 mm spacer ring for light sensor positioning; Hood: 3.4 cm diameter, 3.2 cm height; Amplifier: 5 cm x 5 cm x 5 cm (w x l x h)

Weight: 175 g

TRANSPORT BOX PHYTO-T

Design: Aluminum box with custom foam packing for PHYTO-PAM-II and accessories
Dimen.: 60 cm x 40 cm x 34 cm (l x w x h)
Weight: 5 kg

MODULAR VERSION

POWER-AND-CONTROL-UNIT PHYTO-II-C

Sockets: CHARGE socket for Battery Charger MINI-PAM/L, AUX socket for US-SQS/WB Spherical Micro Quantum Sensor, USB socket, socket for Miniature Magnetic Stirrer PHYTO-MS, DETECTOR socket for connecting PHYTO-II-D Photomultiplier-Detector Unit, LED ARRAY and FLUO ML sockets for connecting PHYTO-II-E Multi-Color-Emitter Unit

User interface: Windows computer with PhytoWin-3 software
Communication: USB 2.0 and USB 3.0 compatible

Power supply: Rechargeable sealed lead-acid battery 12 V/2 Ah; Battery Charger MINI-PAM/L (100 to 240 V AC)

Dimensions: 29 cm x 30 cm x 18 cm (l x w x h), aluminum housing with carrying handle

Power consumption: Basic operation, 1.5 W; with Measuring and Actinic Light at maximal currents, 4.5 W. Saturation Pulse at maximum intensity, 7 W
Weight: 4.2 kg (including battery)
Operating temperature: -5 to +40 °C

OPTICAL UNIT FOR SUSPENSIONS ED-101US/MP

Design: Black-anodized aluminum body with central 10 x 10 mm standard glass cuvette; for attachment of PHYTO-II-D, PHYTO-II-E and Miniature Magnetic Stirrer PHYTO-MS; two additional ports available
Weight: 750 g

MULTI-COLOR-EMITTER UNIT PHYTO-II-E

Chip-on-board multi-wavelength measuring light LED emitter: 440, 480, 540, 590 and 625 nm for pulse-modulated measuring light; 2 intensity settings; 8 settings of pulse frequency and 3 settings of Auto MF-high pulse frequency

Chip-on-board multi-wavelength actinic LED array: 440, 480, 540, 590, 625 and 420-640 nm (white) for continuous actinic illumination, up to 3000 µmol m^{-2} s^{-1} PAR; actinic pulses for Fast Kinetics, up to 11000 µmol m^{-2} s^{-1} PAR; saturation pulses up to 12000 µmol m^{-2} s^{-1} PAR

Far-Red LED: emission peak at 725 nm
Dimen.: 6.6 cm x 10.6 cm x 10 cm (l x w x h)
Weight: 490 g

PHOTOMULTIPLIER-DETECTOR UNIT PHYTO-II-D

Signal detection: Photomultiplier detector based on Photosensor Module H-10720 (Hamamatsu)
Standard detector filter: long-pass > 650 nm
Weight: 510 g
Dimension: 5.3 cm x 11 cm x 7.1 cm (l x w x h)

BATTERY CHARGER MINI-PAM/L

See COMPACT Version

SPHERICAL MICRO QUANTUM SENSOR US-SQS/WB

Design: 3.7 mm diffusing Plexiglas sphere coupled to integrated PAR-sensor via 2 mm fiber, compact amplifier unit and special holder for mounting on sample cuvette
Connects to: PHYTO-PAM-II AUX connector
Cable length: 3 m + 0.5 m

Size: Sensor: diameter 1 cm, length: 11 cm; 19 mm spacer ring for light sensor positioning; Hood: 3.4 cm diameter, 3.2 cm height; Amplifier: 5 cm x 5 cm x 5 cm (w x l x h)
Weight: 175 g

TRANSPORT BOX PHYTO-T

See COMPACT Version

ACCESSORIES

STIRRING DEVICE WATER-S

For COMPACT Version

Design: Miniature stirring motor in plastic housing with adapter to mount on top of the PHYTO-PAM II/ED cuvette; equipped with disposable Perspex stirring paddle; self-contained unit featuring long-life 3 V Lithium Battery; potentiometer for adjustment of stirring rate
Dimen.: 80 mm x 50 mm x 30 mm (l x w x h)
Weight: 95 g (incl. battery)

TEMPERATURE CONTROL UNIT US-T

For MODULAR Version

Power-and-Control Unit US-T/DR

Display: Three line LCD display
Control range: 0 °C to 50 °C at 0.1 K steps
Operating voltage: 11 V - 14 V DC
Maximum Peltier current: 1 A
Size: 105 mm x 90 mm x 130 mm (w x h x d)
Weight: 570 g

Peltier Heat-Transfer Head US-T/DS

Achievable temperatures: 12 K below ambient temperature, 15 K above ambient temperature (Quartz cuvette placed in Optical Unit for Suspensions ED-101US/MD with 1.5 ml water and stirrer PHYTO-MS on)
Size: diameter 55 mm, 110 mm height
Cable length: 130 cm
Weight: 290 g (including cable)

AC Adapter

Input: 100 V - 240 V AC 1.5 A 50-60 Hz
Output: 12 V DC 5.5 A
Size: 130 mm x 56 mm x 30 mm (l x w x h)
Weight: 500 g (including cable)

MINIATURE MAGNETIC STIRRER PHYTO-MS

For MODULAR Version

Design: Based on rotating magnetic field; connecting to Power-and-Control Unit PHYTO-II-C; with special adapter plug to be mounted in bottom port of Optical Unit ED-101US/MP

Weight: 16 g

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High Quality Instrumentation for Plant Sciences

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