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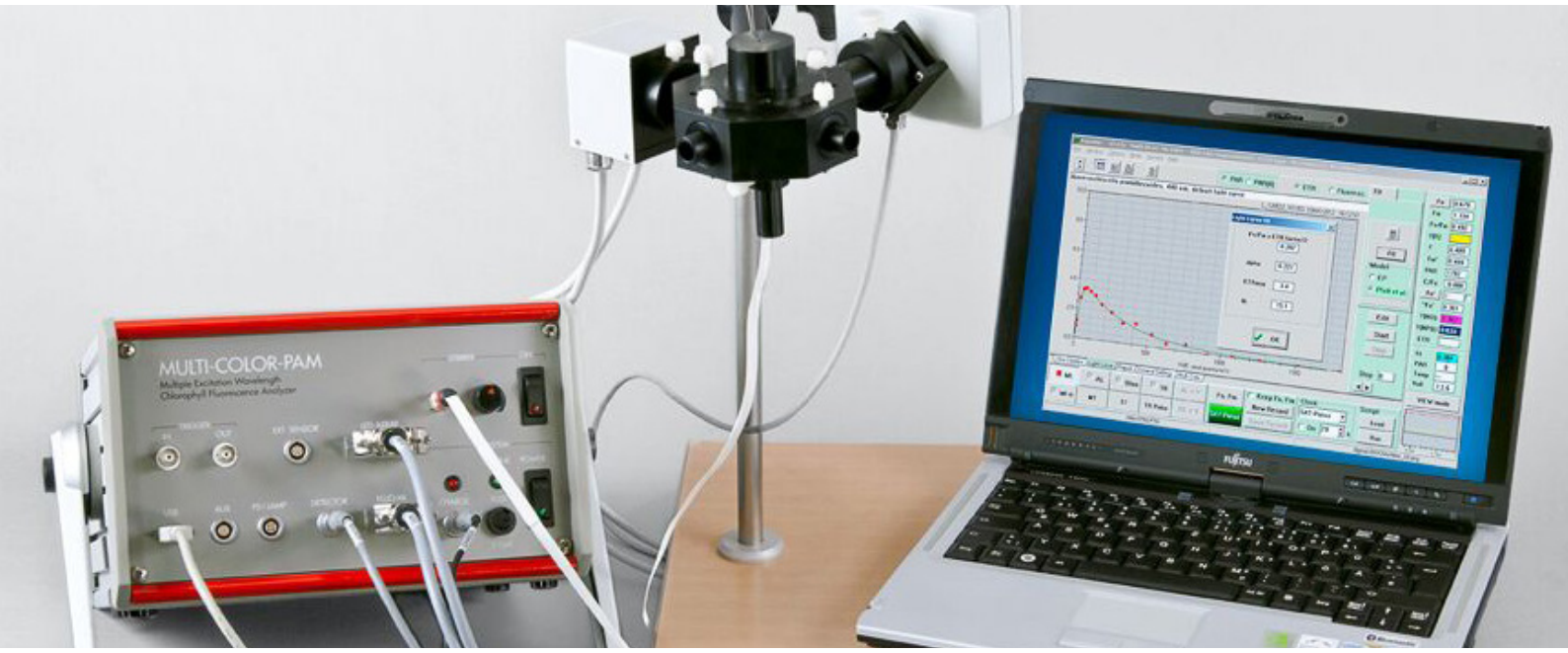
MULTI-COLOR-PAM

Multiple Excitation Wavelength Chlorophyll Fluorescence Analyzer



High Quality Instrumentation for Plant Sciences

WALZ

Accessories for MULTI-COLOR-PAM - Suspension Configuration

Spherical Micro Quantum Sensor US-SQS/WB

Exact light measurements in suspensions (but also in air) can be carried out by the spherical micro quantum sensor US-SQS/WB. The sensor has a 3.7 mm diameter sphere as the entrance optics. When the sensor is connected to the control unit MCP-C, data will be acquired and processed by the PamWin-3 software.

Temperature Control Unit US-T

The US-T unit consists of 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 a Walz optical unit (ED-101US-type) so that the dip 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.

Download the manual for detailed information.

Miniature Magnetic Stirrer PHYTO-MS

Settling of particles is prevented by using a miniature magnetic stirrer (US-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 MULTI-COLOR-PAM control unit (MCP-C). Stirring can be switched on and off by the PamWin-3 software.

Temperature Control Block ED-101US/T

For measurements under defined temperatures, the temperature control block ED-101US/T can be mounted on the optical unit ED-101US/MD. The block consists of an inner flow-trough metal part which is slightly pressed on the sample cuvette by a spring mechanism, and an external foam part for temperature insulation. Temperature control is achieved by an external flow-through water bath (not included) connected to the temperature block.

Accessories for MULTI-COLOR-PAM - Leaf Configuration

Optical Unit for Leaf Measurements MCP-BK

This optical unit is designed for measurements of leaves or flat photosynthetic surfaces. The unit features a clip to position leaves optimally for fluorescence measurements. The clip has a port for a Mini Quantum Sensor US-MQS/WB.

Mini Quantum Sensor US-MQS/WB

A cosine-corrected mini quantum sensor measures light intensities which are relevant for plant leaves or flat surfaces. When the sensor is connected to the control unit MCP-C, data will be acquired and processed by the PamWin-3 software.

90 Degree Measuring Head Holder DUAL-H90

For fluorescence measurements with leaves. The holder positions two measuring heads so that their optical axes are at right angles to each other. Fluorescence excitation and detection is at an angle of 45 degrees. Designed for simultaneously recording short and long wavelength fluorescence (DUAL-PAM-100 application), and for assessment of epidermal UV-A screening (MULTI-COLOR-PAM application).

Specifications for MULTI-COLOR-PAM

Power-and-Control-Unit MCP-C
General design: Microcontroller: 2 x AVR-RISC (8 MHz) + 4 MB SRAM; 256000 data points with 12 bit resolution can be stored
Sockets: 2 sockets for measuring light and actinic light of MCP-E Multi-Color Emitter Head, socket for signal detection by MCP-D Detector Head, charge socket or Battery Charger MINI-PAM/L, output socket for PHYTO-MS Miniature Magnetic Stirrer, BNC sockets for 5 V trigger-in and trigger out signals, input socket for US-SQS/WB Spherical Micro Quantum Sensor or US-MQS/WB Mini Quantum Sensor, input socket for auxiliary devices, connector for optional PS I lamp, USB socket
Communication: USB 2.0 and USB 3.0 compatible
User interface: Windows computer with PamWin-3 software
Power supply: Rechargeable sealed lead-acid battery 12 V/2 Ah; Battery Charger MINI-PAM/L (100 to 240 V AC)
Dimensions: 31 cm x 16 cm x 33.5 cm (W x H x D), aluminum housing with carrying handle
Power consumption: Basic operation 1.6 W, 8 W with all internal light sources operated at maximum output. Saturation Pulse at maximum intensity, 30 W
Weight: 2.5 kg (including battery)
Operating temperature: -5 to +40 °C

Multi-Color Emitter Head MCP-E
Chip-on-board multi-wavelength measuring light LED emitter: 400, 440, 480, 540, 590, and 625 nm for pulse-modulated measuring light; 20 intensity settings and 14 settings of pulse frequency
Chip-on-board multi-wavelength actinic LED array: 440, 480, 540, 590, 625 and 420-640 nm (white) for continuous actinic illumination, max. 4000 µmol m^{-2} s^{-1} PAR; saturating single turnover flashes, max. 200000 µmol m^{-2} s^{-1} PAR, adjustable between 5 and 50 µs; multiple turnover flashes, max. 12000 µmol m^{-2} s^{-1} PAR, adjustable between 1 and 800 ms
Far-Red LED: peak wavelength 730 nm
Dimensions: 10.5 cm x 5.5 cm x 7 cm (L x W x H)
Weight: 500 g (incl. cables, 1 m long)

Detector Head MCP-D
Signal detection: PIN photodiode with special pulse preamplifier for measuring fluorescence changes with maximum time resolution of 10 µs
Filter box: For up to 14 mm filter thickness
Standard detector filter: long-pass filter > 650 nm (3 mm RG 665) plus short-pass filter SP 710
Dimensions: 6.9 cm x 9.8 cm x 6.4 cm (L x W x H)
Weight: 355 g (incl. cables, 1 m long)

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

Optical Unit for Suspensions ED-101US/MD
Design: Black-anodized aluminum body with central 10 x 10 mm standard glass cuvette; for attachment of Measuring Heads MCP-E and MCP-D, and Miniature Magnetic Stirrer PHYTO-MS; two additional ports for attachment of two additional devices
Weight: 750 g

Stand ST-101
Stand for mounting the Optical Units ED-101US/MD (suspensions) or MCP BK (leaves)

Transport Box PHYTO-T
Design: Aluminum box with custom foam packing for MULTI-COLOR-PAM and accessories

Dimensions: 60 cm x 40 cm x 34 cm (L x W x H)

Weight: 5 kg

System Control and Data Acquisition

Software: PamWin-3 System Control and Data Acquisition Program for operation of measuring system via PC, data acquisition and analysis

Saturation Pulse Analysis

Measured: Ft, Fo, Fm, F, Fo' (also calculated), Fm'. Fast polyphasic rise and decay kinetics (time resolution up to 10 µs). PAR using Spherical Micro Quantum Sensor US-SQS/WB or Mini Quantum Sensor US-MQS/WB.

Calculated: Fo' (also measured), Fv/Fm and Y(II) (maximum and effective photochemical yield of PS II, respectively), q_L, q_P, q_N, NPQ, Y(NPQ), Y(NO) and ETR (electron transport rate), C/Fo (constant fraction of Fo not constituting PS II chlorophyll fluorescence)

Fitting Routines

Fitting routine for fast fluorescence rise from 0 to the I_1 level to determine functional absorption cross-section of PS II and PS II-specific electron transport rates. Fitting of fluorescence decay after light-to-dark transition by up to three exponentials to estimate primary electron transfer rates. Fitting routine for determination of the cardinal points α, I_k and ETR_{max} of light curves.

Computer Requirements

Processor, 0.8 GHz. RAM, 512 MB. Screen resolution, 1024 x 600 pixels. Interface, USB 2.0/3.0.
Operating system: Microsoft Windows XP/Vista/7/8/10

Specifications for MULTI-COLOR-PAM - Accessories

Suspension Configuration

Temperature Control Block for Cuvette ED-101US/T

Sectioned block with central 10 x 10 mm opening to be mounted on top of the ED-101US/MD unit; to be connected to external flow-through water bath (not included), weight: 250 g

Temperature Control Unit US-T

Consisting of Power-and-Control Unit US-T/DR with separate AC power supply and Peltier-Heat-Transfer Head US-T/DS. Cooling down to 12 K below ambient temperature, heating up to 15 K above ambient temperature. To be mounted on top of Walz ED-101US-type optical unit accommodating a 10 x 10 mm cuvette

Spherical Micro Quantum Sensor US-SQS/WB

3.7 mm diffusing sphere coupled to integrated PAR-sensor via 2 mm fiber, compact amplifier unit and special holder for mounting on Optical Unit ED-101US/MD; to be connected to Power-and-Control-Unit MCP-C

Miniature Magnetic Stirrer PHYTO-MS

Type Variomag Mini, with adapter for bottom port of Optical Unit ED-101US/MD and connector to plug into Power-and-Control-Unit MCP-C. Control via MCP-C and PamWin software

Leaf Configuration

Optical Unit for Leaf Measurements MCP-BK

Featuring optical ports for mounting Measuring Heads MCP-E and MCP-D; including leaf clip holder, with opening for fixing Mini Quantum Sensor US-MQS/WB in the leaf plane. To be mounted on stand

Mini Quantum Sensor US-MQS/WB

Consisting of cosine-corrected PAR-sensor (housing: diameter 14 mm, height 16 mm; diffuser diameter 5.5 mm) with compact amplifier unit. To be connected to the Power-and-Control-Unit MCP-C. For measuring incident PAR, when using the Optical Unit for Leaf Measurements MCP-BK

90 Degree Measuring Head Holder DUAL-H90

Consisting of a right angle bracket made of black anodized aluminum (10.0 cm x 4.0 cm x 5.5 cm, W x D x H. Weight 175 g), with metal rod for attachment to a laboratory stand, each bracket arm with special adapter made of Polyoxymethylene (POM) to position a measuring head. Including a laboratory scissor jack (14.0 cm x 12.0 cm x 6.0 cm, W x D x H. Weigth 1370 g) and non-fluorescent rubber foam mat

Multi-Color Emitter Head with UV-A Measuring Light MCP-E/UVA

All specifications identical to Multi-Color Emitter Head MCP-E except the 400 nm pulse-modulated measuring light replaced by 365 nm pulse-modulated measuring light on Chip-on-board multi-wavelength measuring light LED emitter.