Product Catalog

High Quality Instrumentation for Plant Sciences

WALZ
Mess- und Regeltechnik

Editorial

Innovation and Tradition:
These are the driving forces which made the Heinz Walz GmbH one of the world's top producers of highly sophisticated photosynthesis measuring systems.

Close connections to leading scientists in basic and applied research have stimulated many innovative developments. Excellence in product quality and service have been a tradition of this company since its founding in 1972.

The current product line ranges from the well known PAM-Chlorophyll Fluorometers to measuring systems of plant gas-exchange for physiological and ecophysiological research. Dew-Point Mirror Measuring Systems as well as Cold Traps and Measuring Gas Coolers complement the line of products.

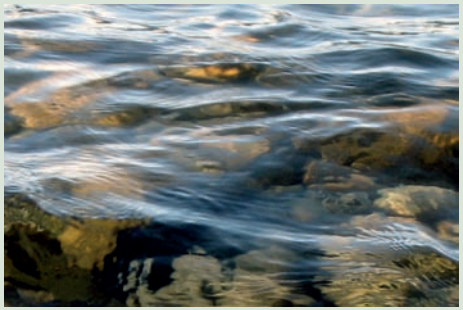
Since the edition of our last Product Catalog in 2004, some exciting new developments have taken place. After having served generations of scientists for 20 years, the "good-old" PAM-101/102/103 eventually was replaced by the new Dual-PAM-100. Likewise, the HCM-1000 portable gas-exchange system was replaced by the new GFS-3000 Portable Gas-Exchange Fluorescence System. Furthermore, with the introduction of the IMAGING-PAM *M-Series* the range of applications of chlorophyll fluorescence imaging was largely extended.

This Product Catalog can only illustrate the most important aspects of the various instruments. More detailed information on all products is given on our homepage www.walz.com, from where various brochures can be downloaded. A network of distributors in many countries provides close contact and technical advice to customers throughout the world.

Chlorophyll Fluorescence & P700 Absorbance Measuring Systems

Since the introduction of our first chlorophyll fluorometer in 1985, PAM-Chlorophyll-Fluorometers manufactured by the Heinz Walz GmbH have become a standard in basic and applied photosynthesis research. Walz PAM-Fluorometers have contributed decisively to progress in photosynthesis research as well as plant eco- and stress-physiology. These contributions are documented in countless publications in numerous scientific journals and books.

Meanwhile, a large family of PAM-Fluorometers for many different applications has evolved. PAM-Fluorometers are applied for measurements of photosynthetic parameters of plants in terrestrial as well as aquatic environments.



They provide detailed information from the level of whole leaves down to single cells and chloroplasts. All of these instruments employ the "Pulse-Amplitude-Modulation" (PAM) measuring principle, which is unique in providing a highly selective measure of the relative chlorophyll fluorescence quantum yield. In conjunction with the "saturation pulse method", PAM-Fluorometers allow rapid assessment of photosynthetic energy conversion, wherever this takes place, in the field, greenhouse or laboratory.

The most recent member of the PAM family, the P700 & Fluorescence Measuring System Dual-PAM-100, stands for the beginning of a new generation of extremely versatile and powerful instruments. Based on the original Pulse-Amplitude-Modulation (PAM) measuring principle, these instruments provide a second signal channel for measuring other photosynthesis parameters (like P700, P515 or NADPH) in parallel with Chl fluorescence. This opens the way for a deepened analysis of photosynthetic performance.

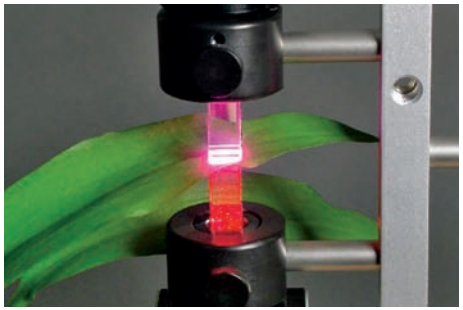
On the following pages, we provide a short description of the various instruments and measuring systems, highlighting special features and optional accessories.

Products

NIR & FR
LED ARRAY

Dual-PAM-100

P700 & Chl Fluorescence Measuring System



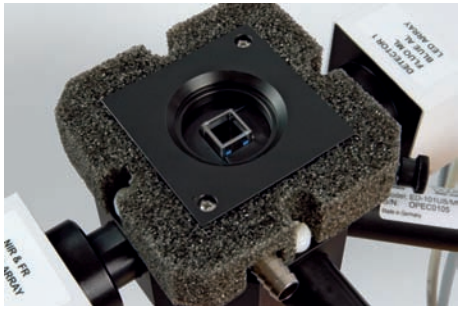
The Dual-PAM-100 is the successor of the well-proven PAM-101/102/103, with considerable improvements in opto-electronic design, data acquisition and range of applications. It is optimized for simultaneous measurements of Chl fluorescence and P700 absorbance, thus providing analogous information on the efficiency of energy conversion in PS I and PS II.

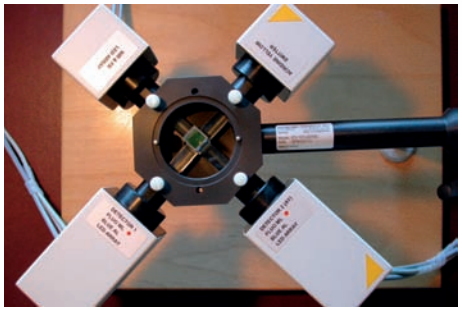
Alternatively, instead of P700 other key photosynthesis parameters (ΔpH, membrane potential, NADPH) can be measured in parallel with Chl fluorescence, using optional emitter-detector modules. With the help of a novel high-frequency differential dual-wavelength modulation technique high signal/noise ratios are obtained at high time resolution.

Various optical configurations are available for measurements on leaves and suspensions. For high sensitivity fluorescence applications a photomultiplier detector module is available.

While optimal results are obtained with P700 measurements in the transmission mode, also a fiberoptics version for high-quality measurements from sample surfaces (remission mode) has been developed.

The Dual-PAM-100 is fully computer-controlled and all essential light sources (including LED array for single and multiple turnover saturating flashes) are integrated in the basic system.



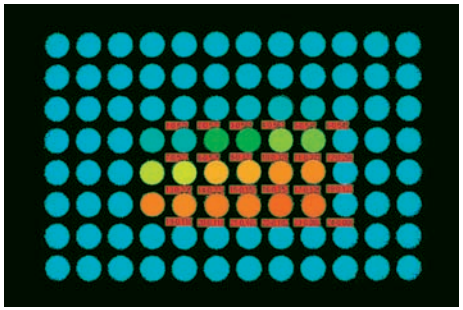


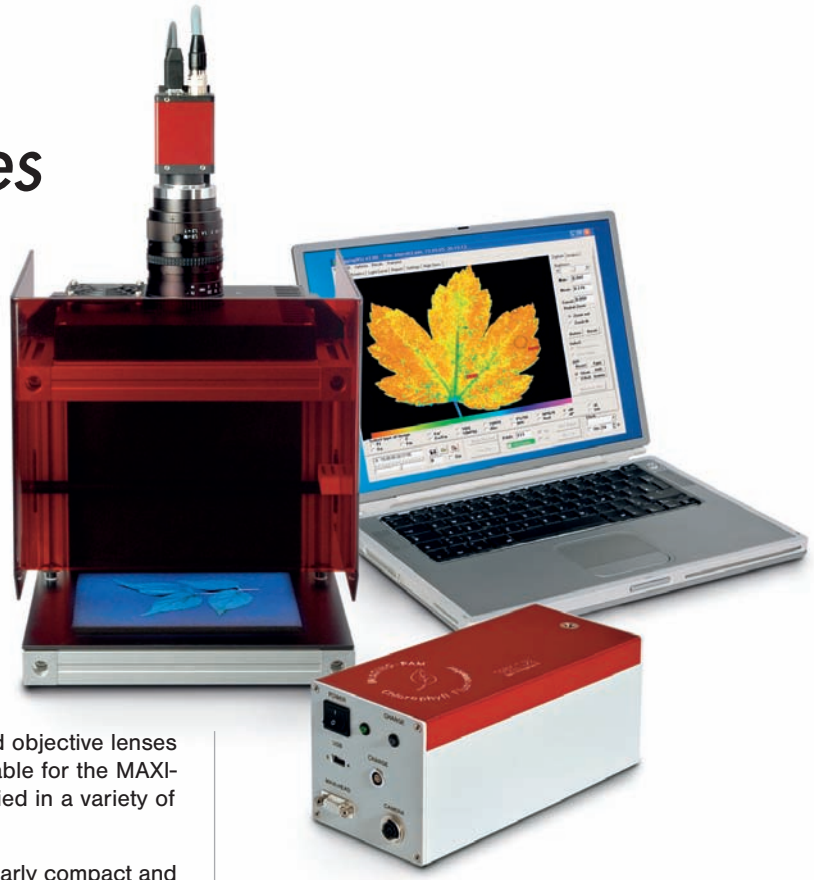
Accessories

- Optical Unit ED-101US/MD
- Temperature Control Block for cuvette ED-101US/T
- P515 Emitter-Detector Module
- NADPH Fluorescence Module
- Photomultiplier Detector Module

IMAGING-PAM *M-Series*

Chlorophyll Fluorometer



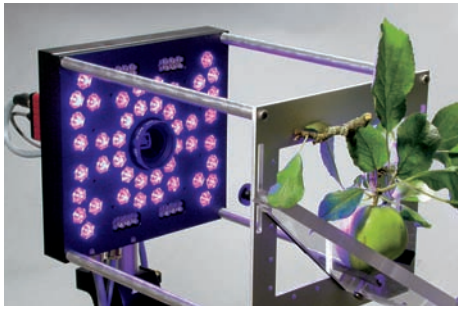


MAXI-Version

The IMAGING-PAM *M-Series* is a family of IMAGING-PAM-Chlorophyll-Fluorometers with varies types of emitter-detector heads for measuring images of photosynthetic activity of a wide range of samples, ranging from single cells (MICROSCOPY-version) to large leaves or samples in multiwell plates (MAXI-version).

Different CCD cameras and objective lenses (including zoom) are available for the MAXI-version which can be applied in a variety of optical configurations.

The MINI-version is particularly compact and best suited for field measurements. The MICRO-version allows imaging at the tissue level, without investment into a sophisticated epifluorescence microscope.



Accessories MAXI-Version

- Alternative 1/2” CCD camera with zoom objective option
- Filter Plate IMAG-MAX/F
- Leaf Distance Holder IMAG-MAX/B
- Stand with Base Plate ST-101
- Compact Tripod ST-1010
- Notebook PC IMAG-PC (for all versions)

Accessories MINI-Version

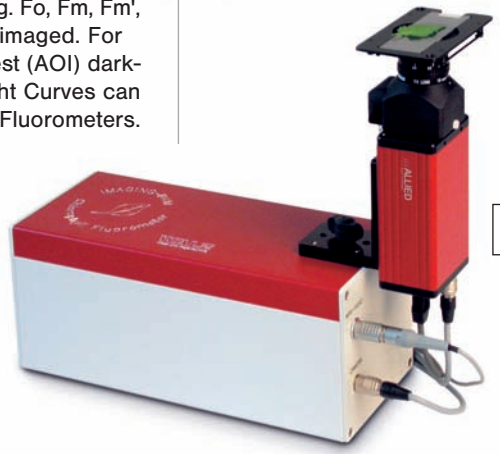
- MINI Measuring Head red (special version for cyanobacteria) IMAG-MIN/R
- MINI Measuring Head for Green Fluorescent Protein IMAG-MIN/GFP
- Leaf Holder IMAG-MIN/BK
- Adapter for GFS-3000 IMAG-MIN/GFS

MINI-Version

The same Multi Control Unit (IMAG-CM) applies for all versions. All instrument functions are computer-controlled using the dedicated ImagingWin software. Besides Chl fluorescence also remitted red and near-infrared light are imaged (MAXI- and MINI-versions), from which images of the absorption of photosynthetically active radiation (PAR Absorptivity, Absorptance) are derived.

Using the Saturation Pulse method all essential fluorescence parameters, as e.g. Fo, Fm, Fm', Y(II), qP, qN and NPQ can be imaged. For defined sample areas of interest (AOI) dark-light Induction Curves and Light Curves can be measured, as with all PAM-Fluorometers.

Special versions are available for imaging Green Fluorescent Protein (GFP) and Reactive Oxygen Species (ROS). The MICROSCOPY-version, for which a Zeiss Axiostar Plus is recommended, can be equipped with a variety of pulse-modulated LED-sources. Using a PC-controlled Red-Green-Blue lamp and a special deconvolution routine, differently pigmented organisms (e.g. green algae, diatoms, cyanobacteria) can be differentiated.



MICRO-Version

MICROSCOPY-Version

Accessory MICRO-Version

- MICRO Measuring Head for Green Fluorescent Protein IMAG-MIC/GFP

Accessories MICROSCOPY-Version

- Alternative Microscopy LED lamps IMAG-L625 (red-orange), IMAG-L365 (UV-A) and IMAG-RGB (red-green-blue)
- Adapter Set for Zeiss Axiostar IMAG-AX
- Fluid-Light-Guide Adapter Set for Zeiss Axiovert and Axioskop IMAG-AXF

PAM-2100

Portable Chlorophyll Fluorometer

Parameter Screen

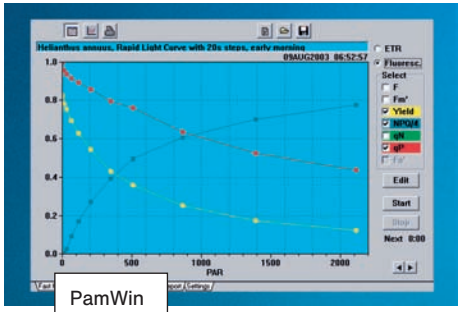
Users expecting a wide range of analytical possibilities and also conducting field work, will favor the PAM-2100, the follow-up model of the well-proven PAM-2000. This device not only allows detailed chlorophyll fluorescence quenching analysis by means of the saturation pulse method, but also rapid kinetic measurements.

The PAM-2100 features a built-in panel-PC with integrated LC-display and keypad. It not only provides comprehensive data processing facilities for stand-alone operation, but can also be operated via an external Windows-PC using the PamWin software.

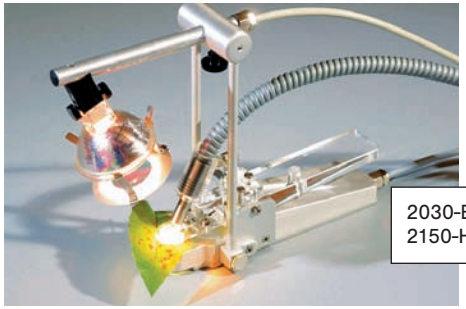
With pre-programmed RUN files, the user can run sophisticated protocols and standardized routines (such as measurement of light saturation curves) in a reliable and reproducible way.

The PAM-2100 originally was designed with emphasis on measurements of foliage. However, it can also be adapted for measurements with suspensions, making use of a special suspension cuvette.

A sophisticated leaf-clip holder is available as an accessory for measuring quantum flux density and temperature at precisely the spot where photosynthetic quantum yield is quantified by fluorescence measurement.



PamWin software



2030-B and 2150-H

Accessories

- Leaf Clip Holder 2030-B
- Arabidopsis Leaf Clip 2060-B
- Dark Leaf Clips DLC-8
- Micro Quantum/Temp.-Sensor 2060-M
- External Halogen Lamp 2150-H
- Suspension Cuvette KS-101

MINI-PAM

Photosynthesis Yield Analyzer

Compact design and easy operation are the most outstanding features of the MINI-PAM. The capacity of the MINI-PAM was intentionally restricted to the analysis of relatively slow fluorescence changes making this device particularly well suited for determination of quantum yield and photosynthetic electron transport rate (Genty-method).

An innovative optical system provides extremely high actinic intensities of white light via flexible 5.5 mm Ø glass fiberoptics. For an exact assessment of the quantum flux density at the fluorescence measuring site, the user can apply the same leaf-clip holder that works with the PAM-2100.

The best measuring results are obtained with leaves or material with similar chlorophyll content. The instrument is delivered with either red or blue measuring LEDs.

Excellent signal quality is also achieved by using an optional 2 mm Ø plastic fiberoptic. This can be attached to the cover of a gas-exchange cuvette providing parallel gas-exchange and fluorescence measurements without shading.

While the MINI-PAM normally is operated in the stand-alone mode, it can be also operated in conjunction with a PC using the WinControl software. Data stored in the stand-alone mode (up to 4,000 data sets) can be readily transferred to a PC for further analysis under WinControl.

Particularly important information on the photosynthetic performance of plants under natural light conditions can be obtained by preprogrammed Rapid Light Curves.

2030-B and 2050-HB

Accessories

- Leaf Clip Holder 2030-B
- Arabidopsis Leaf Clip 2060-B
- Micro Quantum/Temp.-Sensor 2060-M
- Dark Leaf Clips DLC-8
- External Halogen Lamp 2050-HB
- Miniature Fiberoptics MINI-PAM/F1

MONITORING-PAM

Multi-Channel Chlorophyll Fluorometer

MONI-HEAD/485

The MONITORING-PAM is designed for continuous monitoring of chlorophyll fluorescence parameters at multiple measuring sites under field conditions. Up to 4 measuring heads can be operated in parallel using the same data acquisition system (multi-site version of WinControl software), with a maximal distance of 10 m between the measuring sites.

All components are robust and waterproof, so that the MONITORING-PAM can be kept without attendance for longer times under natural environmental conditions.

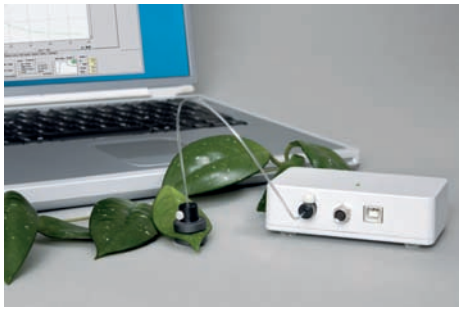
The system consists of several emitter-detector heads (MONI-Head/485) connected via RS-485 with a central Interface Box (MONI-IB4/USB) powered by 12 V supply. Communication of the Interface Box with an external PC is via USB.

A special leaf-holder is provided, featuring a white diffuser/reflector that serves for PAR-detection at the site of fluorescence measurement. In this way, measurements of fluorescence parameters by the Saturation Pulse method provide reliable information on the long-term photosynthetic performance of plants in their natural environment.

MONI-IB4/USB

JUNIOR-PAM

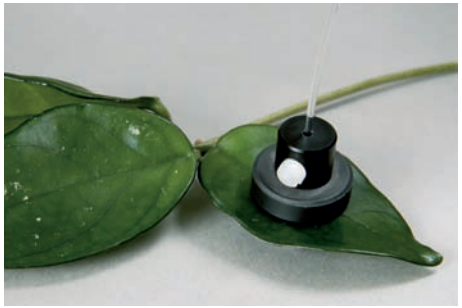
Chlorophyll Fluorometer

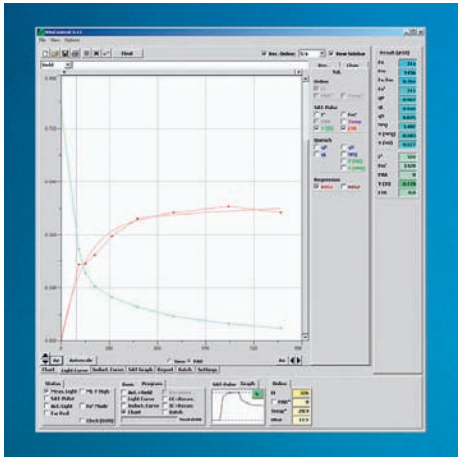


The JUNIOR-PAM features the best price-performance ratio of all PAM-Fluorometers. It excels by its simplicity and ease of operation. Hence, it is particularly well suited for teaching classes and workshops, where availability of a larger number of instruments is essential for gaining hands-on experience.

The JUNIOR-PAM is operated via a PC using the sophisticated WinControl software, which is also applied in conjunction with larger PAM devices, like MINI-, DIVING- and WATER-PAM. The JUNIOR-PAM is unique in not requiring a separate power supply, as it is powered by the PC via the USB connector.

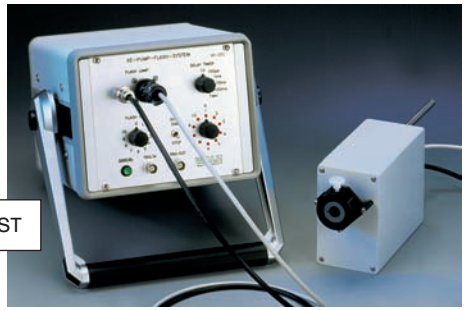
All optical and electronic hardware components are contained in a small box (11.5 x 6.5 x 3.0 cm) that is connected to the sample via a 1 m long single plastic fiber with 1.5 mm diameter. Two different types of leaf-holders are provided, a 60° clip for measurements in ambient light and a dark-clip for Fo-Fm and Fv/Fm measurements. Far-red light can be applied for selective excitation of PS I.





XE-PAM

Chlorophyll Fluorescence Measuring System



XE-ST

Special features of the XE-PAM Fluorometer are its exceptionally high measurement sensitivity and high degree of flexibility for producing various excitation wavelengths. The high sensitivity permits chlorophyll fluorescence quenching analysis of photosynthetically active chlorophyll in natural surface waters (down to 0.5 microgram Chl/l). As an alternative, it is also possible to perform an analysis using the ”pump-and-probe” method.

Hence, the XE-PAM constitutes an ideal measuring system for phytoplankton research. In addition, this device is also well-suited for various other applications. In the pump-and-probe operating mode, the reoxidation of the primary PSII-acceptor Q_A can be assessed with a time resolution of 10 microseconds (herbicide research). For this purpose the special Single Turnover Pump Flash Lamp XE-ST is available.

Using special sets of excitation and detection filters, it is also possible to measure fluorescence changes of 9-aminoacridine (indicator of the transmembrane proton gradient) and of NADPH (in vitro and in vivo) with high resolution. An application of particular current interest are measurements of UV-excited chlorophyll fluorescence for the determination of the UV-filtering properties of the leaf epidermis (approach according to Bilger et al.).

PDA-100

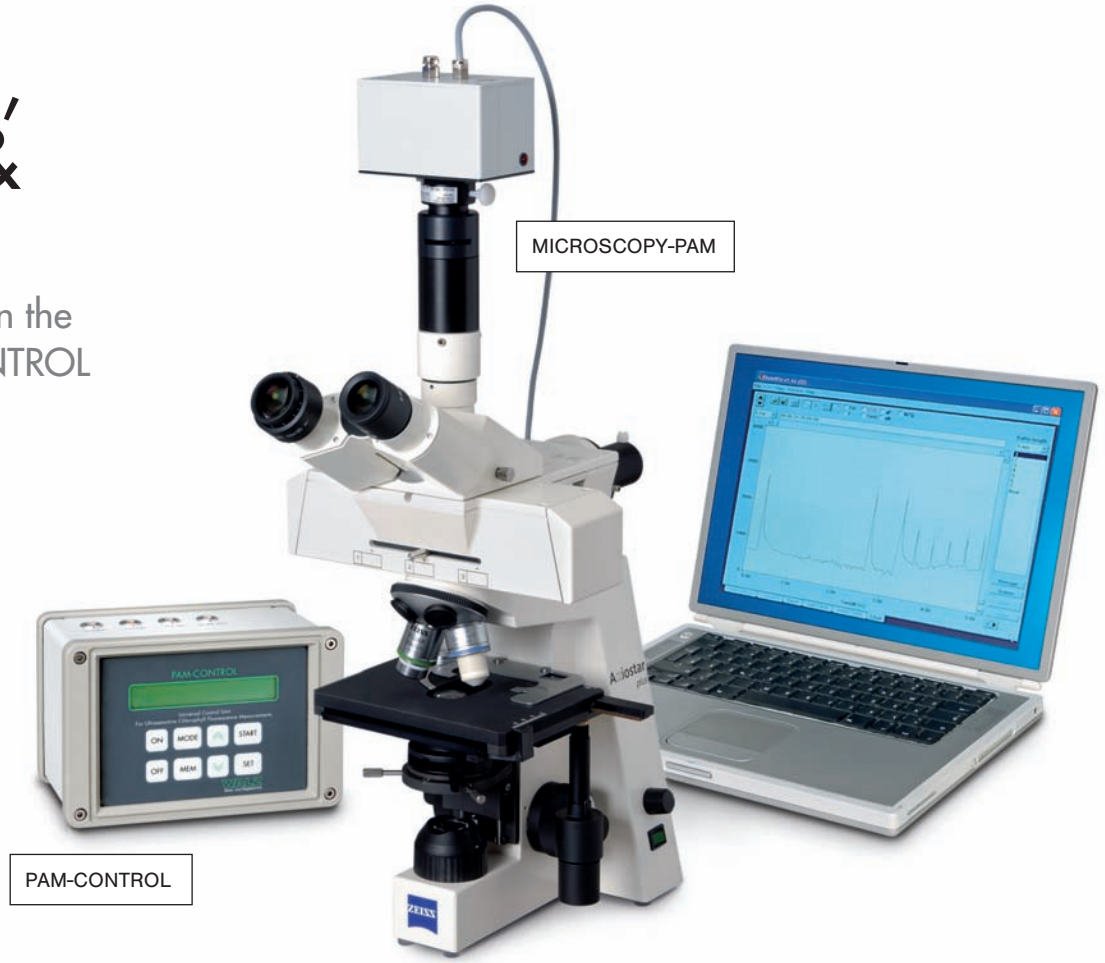
US-T

Accessories

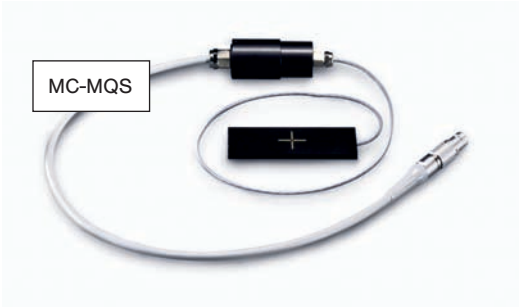
- Actinic-/Saturation Light Unit XE-AL
- Fiberoptics 101-F and 101-F5
- Flash Lamp XE-ST for ”Pump-and-Probe” measurements
- Filtersets FS-9AA, FS-NADPH and FS-UV for special applications
- PAM-Data-Acquisition-System PDA-100
- Spherical Micro Quantum Sensors US-SQS/IB and US-SQS/WB
- Temperature Control Unit US-T

MICROSCOPY-, MICROFIBER- & WATER-PAM

Chlorophyll Fluorometer based on the Universal Control Unit PAM-CONTROL



The PAM-CONTROL Universal Control Unit is a microprocessor-based device for conducting extremely sensitive chlorophyll fluorescence measurements in a variety of specialized optical geometries using a photomultiplier fluorescence detector. Light-emitting diodes (LED) not only serve as sources of pulse modulated measuring light, but of actinic light and saturation pulses as well.

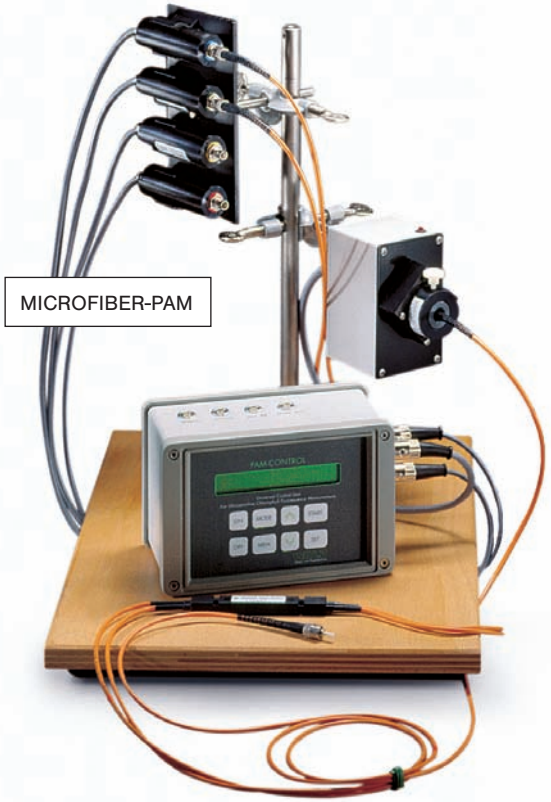


The PAM-CONTROL may be operated as a portable stand-alone device (in analogy to the MINI-PAM Photosynthesis Yield Analyzer) or operated in conjunction with a PC using the dedicated WinControl software.

The PAM-CONTROL combined with an Epifluorescence Microscope constitutes the **MICROSCOPY-PAM**, enabling the full spectrum of chlorophyll fluorescence quenching analysis at the level of single cells or even single chloroplasts.

Accessories MICROSCOPY-PAM

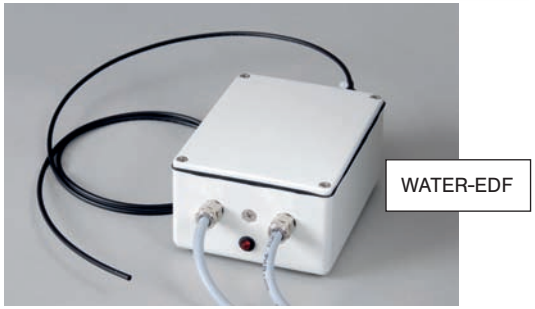
- Epifluorescence Microscope Zeiss Axiostar Plus MC-AXIOSTAR
- Adapter Set for Zeiss Axio-Series MC-AX25
- Micro Quantum Sensor MC-MQS



Combining the PAM-CONTROL with a Multimode Fibercoupler yields the **MICRO-FIBER-PAM**, an instrument suitable for small spot measurements at the surface and in different cell layers of photosynthesizing tissues. For this purpose a number of differently colored LED-Light sources with integrated fiber coupler optics are available.

Three different versions of the **WATER-PAM** with different emitter-detector units are manufactured: The standard WATER-ED featuring a 15 mm Ø quartz glass cuvette enclosed in a compact housing is optimized for high sensitivity phytoplankton measurements. The fiberoptics version WATER-EDF is equipped with a single 1.5 mm Ø plastic fiber and can be recommended for measurements on periphyton/microphytobenthos and endolithic algae.

The flow-through version WATER-FT consists of a highly sensitive measuring head (exceptionally low background signal) enclosed in a water-proof flow-through chamber. It is well suited for continuous monitoring of surface water pumped from reservoirs, lakes, rivers and oceans. All versions are available either with red or blue excitation.

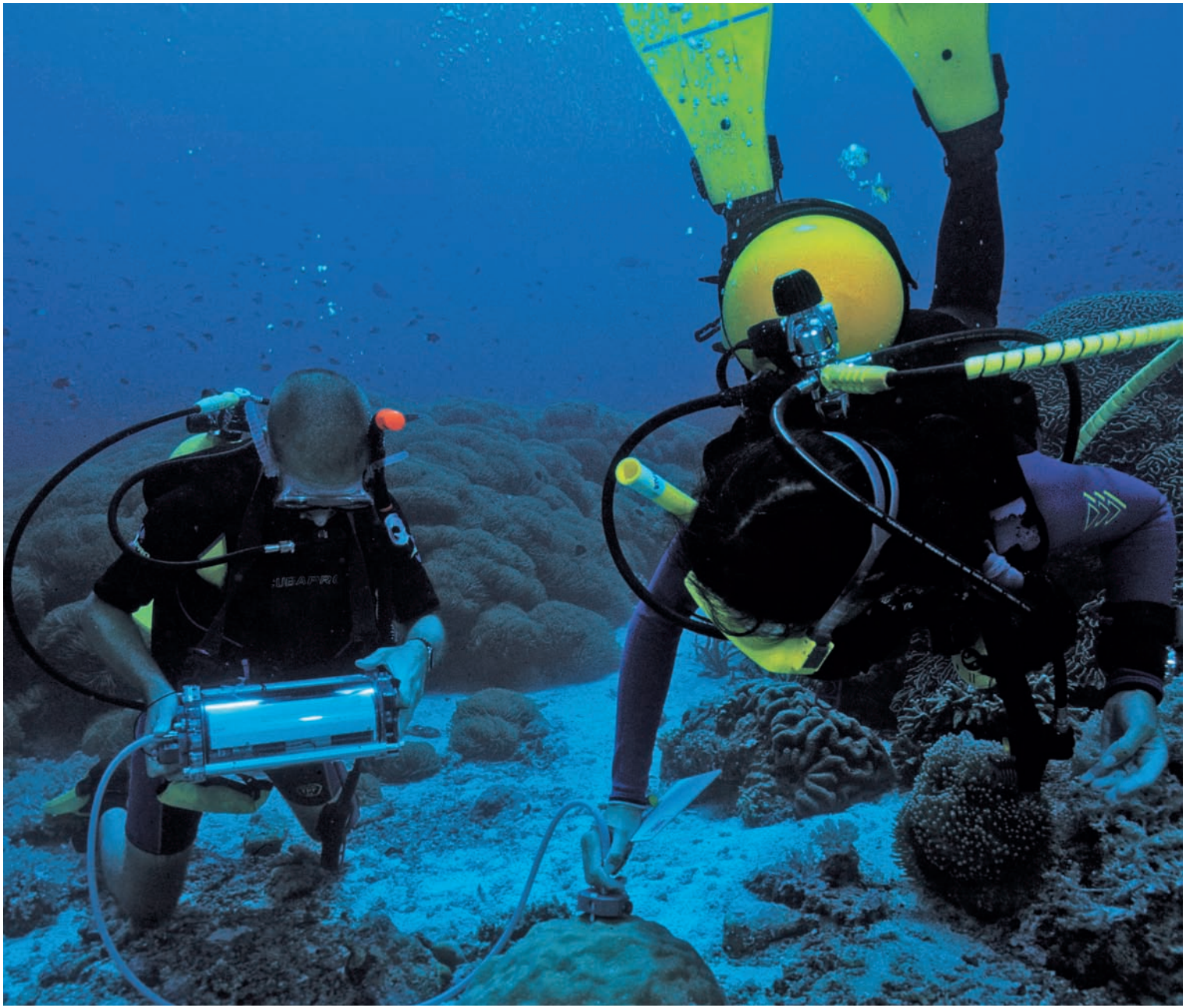


Accessories MICROFIBER-PAM

- LED Measuring Light Sources MF-L520, MF-L630 and MF-L650
- Working Fiber 100/140 micrometer MF-F

Accessories WATER-PAM

- Stirring Device WATER-S
- Spherical Micro Quantum Sensor US-SQS/WB



DIVING-PAM

Underwater Fluorometer

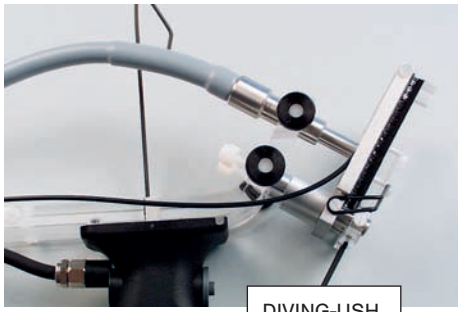
The DIVING-PAM was developed especially for underwater photosynthesis measurements. From the perspective of electronics and data acquisition, it is practically identical with the MINI-PAM, except that the DIVING-PAM is integrated into a submersible housing and equipped with integrated light, temperature and depth sensors.

This thoroughly unique device is suited for detailed investigations of submersed plants in situ, down to a depth of 50 m, including the very interesting phycosymbionts in corals, sea anemones, ascidians, etc., which until now have been little researched. For handling of various types of samples (corals, seagrass, periphyton etc.) the Universal Sample Holder DIVING-USH is available.

An innovative keyboard functions on the basis of light reflected from a fingertip and ensures simple handling of the DIVING-PAM, even in difficult underwater conditions. A special aspect of this device is its extensive data storage capacity (4,000 data records).

Data can be transferred later to a PC for further analysis. Also, via an underwater interface cable, the DIVING-PAM can be directly linked to a PC and remotely controlled using the WinControl software.

Particularly important information on the photosynthetic performance of aquatic organisms in a rapidly changing light environment can be obtained by preprogrammed Rapid Light Curves.



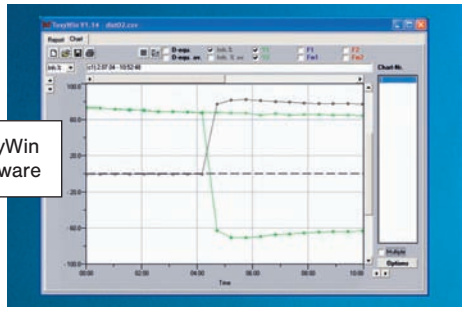
DIVING-USH

Accessories

- Universal Sample Holder DIVING-USH
- Dark Leaf Clips DIVING-LC
- Magnet Sample Holders DIVING-MLC
- Miniature Fiberoptics DIVING-F1
- Underwater Cable DIVING-K (25 m and 50 m long)

ToxY-PAM

Dual-Channel Yield Analyzer



ToxyWin software

The ToxY-PAM is a highly specialized chlorophyll fluorometer which allows detection of very small differences in the effective quantum yield (Y) between two samples. It is exceptionally well suited for detecting toxic substances in water samples (e.g. drinking water, water used in the food industry).

In conjunction with lyophilized thylakoids, the ToxY-PAM provides a highly sensitive bioassay test characterized by a detection limit equivalent to 0.02 microgram Diuron/l. This system excels in the detection of photosystem II herbicides.

Using suspensions of unicellular algae (e.g. diatoms) a more extensive bioassay test can be conducted to detect a large number of other toxic substances that affect the enzymatic steps of photosynthesis, as well as parts of the associated cell metabolism.

The ToxY-PAM features two identical measuring chambers. In the first chamber e.g. algae are suspended in the collected water, while the second chamber contains the same algae suspended in reference water. Both samples are identically pre-illuminated, followed by measurement of the effective quantum yield (Y).

Any difference provides information on phytotoxic effectors contained in the collected water. The measuring routine is controlled by a microprocessor and fully automated.

For PC-operation the dedicated Windows software ToxyWin is provided. The data sets (F, Fm, Y, % Inhibition and Diuron equivalents in microgram/l) are stored automatically and analyzed statistically (standard deviation etc.).

PHYTO-PAM

Phytoplankton Analyzer

PHYTO-ED
System II

System I

The PHYTO-PAM is a 4-wavelength chlorophyll fluorometer for ultrasensitive assessment of chlorophyll content, composition and photosynthetic activity of phytoplankton in natural surface waters as well as of microphytobenthos and periphyton. Outstanding features are:

- Differentiating between green algae, diatoms and cyanobacteria
- Measuring the concentration of active chlorophyll down to ca. 0.1 µg Chl/l
- Assessment of effective quantum yield and relative electron transport rate (ETR)
- Automated recordings of light response curves of Yield- and ETR-parameters
- PhytoWin software for system control, data acquisition and analysis via PC.

Three alternative system versions with different Emitter-Detector units (measuring heads) are available for different types of samples and applications:

1) System I for laboratory work featuring a standard 10x10 mm cuvette using the Optical Unit ED-101US and separate LED-array cones for Measuring and Actinic Light. This system can be particularly recommended for basic research because of the well-defined optics.

PHYTO-EDF
System III

2) System II for field and on-deck work featuring a 15 mm Ø cuvette in the PHYTO-ED unit, with all optoelectronical components being contained in one miniature housing.

3) System III for microphytobenthos and periphyton work featuring the fiberoptics measuring head PHYTO-EDF.

US-SQS/B

Accessories

- Miniature Magnetic Stirrer PHYTO-MS (System I)
- Temperature Control Unit US-T (System I)
- Stirring Device WATER-S (System II)
- Spherical Micro Quantum Sensor US-SQS/B (Systems I and II)

Gas-Exchange Systems & Accessories

Measuring systems for assessing gas-exchange of plants were the first products of the Heinz Walz GmbH. Hence, in this field of instrument development, the Heinz Walz GmbH relies on 35 years of tradition and experience.*

While the first instruments were contained in man-sized boxes and connected to plant chambers with volumes of several liters, the systems have become more and more miniaturized over the years. The present portable instruments require just a few square centimeters of leaf surface for highly accurate and reliable measurements.

From the beginning, the Heinz Walz GmbH favored an ”open” gas-exchange measuring system, in contrast to the systems of other companies. Over the years, this open measuring system has generally become the preferred method. An infrared-gas-analyzer (IRGA) which simultaneously provides differential and absolute data on CO_2 and H_2O exchange is used.

Gas-exchange systems of the Heinz Walz GmbH, ranging from large measuring systems to portable field instruments, all utilize a differential IRGA and feature full control of the essential parameters of light, temperature, humidity and CO_2. The entire product line of gas-exchange measuring equipment includes complete systems as well as numerous accessories, which can be applied independently in various applications. These include Cold Traps, Dew-Point Mirrors and special Lighting Units for plant chambers.

Products

- GFS-3000 (p. 24/25)
- Gas-Exchange Stations (p. 26)
- FL-460 (p. 27)
- TS-2 (p. 28)
- KF/MGK (p. 29)

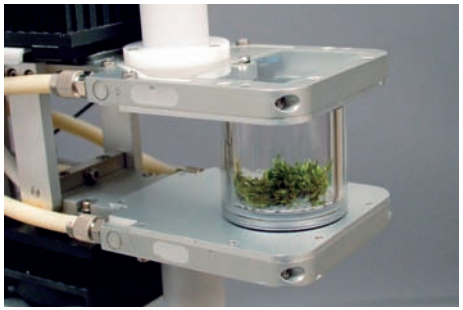
* Koch W., Walz H. (1967):
Kleinklimaanlage zur Messung des pflanzlichen Gaswechsels.
Zeitschrift Naturwissenschaften 54: 321-322

Schulze E.-D., Hall A.E., Lange O.L., Walz H. (1982):
A Portable Steady-State Porometer for Measuring the Carbon Dioxide and Water Vapour Exchanges of Leaves Under Natural Conditions. Oecologia 53: 141-145


GFS-3000

GFS-3000

Portable Gas-Exchange Fluorescence System

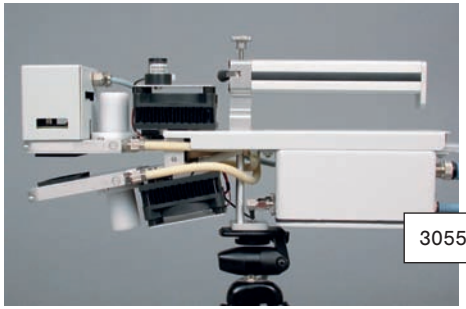


The Portable Gas-Exchange Fluorescence System GFS-3000 is a high-precision gas-exchange measuring system suitable for field, green house and laboratory. The GFS-3000 includes full control of CO_2 and H_2O concentration, cuvette or leaf temperature, ventilation and light.

Complementary information on photosynthetic parameters can be obtained by simultaneous chlorophyll fluorescence measurements using one of 3 alternative PAM-Fluorometers. A special LED-Array/PAM combination can be mounted instead of the standard LED light source, providing fluorescence information over the whole 8 cm^2 sample area.

Alternatively, fluorescence images can be measured using the IMAGING-PAM Mini-Head. Last but not least, for measurements in ambient light a Fiberoptics PAM version is available. The essential fluorescence and gas-exchange parameters are stored in one data record.

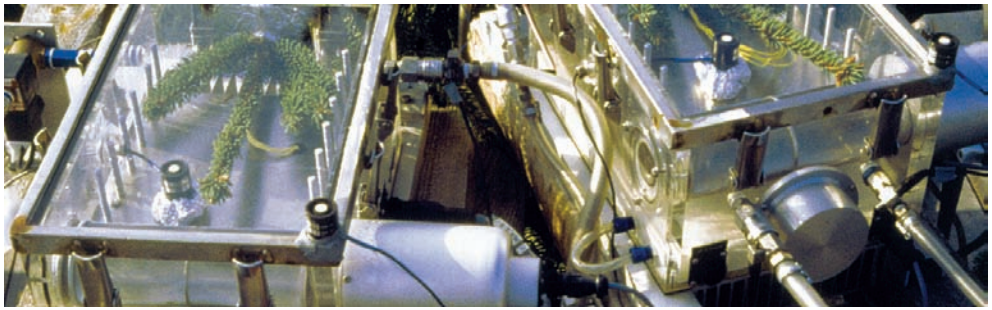
Many special applications are possible like measuring lichens or mosses under very humid conditions, measuring samples growing on surfaces such as stones or bark, and separate assessment of upper and lower leaf side. Furthermore, fully climatized cuvettes with larger volumes can be connected for measurements of small branches or whole plants.



Accessories

- Various cuvettes for Lichens/Mosses, Conifers and Arabidopsis
- Fully climatized cuvettes with larger volume
- Fiberoptics PAM Fluorometer 3050-F
- LED-Array/PAM Fluorometer 3055-FL
- IMAGING-PAM Mini-Head

Gas-Exchange Measuring Stations



Gas-exchange measuring stations are constructed according to customer requirements and are used to operate large gas-exchange chambers. The volume of the gas-exchange chambers ranges from 2.5 up to a maximum of 30 l. These systems can be used for laboratory applications or in the field, e.g. for long-term investigations.

As in the case of the Portable Gas-Exchange Fluorescence System GFS-3000, these systems are also ”open” gas-exchange measuring systems operating on the differential principle.

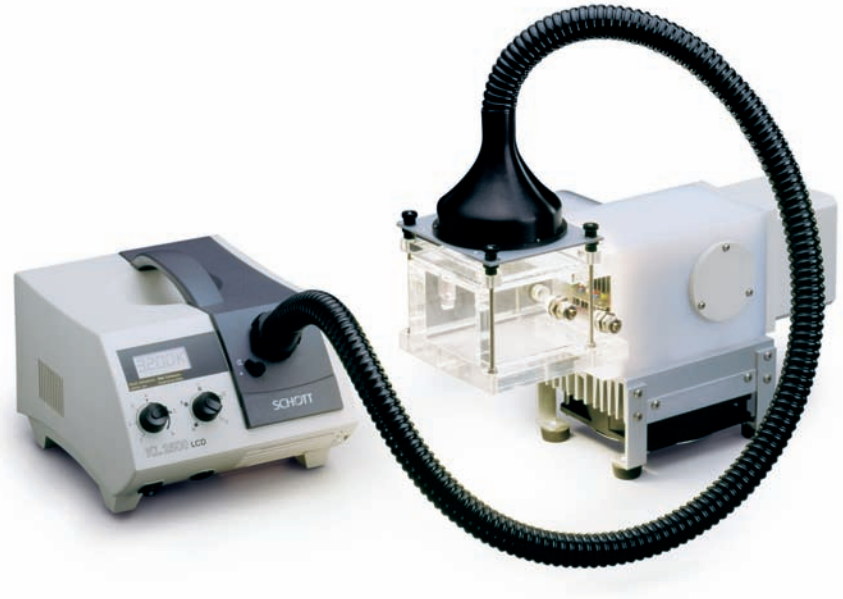
They are normally equipped with a bypass humidity control unit since the quantity of water vapor released in the measuring chamber is high due to the large amount of plant material enclosed. The humidity conditions can be controlled with an input humidity control unit and the CO_2 conditions with a CO_2 gas mixing unit.

Accessories

- Various Measuring Chambers
- Lighting Unit
- Measuring Gas Cooler Unit
- Input Humidity Control Unit
- Gas Mixing Unit
- Bypass Humidity Control Unit

FL-460

Lighting Unit



The Lighting Unit FL-460 uses a halogen lamp as light source and distributes the light using a special fiberoptics. This unit provides the advantages of a halogen lamp, specifically high light intensity and a light spectrum similar to sunlight. The fiberoptics provide a good light distribution and this is complemented by a nearly complete elimination via filtering of infrared radiation.

These advantages make the Lighting Unit FL-460 not only highly suitable for our gas-exchange chambers but also for many other applications. The light intensity can either be set electronically or by using neutral filters. Two filter shafts are available for the neutral filters. However, it is also possible to control the light intensity by an external signal.

The special fiberoptics, 120 cm in length, consists of approx. 200 single Plexiglass fibers, with a diameter of 1 mm each. These fibers are randomly mixed and arranged in an array, forming a joint circular output area of 9 cm in diameter. A flange at the light outlet is used to mount the special fiberoptics to a gas-exchange chamber, laboratory stand, etc.

TS-2

Dew-Point Mirror Measuring System

The model TS-2 belongs to the third generation of dew-point mirror measuring systems, which feature extended measuring ranges and meet modern requirements with respect to operation and data processing. The dew-point mirror measuring system TS-2 is designed for use as a stand-alone unit or it can be integrated into a wide variety of equipment. It is ideally suited for control or alarm monitoring applications.

The dew-point mirror measuring system basically consists of a control and display unit and the dew-point mirror measuring head. Use of the optional temperature transducer (for connecting a Pt100 sensor), enables the measuring gas temperature to be recorded. In this case the relative humidity is also calculated via software and displayed.

The dew-point mirror measuring system is microprocessor-controlled and the operator interacts with the unit using three push-buttons. Operation is very simple. However, the control and display unit can also be addressed via the RS232 interface.

Accessory

- Temperature Transducer TS-2MU

KF/MGK

Cold Traps and Measuring Gas Coolers

KR-KW-12/2

KF-18/2

Cold Traps (one gas path) and Measuring Gas Coolers (two pneumatically separated, parallel gas paths) control the dew-point in a gas stream. For this purpose, the gas stream is simply directed through the Cold Trap or the Measuring Gas Cooler and cooled down to the temperature set on the temperature controller.

KR-K-9/2

If the dew-point of the penetrating gas is above the set temperature value, the excessive water vapor condenses; the outstreaming gas has a defined dew-point, corresponding to the set temperature.

Cold Traps and Measuring Gas Coolers are available in different versions. They are very powerful and may be applied to achieve temperature differences of more than 30 °C with respect to ambient temperature. In addition to this, the dew-point setting is very accurate (0.1 °C). Besides being typically applied in gas-exchange measuring systems, additional important applications relate to humidity control, and include:

- Calibration of humidity sensors, dew-point mirror measuring systems, H_2O-gas analyzers, etc.
- Drying of gases
- Generation of defined humidity conditions

MGK-1

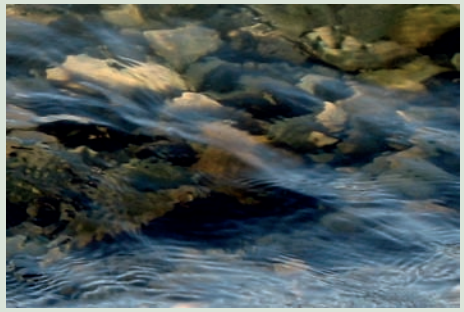
Outlook

While the Heinz Walz GmbH has been serving science for 35 years with sophisticated instrumentation for photosynthesis/plant research, the course is set for further innovations and developments. Technical progress, e.g. in LED technology, enables the development of novel instrumentation, which again drives progress in science. *Vice versa*, scientific research reveals the demands for new instrumentation, thus stimulating its development and indirectly also driving technical progress.

This kind of fruitful mutual stimulation relies on extensive communication and exchange of information/ideas between researchers and instrument makers. In this context, the Heinz Walz GmbH is well prepared for the future by having employed several full-time plant scientists within the company and being closely associated with a group of external scientists, who are mainly responsible for instrument development (Ulrich Schreiber, Jörg Kolbowski, Rolf Gademann and Christof Klughammer). Based on their own practical experience, these scientists are well aware of the needs of basic/applied research and able to communicate with other scientists on special demands and applications.

When Walz introduced the first open gas exchange measuring systems more than 30 years ago and the first PAM-Fluorometers in 1985, this triggered a wave of research activities, with the range of new applications steadily growing until today. While PAM fluorometry so-far has been used primarily for assessment of PS II activity, after introduction of the Dual-PAM-100, now enhanced research activities on properties of PS I, cyclic and intersystem electron transport may be foreseen.

The same high-frequency differential dual-wavelength modulation technique, which opened the way for high performance P700 and P515 measurements, can be applied for measuring numerous other optical signals in intact leaves as well as in suspensions of chloroplasts, algae and cyanobacteria. In this context, we and as well as the photosynthesis research community can look forward to the newly developed KLAS-100 Kinetic LED-Array Spectrophotometer that will become available in the near future. This very innovative device will allow the deconvolution of 9 different, simultaneously measured absorbance changes (Cyt f, Cyt b-559, Cyt b-563, C550, P515, light scattering peaking at 535 nm, zeaxanthin peaking at 506 nm, P700, plastocyanin) and thus may be expected to give new impulses for basic and applied photosynthesis research.



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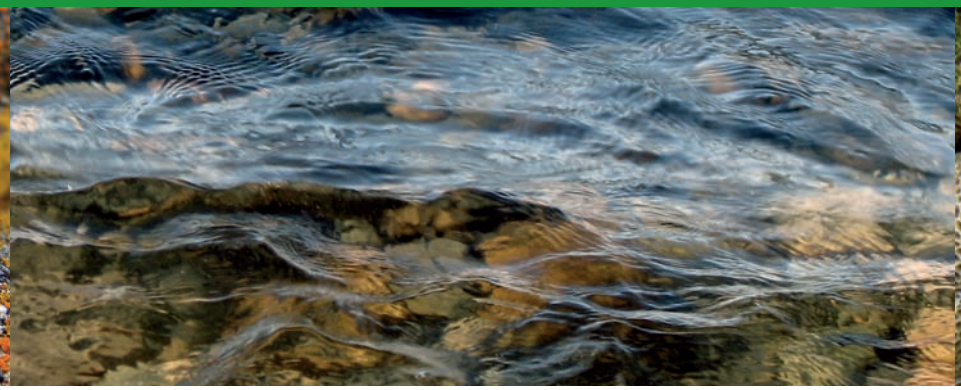
At our website www.walz.com all PC software and instruction manuals as well as some key papers and brochures can be downloaded.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