The most advanced field portable, pulse modulated fluorometer for the detection and accurate measurement of most types of plant stress

**OS5p+**

Advanced portable pulse modulated chlorophyll fluorometer

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Changing the perception of modulated fluorometers

If you have a perception that sophisticated pulse modulated fluorometers always have to be bulky, heavy and complex to use, ADC BioScientific Ltd. would like to introduce to you the compact OS5p+ advanced field portable chlorophyll fluorometer.

The OS5p+ is the latest generation of OS chlorophyll fluorometer and is the most powerful and portable research fluorometer yet.

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Powerful plant stress research tool

The OS5p+ employs the proven pulse modulation technique, where a rapidly pulsing excitation light is used to induce a corresponding pulsed fluorescence emission. The sophisticated detection system distinguishes between the pulsed response and the non-pulsed response allowing ambient light, artificial light and dark adapted experiments to be performed.

Chlorophyll fluorescence can be used to measure most types of plant stress and also provide detailed analysis of the photosynthetic process. The OS5p+ offers more testing protocols, measured more accurately, than any other portable chlorophyll fluorometer.

Automated experiments provided as standard include: $F_{V}/F_{M}$, Quantum Photosynthetic Yield $Y(II)$, OJIP, Rapid light curves and a variety of Quenching protocols.

To ensure the most accurate chlorophyll fluorescence data the OS5p+ enables natural chloroplast migration during experiments and features Quantum Photosynthetic Yield $Y(II)$ with Multiflash-$F_{M}'$ correction.

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- Widest range of automated testing protocols
  (Inc: $F_{V}/F_{M}$, Yield $Y(II)$, OJIP, Rapid light curves, a variety of Quenching protocols)

- Accurate and reliable fluorescence data
  (Inc: Multi-flash $F_{M}'$ correction and natural chloroplast migration)

- Truly portable, ultra compact and field rugged

- Touch screen, colour, graphic display
Truly field portable
The OS5p+ sets new levels in portability and performance for a modulated fluorometer.

Weighing just 1.6kg, this powerful and robust battery portable system, offers up to 12 hours of continuous operation from a single charge.

The OS5p+ is supplied in a rugged transport case, with shoulder strap and carry bag.

User-friendly
The OS5p+ has been designed with the highest degree of automation. Full programming and operation is achieved by a series of simple menus on a large, backlit, colour, touch screen display.

Many stress test protocols are pre-programmed into the OS5p+, greatly simplifying the experimental set up. These routines can be easily changed by the researcher in the field. No separate PC is required.

Colour graphic display
Calculated parameters and real time fluorescence transient curves are displayed on a daylight variable colour graphic display.

Data can either be stored in the large 1Gb internal memory, capable of storing thousands of test data sets and traces, or on removable SD memory cards. Data may also be downloaded via a USB port.

The OS5p+ is supplied as standard with an open body cuvette, a PAR clip and 10 dark adaption cuvettes.

New techniques provide accurate and reliable fluorescence data
Enables chloroplast migration-qM
For accurate light adapted measurements

For reliable measurements of all light adapted parameters the OS5p+ features an internal, ultra stable, white actinic light source supplying constant light levels between 0-5,800µmols m^{-2} s^{-1}. This white light ensures that chloroplast migration (qM) occurs as in nature. Errors in NPQ measurements of up 30% are possible when using other coloured light sources, that do not encourage chloroplast migration. There is no requirement to use any external light source.

Multi-flash F_M' correction
For the accurate measurement on leaves with a high light level history

A multi-phase saturation pulse technique (Loriaux 2013*) to determine F_M' is provided to ensure accurate measurements of Y(II) and ETR on leaves with a high light level history.

PAR Clip
For accurate photosynthetic Yield Y(II) data

Quantum Photosynthetic Yield Y(II) varies not only with different types of plant stress, but also with light and temperature.

To achieve reliable results the supplied PAR clip features high quality PAR and leaf temperature sensors. It is designed with an underside opening mechanism, to prevent the weight of the fibre optic cable opening the PAR clip unexpectedly.
Quenching protocols:
Includes the widest range of quenching protocols available, which may be performed using multiflash $F_M'$ correction.
Henrickson lake: $Y(II)$, $Y$(NPQ), $Y$(NO), NPQ.
Kramer lake: $Y(II)$, $Y$(NPQ), $Y$(NO), qL.
Puddle: $Y(II)$, NPQ, qP, qN.
Quenching relaxation parameters includes new qM (Chloroplast migration), qE, qZ, qT, qL.

Quantum Photosynthetic Yield $Y(II)$: Also referred to as light adapted quantum yield of PSII. The most widely used light adapted test, sensitive for most types of plant stress. $Y(II)$ reduces under stress. The OS5p+ features multiflash $F_M'$ correction ensuring accurate measurements even for leaves with a high actinic light history.

OJIP: Dark adaption test for analysing the shape and steps in the initial rise in fluorescence at high time resolution. Strasser protocol parameters O, J, I, P, t100µs, t300µs, $M_o$, $P_{ABS}$, A, and $t_F M$ are all displayed. Test results are easily compared by overlaying multiple graphs on the colour display.

OJIP Vredenberg protocol: For the sophisticated investigation of NPQ using user defined scripts during the fluorescence rise.

Rapid light curves: Automated multi-step light response curve of chlorophyll fluorescence response at different PAR concentrations. Provides more accurate analysis of chlorophyll fluorescence under variable light conditions, such as is found under a canopy and in aquatic environments.

FV/FM: Photochemical efficiency or Maximum quantum Yield. Popular, robust and simple dark adapted test. FV/FM ratio reduces under stress. Can take less than two seconds to perform. Pre-illumination with far red light is also possible.
Fluorescent measurement experiments exist to measure many types of plant stress, although some tests are more suited for a specific stress than others. To assist researchers, a Plant Stress Guide is available which lists the value and limitations of different types of measurement for different kinds of plant stress.

This very informative document has been compiled from worldwide published research independent of fluorometer brand.

Plant stresses include: Light, drought, heat, nutrient (including nitrogen), cold, over watering, herbicide, heavy metal and CO₂.

Contact ADC BioScientific if you would like to receive a complementary copy of the Plant Stress Guide.

Parameters include:

- Y(II): Quantum photosynthetic yield (light adapted quantum yield of PSII)
- Fo: Minimum fluorescence
- Fm: Maximal fluorescence
- Fv: Variable fluorescence
- Fv/Fm: Photochemical efficiency
- Fv/Fo: More sensitive detector of plant stress than Fv/Fm
- Fm (Fm'): Maximal fluorescence under steady state conditions (Fm')
- Fs: Fluorescence signal prior to saturation pulse (F')
- qP: Photochemical quenching
- qN: Non-photochemical quenching
- qL: Photochemical quenching
- NPQ: Non-photochemical quenching
- Y(NPQ): Photo-protective heat dissipation
- Y(NO): Non-photoprotective heat dissipation
- Ft: Current fluorescence readout
- ETR: Electron transport rate (with PAR clip)
- rETRMAX: Leaf photosynthetic capacity
- PAR: Photosynthetic Active Radiation (with PAR clip)
- T: Leaf temperature (with optional PAR sensor)
- qE, qT, qL, qM, qZ: Quenching relaxation parameters
- Strasser OJIP parameters: O, J, I, P, t100µs, t300µs, M₀, P₁ABS, A, tFM

Specifications

Excitation sources:
- Saturation pulse: White LED with 690nm filter. 0-15,000 µmols m⁻² s⁻¹, 7,500 µmols m⁻² s⁻¹ with PAR clip
- Modulating light: Two channel 660nm (red) and 450nm (blue) LED
- Actinic light: White LED 0-5,800µmols m⁻² s⁻¹ 0-1,850 µmols m⁻² s⁻¹ with PAR Clip
- Far red: Intensity adjustable 740nm LED

Detection method: Pulse modulation

Detector: PIN photodiode with 700-750nm filter

Sampling rate: Auto-switching from 1 to 10,000 points per second, depending on test and phase of test

Test duration: Adjustable 0.1 seconds - 12 hours

Data storage: 1Gb internal memory for thousands of data sets and traces. Removable SD cards

Digital output: USB & 1GB SD cards

User interface: Graphic, backlit, colour, touch screen display (114mm x 89mm)

Battery: Rechargeable nickel metal hydride providing up to 12 hours of continuous operation

Operating temperature range: 0°C-50°C

Dimensions: 18cm x 14cm x 8cm

Weight: 1.6kg