



OS5p+



Advanced portable pulse modulated chlorophyll fluorometer

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

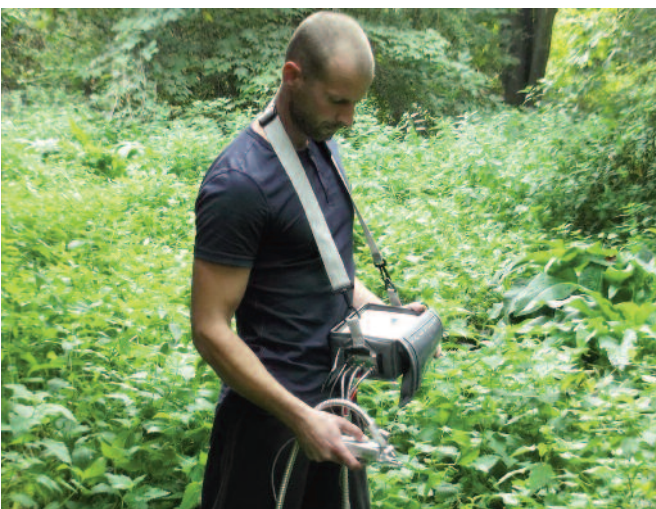
- **Widest range of automated testing protocols** (Inc: F_v/F_M , Yield $Y(II)$, OJIP, Rapid light curves, a variety of Quenching protocols)
- **Accurate and reliable fluorescence data** (Inc: Multi-flash F_M' correction and natural chloroplast migration)
- **Truly portable, ultra compact and field rugged**
- **Touch screen, colour, graphic display**



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.



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.

Truly field portable

The OS5p+ sets new levels in portability and performance for a modulated fluorometer.

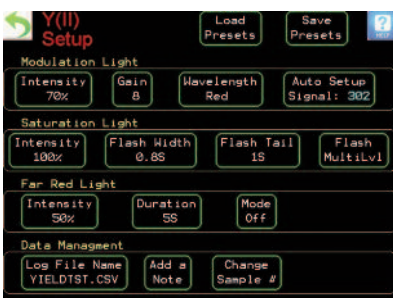
Weighing just 1.6kg, this powerful and robust battery portable system, offers up to 12 hours of continuous operation from a single charge.

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

User-friendly

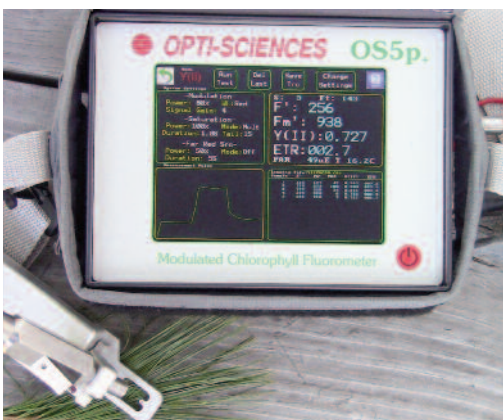
The OS5p+ has been designed with the highest degree of automation. Full programming and operation is achieved by a series of simple menus on a large, backlit, colour, touch screen display.

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- q_M For accurate light adapted measurements

Chloroplasts in cell after dark adaptation

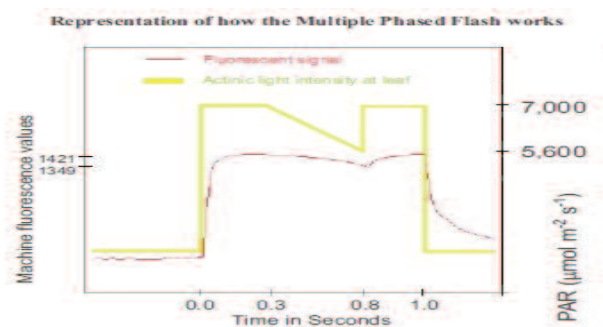


Chloroplasts in cell after white actinic light adaptation

For reliable measurements of all light adapted parameters the OS5p+ features an internal, ultra stable, white actinic light source supplying constant light levels between 0-5,800 $\mu\text{mol m}^{-2} \text{s}^{-1}$. This white light ensures that chloroplast migration (q_M) 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



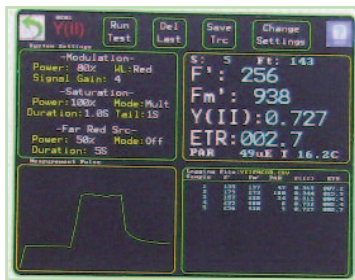
Quantum Photosynthetic Yield Y(II) varies not only with different types of plant stress, but also with light and temperature.

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.

Widest range of automated testing protocols

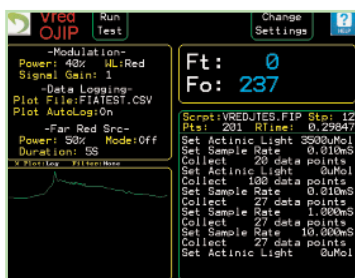
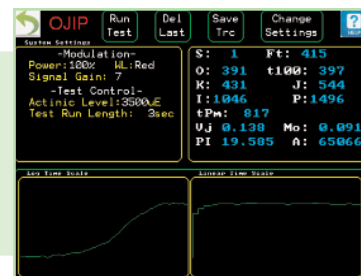
More than any other portable fluorometer

F_v/F_M : Photochemical efficiency or Maximum quantum Yield. Popular, robust and simple dark adapted test. F_v/F_M ratio reduces under stress. Can take less than two seconds to perform. Pre-illumination with far red light is also possible.



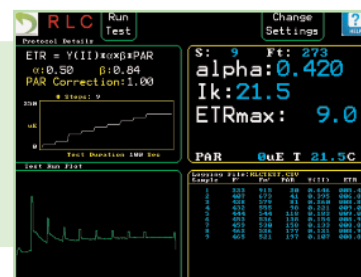
Quantum Photosynthetic Yield Y(II): Also referred to as light adapted quantum yield of PSII. The most widely used light adapted test, sensitive for most types of plant stress. Y(II) reduces under stress. The OS5p+ features multflash F_M' correction ensuring accurate measurements even for leaves with 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, $t_{100\mu s}$, $t_{300\mu s}$, M_o , PI_{ABS} , A, and t_{F_M} are all displayed. Test results are easily compared by overlaying multiple graphs on the colour display.



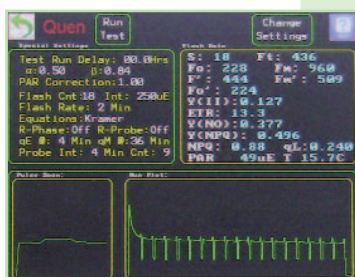
OJIP Vredenberg protocol: For the sophisticated investigation of NPQ using user defined scripts during the fluorescence rise.

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.

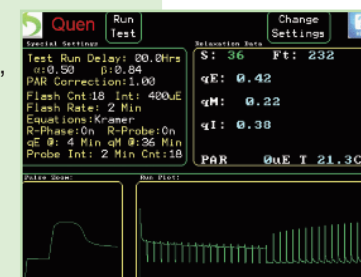


Quenching protocols:

Includes the widest range of quenching protocols available, which may be performed using multflash 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.



Selected references

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Online resources

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For over 45 years ADC's name has been synonymous with plant physiology research, with an outstanding reputation for the manufacture and supply of truly field portable instrumentation.

The OS range of portable chlorophyll fluorometers are proven to be reliable and innovative research tools.

The introduction of the OS5p+ maintains our "leaders in portability and ease of use" status.

ADC is committed to quality: "Quality of product and quality of service".

From design to delivery, ensuring optimal performance and reliability is of paramount importance to our team of experienced engineers. Once in the field you are supported by our network of over 30 customer support centres worldwide.

Plant Stress Guide

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.

*Loriaux S.D, Avenson T.J, Welles J.M, McDermitt D.K., Eckles R.D., Riensche B. Genty B (2013). Closing in on maximum yield of chlorophyll fluorescence using a single multiphase flash of sub-saturating intensity. Plant Cell and Environment 36: 1755-1770



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Parameters include:

Y(II): Quantum photosynthetic yield (light adapted quantum yield of PSII)
F_o: Minimum fluorescence
F_m: Maximal fluorescence
F_v: Variable fluorescence
F_v/F_m: Photochemical efficiency
F_v/F_o: More sensitive detector of plant stress than F_v/F_m
F_{ms} (F_m'): Maximal fluorescence under steady state conditions (F_m')
F_s: Fluorescence signal prior to saturation pulse (F'_s)
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
F_t: Current fluorescence readout
ETR: Electron transport rate (with PAR clip)
rETR_{MAX}: 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, t_{100μs}, t_{300μs}, M₀, P_{IABS}, A, t_{F_M}

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