



FMS 2

Field Portable Pulse Modulated Chlorophyll Fluorescence Monitoring System

- ✓ Integral amber (594nm) modulating LED (optional 470nm blue LED), 735nm far-red LED & dual purpose tungsten-halogen light source
- ✓ Field swappable battery system
- ✓ Programmable by Hansatech Scripting Language (HSL)
- ✓ FMS/PTL leaf-clip with integral PAR/temperature sensor
- ✓ Temperature compensated electronics
- ✓ Fibre-optic cable suitable for incorporation into O₂ electrode chambers & legacy IRGA systems
- ✓ Windows® data acquisition & data analysis software



Hansatech Instruments is a small, British, scientific instrument company located in the heart of rural Norfolk. For over 40 years, our efforts have been concentrated towards the design & manufacture of high quality instrumentation for teaching and research in the fields of cellular respiration and photosynthesis. Our instruments are now in use in a wide range of programs in more than 100 countries throughout the world and have gained an enviable reputation for quality, reliability and excellent price/performance.

Overview

The FMS 2 field portable modulated chlorophyll fluorimeter consists of a control unit housing all of the electronics, optics and light sources necessary to derive most common chlorophyll fluorescence parameters. These are optically linked to the sample by a statistically randomised fibre optic cable that is positioned at an adjustable distance from the leaf when inserted into the supplied FMS/PTL PAR/temperature leafclip. The fibre optic cable is also suitable for insertion into a range of sample containers such as oxygen electrodes, gas analysis chambers, petri dishes and microtitre plates.

The system may be operated in 2 different modes. Connection via RS232 serial communications to a Windows® PC enables real-time instrument control and data presentation. Captured data is simultaneously presented as a real-time chart recorder emulation and parameters-only format for easy identification of key experimental events. This PC mode of operation is suitable for development of complex protocols which may be programmed into the instrument using the simple drag and drop editor to generate user-defined scripts. These scripts automate the execution of experiments, allowing complex protocols involving many control events to be operated with the same ease as single control event measurement such as Fv/Fm.

Once programmed, the FMS 2 chlorophyll fluorimeter can be operated as a stand-alone system in either laboratory or field situations, running from internal field-swappable batteries; 5 of which are supplied along with a multi-charger which will give a full day's measurement in the field. A 12V power supply is also available to facilitate laboratory-based measurements. The unit can store up to six experimental protocols, any one of which may be accessed and executed using the built-in menu system. When data collection is complete the results can be downloaded to the Windows® software for full analysis.

All of the light sources required for modulated measurement of common chlorophyll fluorescence parameters are self-contained within the instrument.

- 594 nm amber modulating beam with 4 step frequency control (Optional 470 nm blue LED)
- Dual-purpose halogen light source providing actinic light (0 – 3000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ in 50 steps) and saturating pulse (0 – 20,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ in 100 steps)
- 735 nm far-red LED source for preferential PSI excitation allowing accurate determination of the F_0' parameter

The PAR/temperature leafclip (FMS/PTL) allows measurements to be made under ambient light conditions. Fluorescence measurements can be made without the leafclip but a value of PAR from the light sensor on the leafclip is essential for the estimation of electron transport rate. Other chlorophyll fluorescence parameters are unaffected if the system is operated without the leafclip. The FMS/PTL leafclip consists of a sprung upper section which gently grips the sample in a gentle clamping action. A grooved neck mounted at 60° to the plane of the sample accommodates the fibre optic cable which is slid into position. A fully cosine corrected PAR sensor and 0 – 90°C thermocouple are also fitted to the FMS/PTL. The PAR sensor has been designed for both recording of ambient light intensities during fluorescence analysis and measurement of FMS actinic and saturating light sources during instrument setup.

PC control from Modfluor32 Windows® software allows real-time trace plotting as a chart-recorder emulation with calculated parameters written to a text parameters window. Instrument features and parameter measurement routines are selected from a toolbar with drop down menus to control file handling and instrument configuration. Complex experimental protocols may be automated to reduce repetitive work by developing Scripts using an iconised Script Editor. Once created scripts may be executed directly from the Modfluor32 program and data viewed while the instrument automatically completes a user-defined experiment. A maximum of six scripts can be downloaded to the instrument's internal memory for operation without a computer.

A further application is also included with the FMS chlorophyll fluorimeter. Parview32 is a stand-alone utility designed to allow easy upload and transfer of multiple parameter files to a spreadsheet type program.

Technical Specifications

Dimensions:	180mm (L) x 100mm (D) x 100mm (H). Weight: 2.0 kg including battery
Light Sources:	Modulation beam: Temperature compensated 594nm amber LED with 4 step frequency control (Optional 470nm blue LED) Halogen source: Actinic up to 3000 $\mu\text{mol m}^{-2} \text{s}^{-1}$, saturating up to 20,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$. Far red: 735nm LED
Detector:	PIN photodiode with >700 nm filter
Detection Method:	Rapid peak pulse tracking
Sampling Rate:	Variable 10 Hz to 20 kHz depending upon instrument mode
Electronics:	16 bit 165 microprocessor, 8 A/D channels 12 bit resolution, 4 external digital I/O lines, Single 12 bit buffered DAC (0 to 4095 mV)
Storage Capacity:	256 Kb backed up RAM storing up to 2,430 full trace or 12,850 parameter only Fv/Fm data sets
User Interface:	20 x 4 LCD display, 4 button keypad
Display:	8 line x 20 character LCD display
Power Supply:	5 x field replaceable 2.0 Ahr lead acid battery, 95 to 260 V universal input mains supply.
Leafclips:	PAR/temperature clip with cosine corrected PAR sensor (0 to 20,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$) and thermocouple (-10 to 90 °C). Remote trigger button and tripod mount. 10 x dark adaptation clips with fibre-optic adapter.