



## FluorPen FP 110 & PAR-FluorPen FP 110-MAX-LM

**FluorPen FP 110** is a portable, battery-powered fluorometer that enables quick and precise measurement of chlorophyll fluorescence parameters in the laboratory, greenhouse, or in the field. It can be effectively used for studying photosynthetic activity, stress detection, herbicide testing, or mutant screening. Affordable price and straight-forward two-button operation makes the FluorPen a perfect tool for teaching photosynthesis.

**PAR-FluorPen FP 110-MAX-LM** is extended version of FluorPen FP 110, which incorporates an integrated Light Meter for direct digital readouts of Photosynthetically Active Radiation (PAR) in the range from 400 to 700 nm, the span in which plants use energy during photosynthesis. PAR is measured as Photosynthetic Photon Flux Density (PPFD), which is indicated by units of quanta (photons) per unit time per unit surface area. The sensor has a uniform response to photons within the 400–700 nm waveband. Instant readouts are provided as average values of 20 measurements.

Measured data are sequentially stored in the internal FluorPen memory.

Data transfer to a PC is via USB and Bluetooth communication. Comprehensive FluorPen 1.1 software provides data transfer routines and many additional features for data presentation in tables and graphs.

Different leaf clips for gentle but firm sample holding are available: standard leaf clip suitable for experiments where short term dark adaptation is needed, open-window leaf clip suitable for measurements in ambient light and detachable leaf clips suitable for experiments where long term dark adaptation is needed.

### APPLICATIONS

- Photosynthesis research and education
- Plant & molecular biology
- Plant screening & field studies
- Stress physiology
- Agriculture & forestry
- Biotechnology

Time	6:26:32 21 2007	6:26:0 21 2007	6:26:32 21 2007	6:27:25 21 2007	6:48:19 21 2007
ID	QY	OJIP	FI	QY'	OJIP
	0.64		355	0.71	
Fo	618			646	
Fj	1422			1491	
Fi	2149			2436	
Fm	2423			2639	
Fv	1905			1933	
Vj	0.445			0.424	
Vi	0.048			0.099	
Fm/Fo	3.921			4.085	
Fv/Fo	2.921			3.085	
Fv/Fm	0.745			0.755	
Mo	0.911			0.921	
Area	4766890			5229888	
Sm	2652.017			2624.129	
Sa	0.489			0.510	
Ni	5422.780			5142.671	
Phi_Po	0.745			0.755	
Phi_E	0.959			0.976	
Phi_Eo	0.413			0.436	
Phi_Do	0.255			0.245	
Phi_Pav	2657.311			2903.289	
ABS/RIC	2.745			2.995	
TRo/RIC	2.045			1.900	
ETo/RIC	1.134			1.129	
Dio/RIC	0.700			0.635	
Description		Arabidopsis A		Arabidopsis B	

# 01 / Pocket-Sized Devices

## FLUORPENS MEASURE

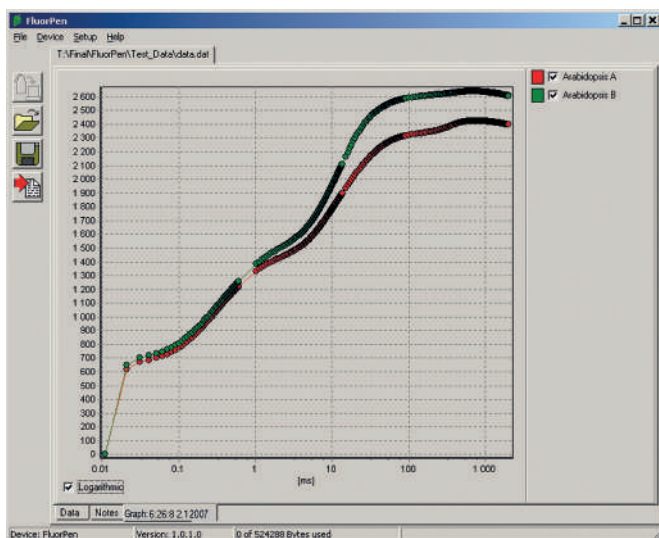
- $F_T$  – continuous fluorescence yield in non-actinic light.  $F_T$  is equivalent to  $F_0$  if the leaf sample is dark-adapted.
- QY – Photosystem II Quantum Yield. QY is equivalent to  $F_v/F_m$  in the dark-adapted samples and to  $F'_v/F'_m$  in the light-adapted samples.
- OJIP – Chlorophyll Fluorescence Induction Kinetics
- NPQ – Non-Photochemical Quenching
- Light Curve (LC) – Photosystem II Quantum Yield estimated from fluorescence that is measured sequentially in several different light levels
- PAR – Photosynthetically Active Radiation measured as Photosynthetic Photon Flux Density (PPFD) (only in PAR-FluorPen FP 110-MAX-LM)

## SOFTWARE

- FluorPen 1.1 software (Windows 7, or higher compatible)
- Real-time and remote control functions
- Bluetooth, USB or serial communication (optional)
- Visualization and data transfer routines to Microsoft Excel (optional)
- GPS mapping

## KEY FEATURES

- Rapid and accurate measurement of photosynthetic parameters
- Photosynthetically Active Radiation measurements
- Leaf clip for dark adaptation
- Fast chlorophyll fluorescence induction kinetics measurements
- Both lab and field applications
- Rugged and compact device
- Easy-to-use two-button operation
- Comprehensive software for data processing
- USB and Bluetooth communication for data transfer
- Li-ion rechargeable battery via USB port of a PC



## TECHNICAL SPECIFICATION

- **Measured/Calculated Parameters:**  $F_0$ ,  $F_T$ ,  $F_M$ ,  $F'_M$ , QY, OJIP, NPQ 1,2, and Light Curve 1,2,3, PAR (measured as PPFD)
- **Cosine Correction:** Cosine corrected up to 80° angle of incidence
- **PAR sensor linearity:** Maximum deviation of 1 % up to per 3,000  $\mu\text{mol.m}^{-2}.\text{s}^{-1}$
- **Saturating Pulse Illumination:** Adjustable from 0 to 100 % (up to 3,000  $\mu\text{mol.m}^{-2}.\text{s}^{-1}$ )
- **Actinic Illumination:** Adjustable from 0 to 100 % (up to 1,000  $\mu\text{mol.m}^{-2}.\text{s}^{-1}$ )
- **Measuring Illumination:** Adjustable from 0 to 100 % (up to 0.09  $\mu\text{mol.m}^{-2}$  per pulse)
- **Detector Wavelength Range:** PIN photodiode with 667 to 750 nm bandpass filters
- **FluorPen 1.1 Software:** Windows 7, or higher
- **Memory Capacity:** 16 Mbit
- **Internal Data Logging:** Up to 149,000 data points
- **Display:** Graphical display
- **Keypad:** Sealed, 2-key tactile response
- **Keypad Escape Time:** Turns off after 8 minutes of no use
- **Power Supply:** Li-ion rechargeable battery
- **Battery Life:** 48 hours typical with full operation
- **Low Battery Detection:** Low battery indication displayed
- **Size:** 134 × 65 × 33 mm
- **Weight:** 188 g
- **Sample Holder:** Mechanical leaf clip closed or open or detachable
- **Operating Conditions:**
  - Temperature: 0 to +55 °C
  - Relative humidity: 0 to 95 % (non-condensing)
- **Storage Conditions:**
  - Temperature: -10 to +60 °C
  - Relative humidity: 0 to 95 % (non-condensing)

