

Leaf Chamber Fluorometer

6400-40, for use with the LI-6400
Portable Photosynthesis System



LI-COR[®]

Biosciences

Simultaneous Fluorescence and Gas Exchange Measurements Over the Same Leaf Area

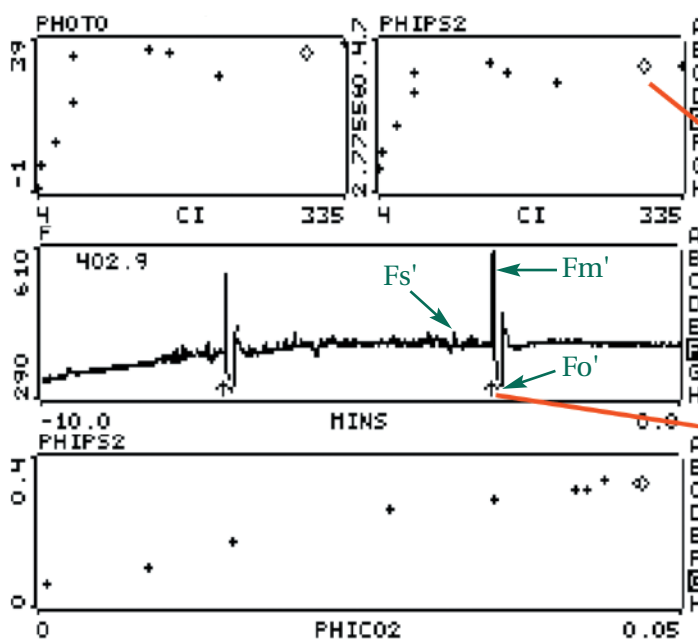
INTRODUCTION

Why add fluorescence to gas exchange measurements?

Chlorophyll Fluorescence provides a more complete picture of leaf photosynthesis by measuring the allocation of absorbed energy to photosynthesis and heat. It also enables researchers to study photosynthetic processes at the pigment and membrane level to better understand the light-dependent and light independent reactions.

The LI-COR 6400-40 Leaf Chamber Fluorometer (LCF) acts as both a leaf cuvette and as a light source/pulse-amplitude modulated (PAM) fluorometer for simultaneous measurement of gas exchange and fluorescence. The LI-6400 Portable Photosynthesis System and LCF combine to provide the most integrated and powerful portable fluorescence and gas exchange system available.

- Simultaneous measurement of gas exchange and fluorescence over the same leaf area
- Complete control of the leaf environment for collection of gas exchange and fluorescence data from a single, portable unit



Current value of Real Time Graph

Indicates time when data was logged.

Real-time, integrated gas exchange and fluorescence data plots of a maize CO_2 response curve. The LI-6400 LCD can display as many as three graphs on each of eight displays. Graph set E above shows the combined A-Ci and fluorescence curves, while F displays the fluorescence trace from the past 10 minutes, and G shows the relationship between the apparent quantum yield calculated from fluorescence (Φ_{PS_2}) and gas exchange (Φ_{CO_2}).

- Independent control of red and blue LED's to customize light quality for driving photosynthesis
- Calibration information for the Leaf Chamber Fluorometer is stored onboard, making it easy to move between different LI-6400 consoles
- Field-installable, the fluorometer easily and quickly attaches to the LI-6400 sensor head
- Flexible, user-friendly software

TECHNOLOGICALLY ADVANCED

The Leaf Chamber Fluorometer is a pulse-amplitude modulated (PAM) fluorometer that can be used to take measurements on both dark- and light-adapted samples. Measured parameters include F_0 , F_m , F_s , F_m' , and F_0' , and calculated parameters include F_v , F_v/F_m , Φ_{PSII} , qP , qN , NPQ , ETR and Φ_{CO_2} , and others.

The unique design of the 6400-40 Leaf Chamber Fluorometer

The LI-6400F Fluorescence and Gas Exchange System



eliminates the need for fragile, awkward fiber optic light guides. Measuring, actinic, saturating, and far-red light are provided by light emitting diodes (LEDs) mounted above the leaf surface. Lightweight design and low power consumption make it possible for one person to gather data quickly and easily.

SOFTWARE AND DATA OUTPUT

Complete control of gas exchange and fluorescence is provided in a single unit using LI-COR's OPEN™ software for the LI-6400. There is no need to carry a computer in the field – real-time numeric and graphic data are displayed on the LI-6400 console. Graphical displays of integrated fluorescence and gas exchange data give researchers powerful tools to fine-tune experimental protocols and collect quality data. The flexible OPEN software facilitates the computation of factory and user-defined parameters. Data files can be viewed

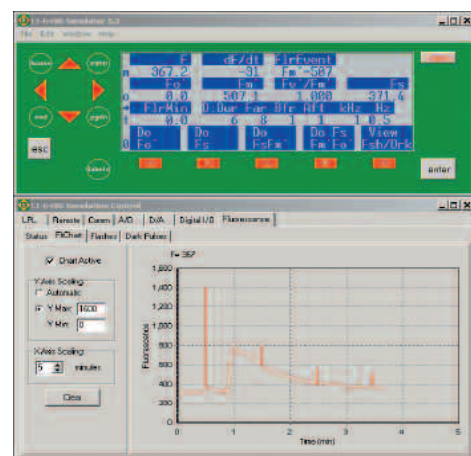
and manipulated onboard, or quickly downloaded in spreadsheet-ready format to Windows-compatible or Macintosh computers. Raw fluorescence analog output is available to view data on a datalogger or chart recorder.

Default automatic protocols are included with the LI-6400 OPEN software. Researchers can quickly and easily modify these protocols or create their own using OPEN's AutoProgram Builder.

Computer control of the LI-6400 and LCF is also possible using Windows or Macintosh software that is included with the LI-6400. This software allows the user to control the LI-6400 and simultaneously relay real time numeric and graphic data to a computer monitor or projector, providing a unique training tool for teaching applications.

OPEN Software, version 5.3 and above, also allows remote control capability via the Internet.

This advanced tool enables the LI-6400 to be viewed and controlled from a computer while the LI-6400 continues to operate. This feature allows technical support staff to remotely diagnose issues and extends user control around the world via the Internet.



Using WinLPL (or MacLPL), you can perform all LI-6400 functions from your computer, as well as view real-time plots of your data.

Obs	HHMMSS	FTime	Photo	Cond	Ci	Fo'	Fm'	Fs	Fv/Fm'	PhiPS2	Adark	LeafAbs	PhiCO2	qP	qN
1	15:02:05	263	5.44	0.0335	89.8	299.6	588.6	378.9	0.491	0.356	-1	0.846	0.008	0.725	1.96
2	15:04:43	420	31.8	0.258	49.3	289.8	524.2	357.8	0.447	0.318	-1	0.846	0.039	0.71	1.80
3	15:07:14	571	25.7	0.313	29.7	279.3	458.8	330.5	0.391	0.28	-1	0.846	0.032	0.715	1.64
4	15:09:43	720	11.1	0.266	12.7	285.5	406.3	330.5	0.297	0.187	-1	0.846	0.014	0.628	1.42
5	15:13:44	961	6.52	0.315	4.87	291.4	368.2	332.1	0.209	0.098	-1	0.846	0.009	0.469	1.26
6	15:16:48	1146	-0.511	0.296	5.08	298.2	360.7	339.9	0.173	0.058	-1	0.846	0.001	0.333	1.2
7	15:20:47	1385	32.2	0.281	145	293.8	554	390.5	0.47	0.295	-1	0.846	0.039	0.628	1.88
8	15:24:59	1637	42.2	0.329	111	305.7	606.4	405.3	0.496	0.332	-1	0.846	0.051	0.669	1.96

An example of an integrated gas exchange and fluorescence data file, in spreadsheet-ready format.

Specifications

Measuring (Modulated) Light:

Red LEDs, 630 nm, modulation frequencies of 0.25, 1, 10 and 20 kHz

Actinic Light:

Blue and Red LEDs, 470 and 630 nm, respectively. Independent control of blue and red intensity, 0 to 100 $\mu\text{mol m}^{-2} \text{s}^{-1}$ PAR for the blue LEDs, 0 to 3000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ PAR for the red LEDs

Saturation Light:

Blue and Red LEDs, 470 and 630 nm, respectively, intensities, 0 to 7000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ PAR

Far-Red Light:

Far-Red LED, 740 nm

Fluorescence Signal Temperature Dependence:

< 1% drift with 10 °C change in temperature

User Interface:

LI-6400 console or remote Windows® and Macintosh® interface

F Data Output (Analog):

±5V analog output for external data acquisition

Power Consumption:

< 6W during saturation pulse

Leaf Area:

2.0 cm²

Operating Temperature Range:

0 - 50 °C

Dimensions:

6H × 6W × 8D cm

Weight:

0.4 kg

* Specifications may change without prior notice.

Ordering Information

Current LI-6400 Users:

Order the 6400-40 Leaf Chamber Fluorometer. Includes spare parts kit, CD with the latest version of OPEN software, and instruction manual.

LI-6400 systems with 1.5 MB memory require an upgrade. The 6400-40DB package includes the 6400-40 Leaf Chamber Fluorometer and the 6400-915 Digital Board upgrade kit at a special price. Contact LI-COR for more details.

New LI-6400 Customers:

Order the LI-6400F or LI-6400R Portable Fluorescence and Gas Exchange System. Special pricing package for the LI-6400F includes the LI-6400 Portable Photosynthesis System, 6400-40 Leaf Chamber Fluorometer, 6400-01 CO₂ Injector System, 9901-013 External Quantum Sensor, and OPEN software. Special pricing package for the LI-6400R includes all items for the LI-6400F, and the 6400-02B Red/Blue LED Light Source.

Other LI-6400 packages are also available. Please contact LI-COR.

Dark Adapting Clips PN 9964-091

An accessory for the 6400-40 Leaf Chamber Fluorometer that allows the user to dark-adapt leaf samples. Each Dark Adapting Clip consists of two "shutters", and a clip that secures the shutters over the leaf. To use, the Dark Adapting Clip (with the shutters in the closed position) is attached to the leaf; after the leaf is fully dark-adapted, the Clip is placed in the Leaf Chamber Fluorometer, the shutters are opened, and the measurement is taken. The kit includes 10 clips and 10 sets of shutters.



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