# Algae Online Monitor AOM 2700
# Algae Online Monitor AOM 2800

## Operation Manual



AOM 2700

AOM 2800

**Please read this guide before operating the AOM device**

# Table of Contents

# 1. List of Equipment

Carefully unpack the carton. You should have received the following items:

- **Algae Online Monitor 2700 or Algae Online Monitor 2800**
- **Flow-Through Cuvette**
- **Anti-Vibration Pad**
- **Mounting Clips**
- **Cables and Connectors**
- **This Operation Manual** *(on a CD or a printed version)*
- **Install CD with the FluorPen software**
- **Optional Accessories (Hoses, Supplementary Cuvette, Pump, Control Valve** *(according to your specific order)*

Note:

If any item is missing, please, contact the manufacturer. Also check the carton for any visible external damage. If you find any damage, notify the carrier and the manufacturer immediately. The carton and all packing materials should be retained for inspection by the carrier or insurer.

For customer support, please write to: **support@psi.cz**

# 2. General Information

Algae Online Monitor (AOM) is a portable, robust device for online detection and continuous monitoring of photosynthetic microorganisms in both natural and artificial water bodies. It can serve for detection and discrimination among variety of cyanobacteria, green and brown algae, diatoms, and other microbes. Its ultra-high sensitivity (30 ng Chl/l) allows early detection of very low concentrations of these organisms.

According to customer's needs, the AOM is equipped with two measuring lights:

- Either with blue (455 nm) and red (630 nm) light.
- Or with blue (455 nm) and amber (590 nm) light.

**The AOM device measures the following chlorophyll fluorescence parameters:**

**$F_T$ - Instantaneous Fluorescence**

$F_T$ is equivalent to $F_0$ if the sample is dark-adapted. $F_T$ is equivalent to $F_S$ in a light-adapted sample.

**QY - Quantum Yield**

QY is a measure of the Photosystem II efficiency. In a dark-adapted sample this is equivalent to Fv/Fm. In a light-adapted sample it is equivalent to Fv'/Fm'.

**OJIP - Chlorophyll Fluorescence Induction Kinetics**

OJIP transients enable observing major changes that occur during exposure of a sample to high irradiance. This biophysical signal is extremely rich in terms of information and reflects the time course of photosynthesis. In AOM device, OJIP is represented by the Fix Area Parameter.
Fix Area = Total area above the OJIP fluorescence transient. This parameter correlates with total change of fluorescence signal in OJIP protocol, with total pigment content and hence with cell concentration.

# 3. Technical Specification

**Measured and Calculated Parameters:**
$F_T$, QY, OJIP (Fix Area)

**Detection Limit:**
Algae – 10 cells/ml; cyanobacteria – 100 cells/ml

**Detector Wavelength Range:**
PIN photodiode with 667 to 750 nm bandpass filters

**Actinic and Saturating Light:**
Adjustable from 0 to 3,000 µmol(photons)/m².s

**Measuring Light:**
Blue (455 nm) and red (630 nm) measuring light adjustable by intensity
Blue (455 nm) and amber (590 nm) measuring light adjustable by intensity

**Communication:**
Serial RS 232, RS 485

**FluorPen Software:**
Windows 2000, XP, or higher*

**Bios:**
Upgradeable firmware

**Memory Capacity:**
4 Mb – up to 100,000 data points (about 300 OJIP curves)

**Display:**
AOM 2800: 2 x 16 characters LC display
AOM 2700: without display

**Keypad:**
AOM 2800: 2-key tactile response
AOM 2700: remote control

**Power Saving Mode:**
Automatic

**Power Supply:**
Power source 24 V (optionally 12 V)

**Size:**
20 cm x 23 cm x 11 cm

**Weight:**
3.4 kg

**Sample Holder:**
Flow-through cuvette made of quartz glass

*\* Windows is a registered trademark of Microsoft Corporation.*

**Case:**

**Waterproof IP65**

**Operating Conditions:**

**Temperature: 0 to 45 ºC; Relative humidity: 0 to 95 % (non-condensing)**

**Warranty:**

**1 year parts and labor (see the last page of this Operation Manual for precise warranty conditions)**

# 4. Maintenance and General Safety Guidelines

- **Connect all peripheral units when the device is switched off!**

- **First connect all peripheral units (pumps, control valves), then switch on the device.**

- **Never submerge the whole device in water!**

- Keep the optical part clean and dry. If cleaning is needed, use the soapy water and soft, non-abrasive tissue.

- The device should not come in contact with any organic solvents, strong acids or bases.

**GENERAL ELECTRICAL SAFETY GUIDELINES:**

- Routinely check the devices and their wiring.

- Replace worn or damaged cords immediately.

- Use electrical extension cords wisely and do not overload them.

- Place the devices on a flat and firm surface. Keep them away from wet floors and counters.

- Avoid touching the device, socket outlet or switch if your hands are wet.

- Do not perform any alterations to the electrical part of the devices or its components.

# 5. Physical Features

## Algae Online Monitor AOM 2700
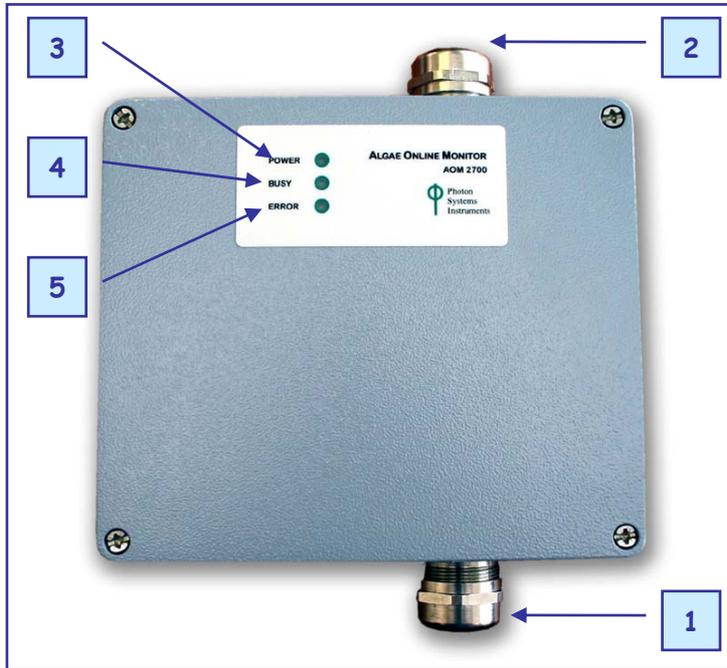


[1] Inlet
[2] Outlet

Three LED Indicators:

[3] On / Off
[4] Device operation
[5] Error

## Algae Online Monitor AOM 2800
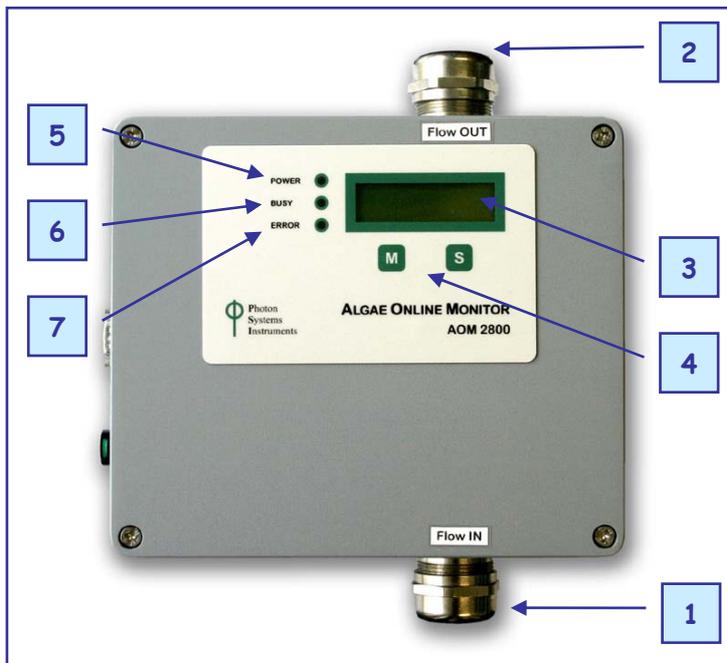


[1] Inlet
[2] Outlet
[3] Display
[4] Control keys

Three LED Indicators:

[5] On / Off
[6] Device operation
[7] Error

# 6. Cable Connections

**Algae Online Monitor AOM 2700**
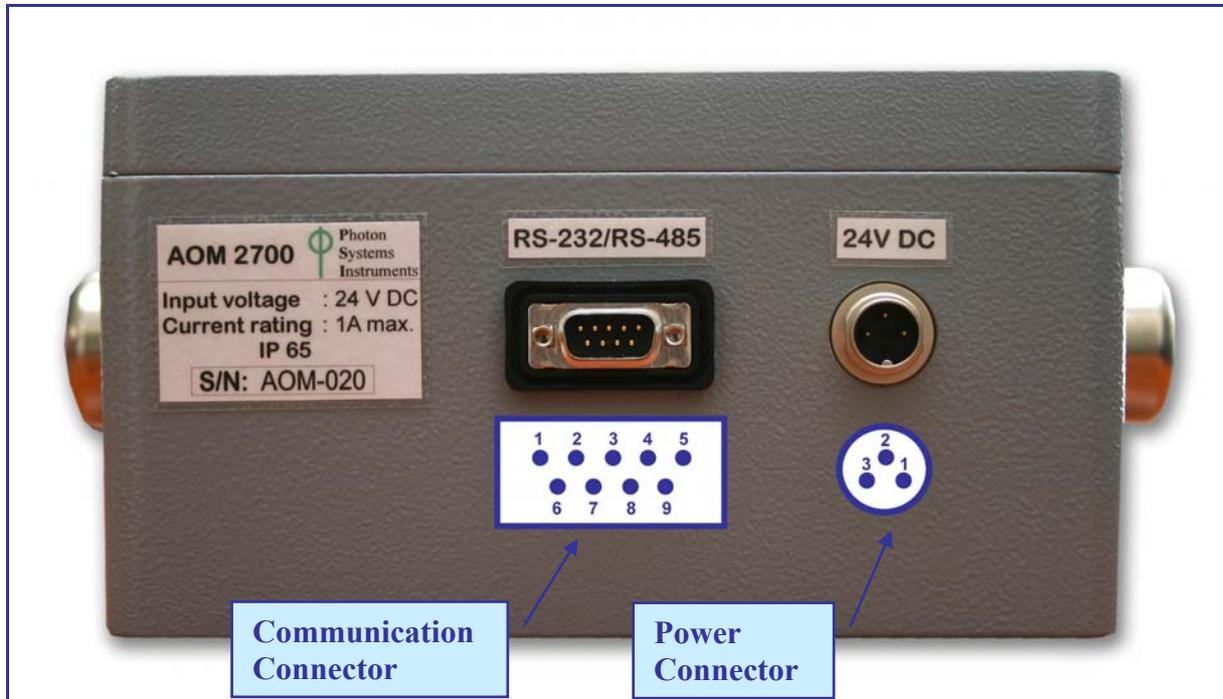


**Communication Connector:**

Serial RS-232: [2] - RXD          Serial RS-485:  [6] - Y
                      [3] - TXD                      [7] - Z
                      [5] - GND                      [8] - A
                                           [9] - B

**Power Connector:**
[1] -   +24 V, +12 V
[2] -   GND

## Algae Online Monitor AOM 2800
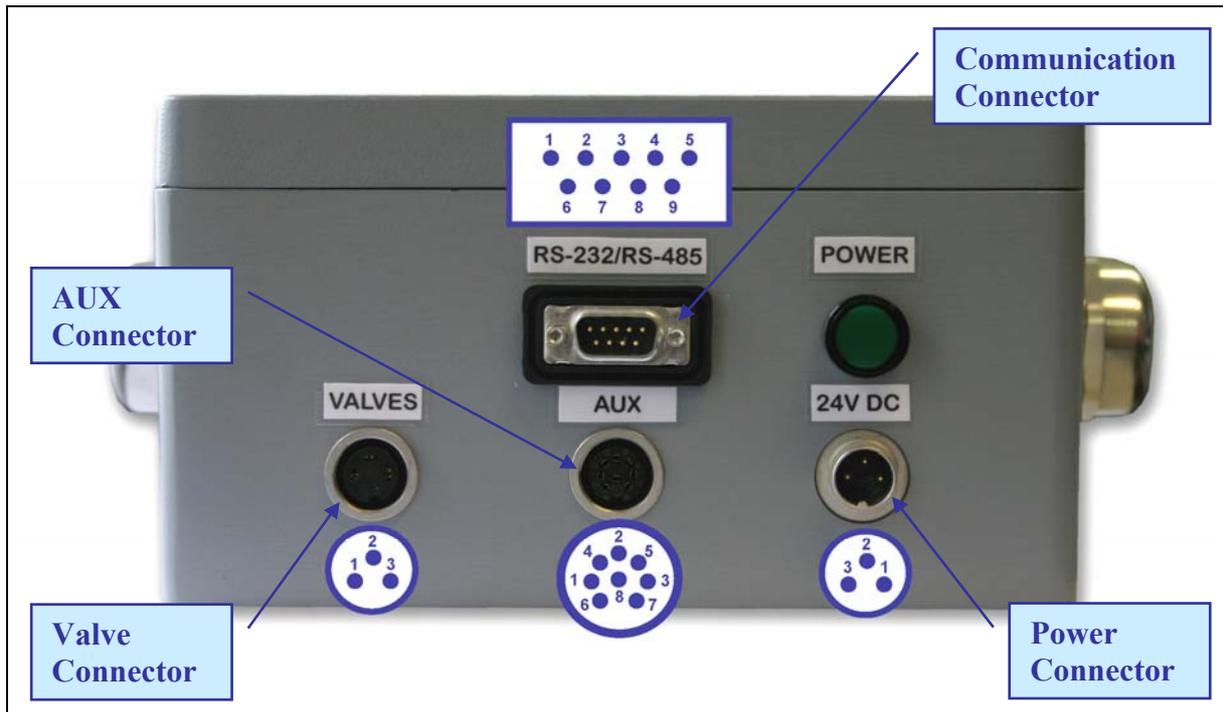


**Communication Connector:**

Serial RS-232: [2] - RXD          Serial RS-485: [6] - Y
              [3] - TXD                        [7] - Z
              [5] - GND                        [8] - A
                                               [9] - B

**Power Connector:**
[1] -  +24 V, +12 V
[2] -  GND

**Valve Connector:**
[1] -  +24 V, 12 V, Common Valve
[2] -  Main Valve/Pump
[3] -  Cleaning Valve/Pump

**AUX Connector:**
[1] - Current Loop
[2] - GND
[3], [4], [5], [6] -   Digital Out
[7] -  Alarm
[8] -  +24V, +12 V

# 7. Device Installation

1. Installation of the measuring instrument on a wall (or other base)
   A) fix four elastic elements(1) on the wall
   B) use four stainless steel nuts(2) and fix the device

2

1
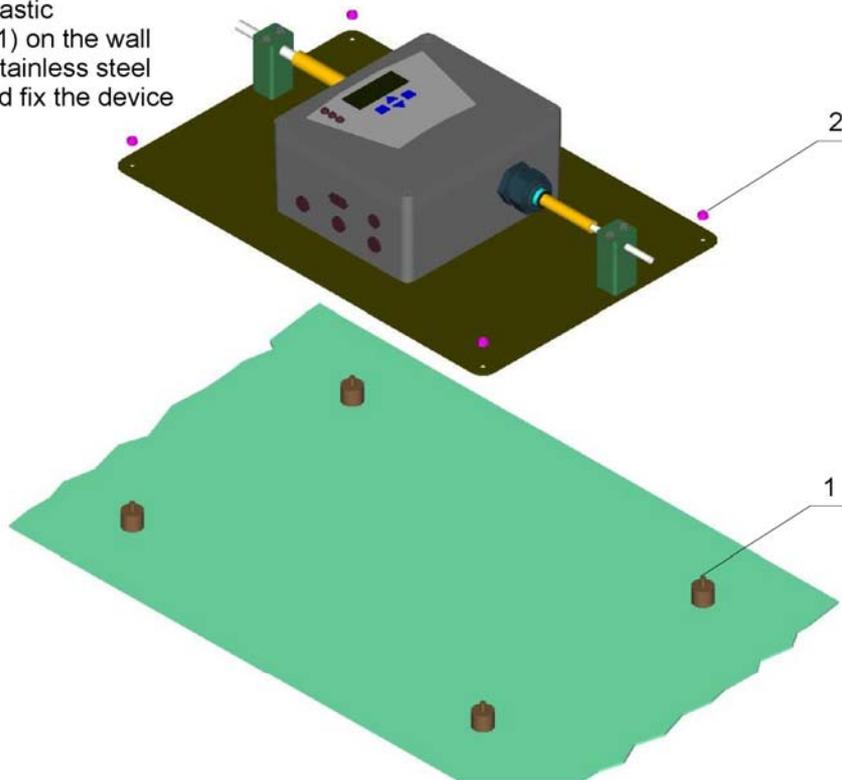
2. Optimal configuration of the measuring instrument
   (3) input tube
   (4) output tube

4

3
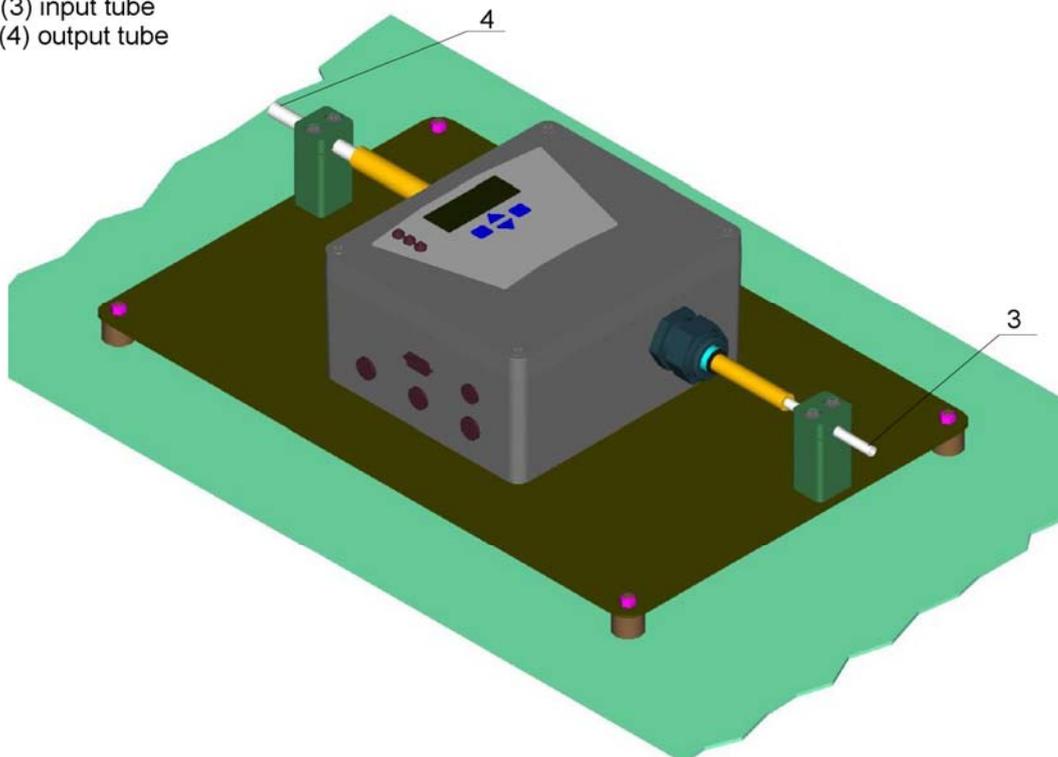
# 3. Installation of the input and output tubes
   (3) input tube
   (4) output tube

4

3
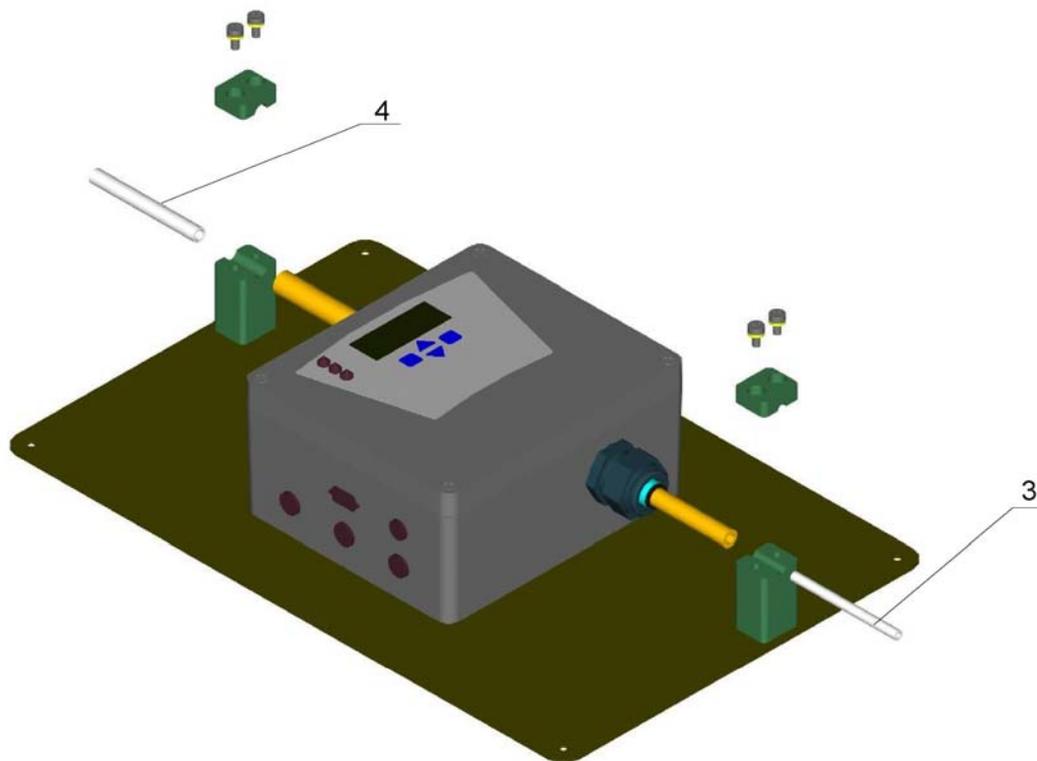
# 4. Replacement of the flow-through cuvette (5)

5
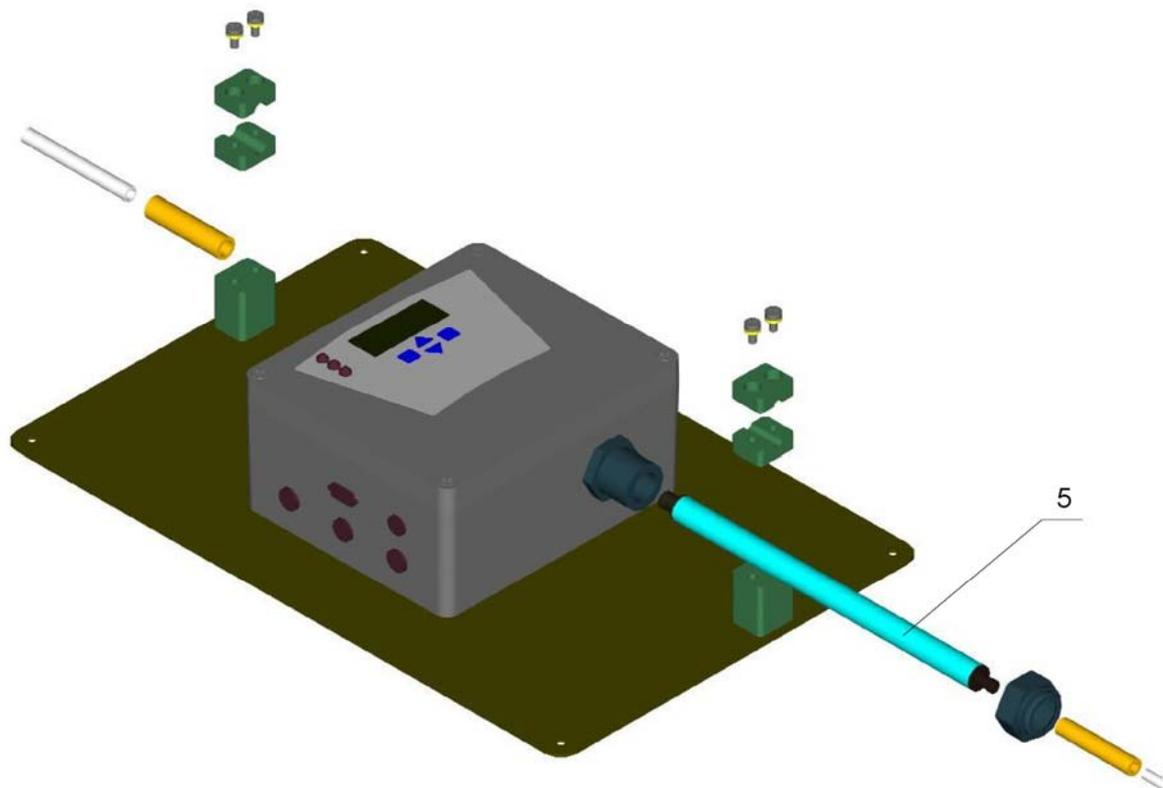
# 8. Operation Instructions

**Algae Online Monitor is operated by two keys:**

- **"S"** key allows the user to select a menu option (based on cursor > position), or to move forward to a "lower level" position.

- **"M"** key allows the user to scroll through single menu and sub-menu options, or to move back to a "higher level" position.

**The next six pages bring graphical presentation of the operation scheme, which is structured into three levels:**

- **Main Menu**
- **First-level Sub-Menus** (Measure, Cleaning, Data Browse and Erase, Setting, Time Indication)
- **Second-level Sub-Menus** (see next pages)

**Explanation of symbols and color differentiation\* used in the graphical presentation:**

- The **blue** color represents the **Main Menu** and its Options.
- The **yellow** color represents the **first-level Sub-Menus** and their Options.
- The **green** color represents the **second-level Sub-Menus** and their Options.
- Full-line arrows are used for the "**S"** key.  ⎯⎯⎯⎯➤
- Dashed-line arrows are used for the "**M"** key.  ┄┄┄┄┄➤

*\* The AOM display does not reflect this color differentiation.*

# Main Menu

**>Measure** — S → Press (S) TO MEASURE:

See the complete Measure Sub-Menu on the next page

Ft
QY
OJIP
Control Mode
Return

**>Cleaning** — S → Press (S) FOR CUVETTE CLEANING

See the complete Cleaning Sub-Menu on the next pages

**>Data Browse and Erase** — S → Press (S) TO BROWSE OR TO ERASE MEASURED DATA

See the complete Data Sub-Menu on the next pages

Browse
Erase
Return

**>Setting** — S → Press (S) TO SET PARAMETERS FOR:

See the complete Setting Sub-Menu on the next pages

f_color
f_pulse
F_pulse
Repeat
Repeat Delay
Control Mode
Main Valve
Cleaning
Time
Return

Parameter
Period
Level 455 nm
Level 590 nm
Range
Regulation Type
Use Repeat Setting
Cleaning Interval
Return

Active State
Active Interval
Return

Active Interval
Cleaning Interval
Rinsing Interval
Return

**>Time Indication** — S → Press (S) TO DISPLAY OR TO SET TIME

# Measure Sub-Menu

>Measure —(S)→ >Ft

**>Ft**
Ft = Instantaneus Chlorophyll Fluorescence.

Press (S) to measure Ft. Ft measurements are repeated automatically.

Displayed is Ft value and the wavelength of used measuring light.

Press (M) to return.

**>QY**
QY = Quantum Yield (QY = Fv'/Fm' if the sample is light-adapted).

Press (S) repeatedly for every new QY measurement.

Displayed is QY value and the wavelength of used measuring light.

Press (M) to return.

**>OJIP**
OJIP = Chlorophyll Fluorescence Induction Kinetics.

Press (S) repeatedly for every new OJIP measurements.

Displayed is the value of Fix Area* (FA) in the following way:
OJIP=200e3 (where 200 = FA value; e3 = $10^3$).

Press (M) to return.

**>Control Mode**
Control Mode serves for repeated measurements with the control parameters preset by the user (set these parameters in the Setting Menu).

Press (S) to activate/disactivate this function.

Press (M) to return.

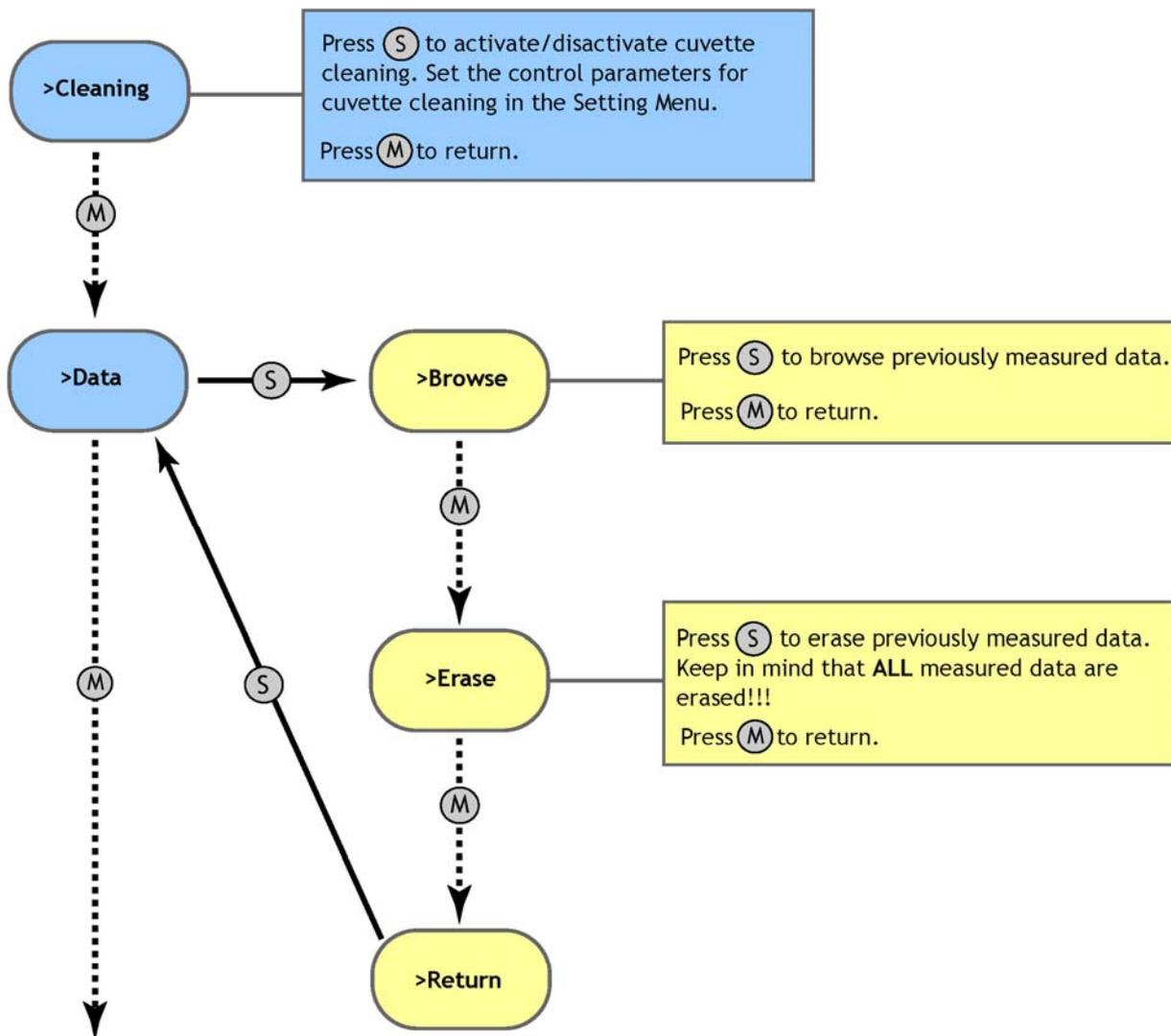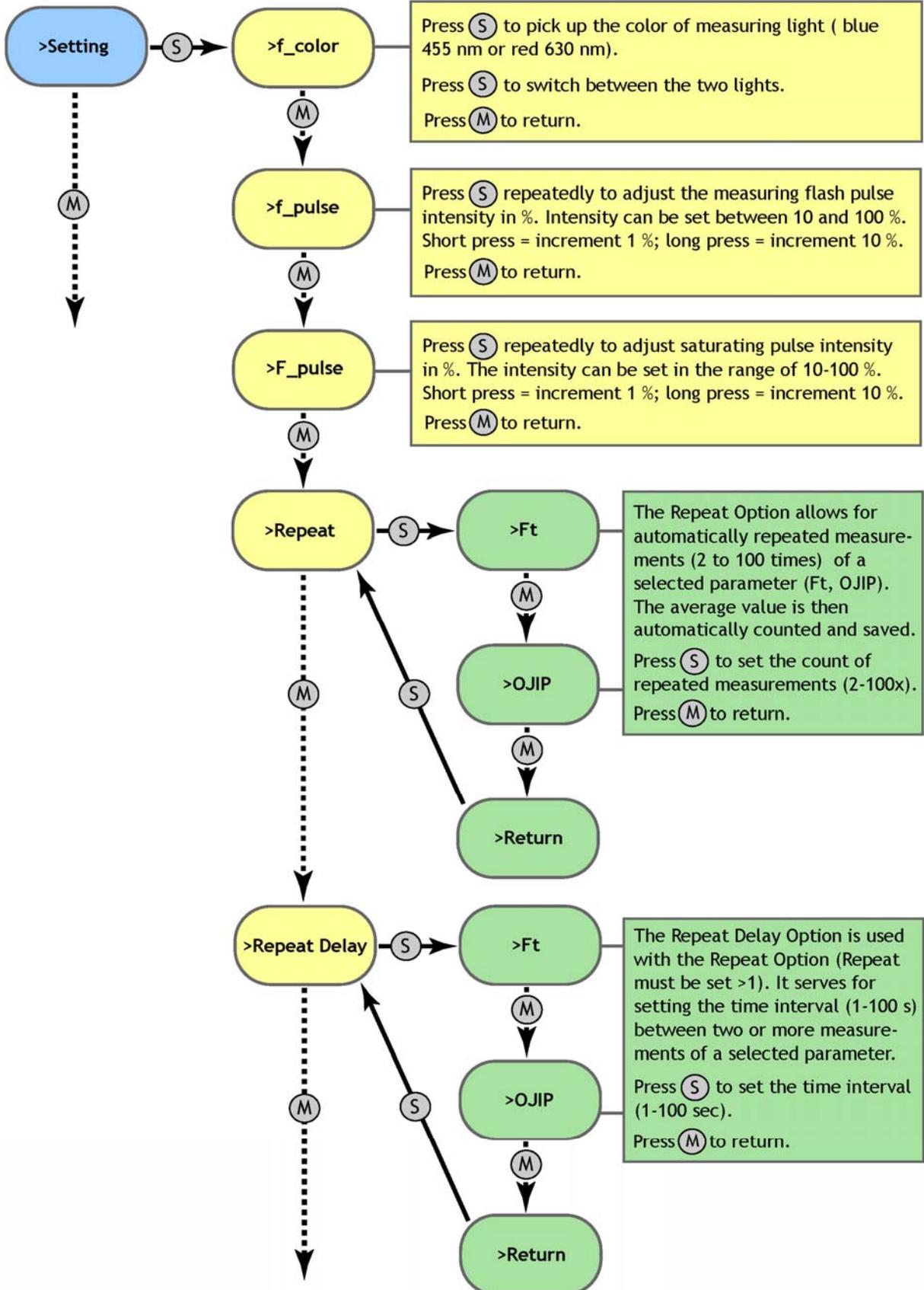**>Return**

*Fix Area = Total area above the OJIP fluorescence transient and total change of fluorescence signal in OJIP protocol. This parameter correlates with total pigment content and hence with cell concentration.*

# Cleaning and Data Sub-Menu

>Cleaning

Press (S) to activate/disactivate cuvette cleaning. Set the control parameters for cuvette cleaning in the Setting Menu.

Press (M) to return.

>Data

(S) →

>Browse

Press (S) to browse previously measured data.

Press (M) to return.

>Erase

Press (S) to erase previously measured data. Keep in mind that **ALL** measured data are erased!!!

Press (M) to return.

>Return

# Setting Sub-Menu (Part 1)

>Setting —(S)→ >f_color

Press (S) to pick up the color of measuring light ( blue 455 nm or red 630 nm).

Press (S) to switch between the two lights.

Press (M) to return.

>f_pulse

Press (S) repeatedly to adjust the measuring flash pulse intensity in %. Intensity can be set between 10 and 100 %. Short press = increment 1 %; long press = increment 10 %.

Press (M) to return.

>F_pulse

Press (S) repeatedly to adjust saturating pulse intensity in %. The intensity can be set in the range of 10-100 %. Short press = increment 1 %; long press = increment 10 %.

Press (M) to return.

>Repeat —(S)→ >Ft

>OJIP

>Return

The Repeat Option allows for automatically repeated measurements (2 to 100 times) of a selected parameter (Ft, OJIP). The average value is then automatically counted and saved.

Press (S) to set the count of repeated measurements (2-100x). Press (M) to return.

>Repeat Delay —(S)→ >Ft

>OJIP

>Return

The Repeat Delay Option is used with the Repeat Option (Repeat must be set >1). It serves for setting the time interval (1-100 s) between two or more measurements of a selected parameter.

Press (S) to set the time interval (1-100 sec).

Press (M) to return.

# Setting Sub-Menu (Part 2)

```
>Setting  —(S)→  >Control Mode  —(S)→  >Parameter
```

**>Parameter** — Choose the controlled parameter (Ft, QY, or OJIP) in this Option. Press (S) to scroll between Ft, QY, and OJIP. Press (M) to return.

(M)

**>Period** — Press (S) to set in minutes the interval between the single measurements (short press = increment 1; long press = increment 10). Press (M) to return.

(M)

**>Level 455 nm** — Press (S) to set Level* for measurings performed with the blue light (455 nm). Press (M) to return.

(M)

**>Level 630 nm** — Press (S) to set Level* for measurings performed with the red light (630 nm). Press (M) to return.

(M)

**>Range** — Press (S) to set Range* in % (5, 10, 15, 20, or 25 %). Press (M) to return.

(M)

**>Regulation Type** — Press (S) to set the Regulation Type* - choose either Over Control or Bellow Control Mode. Press (M) to return.

(M)

**>Use Repeat Setting** — Press (S) to activate/disactivate the Repeat Mode. Control parameters are set in the >Setting>Repeat Option (see previous page). Press (M) to return.

(M)

**>Cleaning Interval** — Press (S) to set interval (in hours) for cuvette cleaning (2 h = cleaning is performed every 2 hours). Press (M) to return.

(M)

**>Return**

*See the graph on page 20 of this Manual to learn more about Level, Range, and Regulation Type Options.*

# Setting Sub-Menu (Part 3)

```
>Setting ──(S)──▶ >Main Valve ──(S)──▶ >Active State
```

**>Active State**

Press (S) to choose the state, which determines the active state of a connected pump or valve.
LOW = zero voltage activation
HIGH = positive voltage activation
Press (M) to return.

**>Active Interval**

Press (S) to set the time period (in sec.) during which the sample is pumped into the cuvette.
Choose "0" for continuous sample flow through the cuvette.
Press (M) to return.

**>Return**

**>Cleaning** ──(S)──▶ **>Active Interval**

Press (S) to set the time period (in seconds) during which the cleaning medium is pumped into the cuvette.
Press (M) to return.

**>Cleaning Interval**

Press (S) to set length of cuvette cleaning (in minutes).
Press (M) to return.

**>Rinsing Interval**

Press (S) to set length of cuvette rinsing (in minutes).
Press (M) to return.

**>Return**

**>Time**

Use (S) to set date and time: Year - Month - Day - Hour - Minute - Second.
Press (M) to scroll between the single items.

**>Return**

**>Time Indication**

# 9. FluorPen Software

**Starting up:**

1. Switch on the computer.

2. Switch on the AOM device.

3. Start the FluorPen program.

---

**Connecting:**

**Select:** Setup>Device ID (Ctrl+I).

If properly connected, the message "Device: FluorPen" appears in the bottom part of the screen.
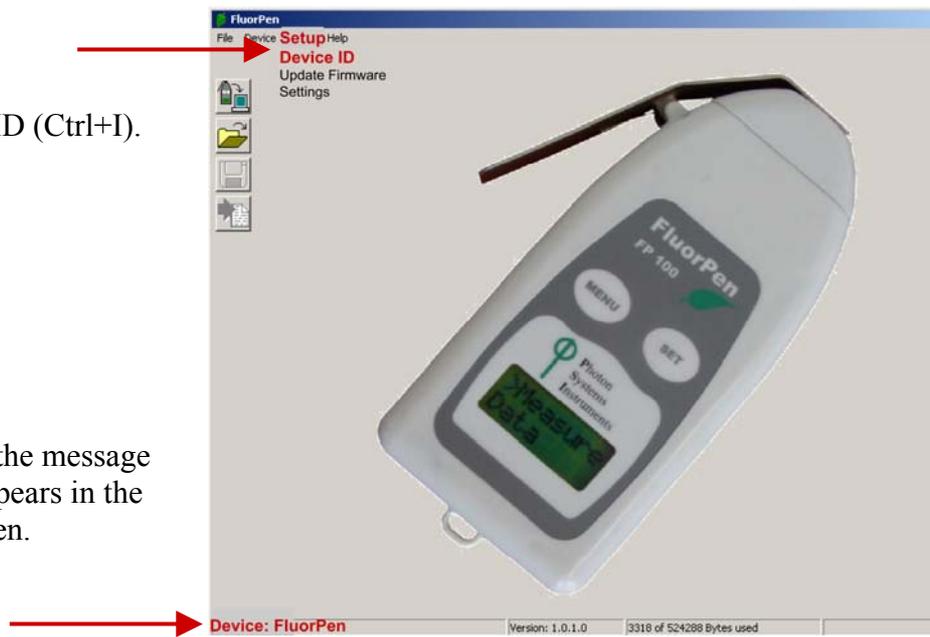
## 9.A. Menu and Icon Explanation

**Menu: File**

| | |
|---|---|
| **Load** | Loads previously saved data files. |
| **Save** | Saves data to hard disc. |
| **Export** | Exports data in .txt format. |
| **Close** | Closes the current experiment. |
| **Close All** | Closes all running experiments. |
| **Exit** | Exits the program. |
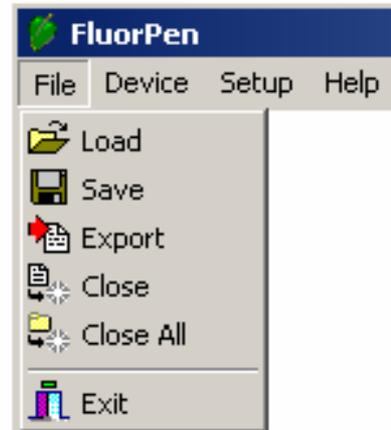
**Menu: Device**

| | |
|---|---|
| **Download** | Downloads data from the AOM to your PC. |
| **Erase Memory** | Erases data from the AOM memory. |
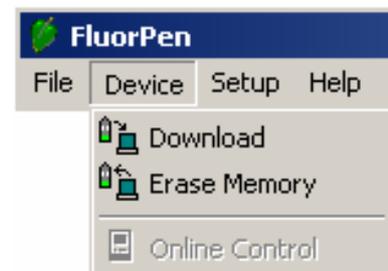
**Menu: Setup**

| | |
|---|---|
| **Device ID** | Detects the connected device. |
| **Update Firmware** | Used for software updates.* |
| **Settings** | Used for modification of the program settings.** |

*\* For more information on software updating, see Chapter 8.D. of this Operation Manual.*

*\*\* See more information on the next page.*

**Menu: Help**

| | |
|---|---|
| **About** | Offers basic information about the program. |
| **Register** | Used for the FluorPen software registration. |
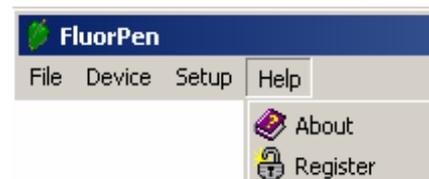
**Menu: Settings**

**After Download - Memory Erase**

If the box is checked the AOM memory is erased
after each data download.

**Data - Inverted**

If the box is checked the polarity of data is
inverted, e.g., multiplied by -1.*

**Data – Add to Opened**

If the box is checked the downloaded data are
added to that of the current opened experiment.
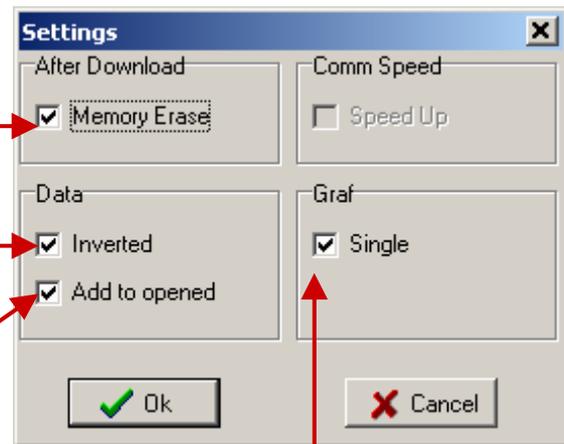
**Graf - Single**

If the box is checked all measured data are visualized in one graph, i.e., the value of each new
measurement is added to the currently used graph window.

If the box is not checked a new graph is opened for every new measurement.

*\* This feature can be helpful for a certain type of experiment when the measured data are undesirably
interpreted as negative values.*

**Icon Explanation:**
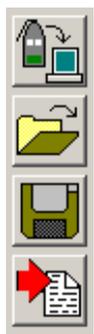
| | | |
|---|---|---|
| | **Download** | Downloads data from the AOM to PC. |
| | **Load** | Loads (opens) previously saved data files. |
| | **Save** | Saves data to hard disc. |
| | **Export** | Exports data in .txt format. |

## 9.B. Example of Data Transfer and Visualization

**Step 1:** Perform a measurement with your AOM device (here, OJIP transient).

**Step 2:** Click the "Download" icon or select Device>Download.

**Step 3:** The Data table appears.

**Step 4:** To visualize measurement in the graphic mode, click the "Graph" field in the bottom bar.

**Step 5:** The colored Graph of measured data appears.



Selection of data corresponds to their description
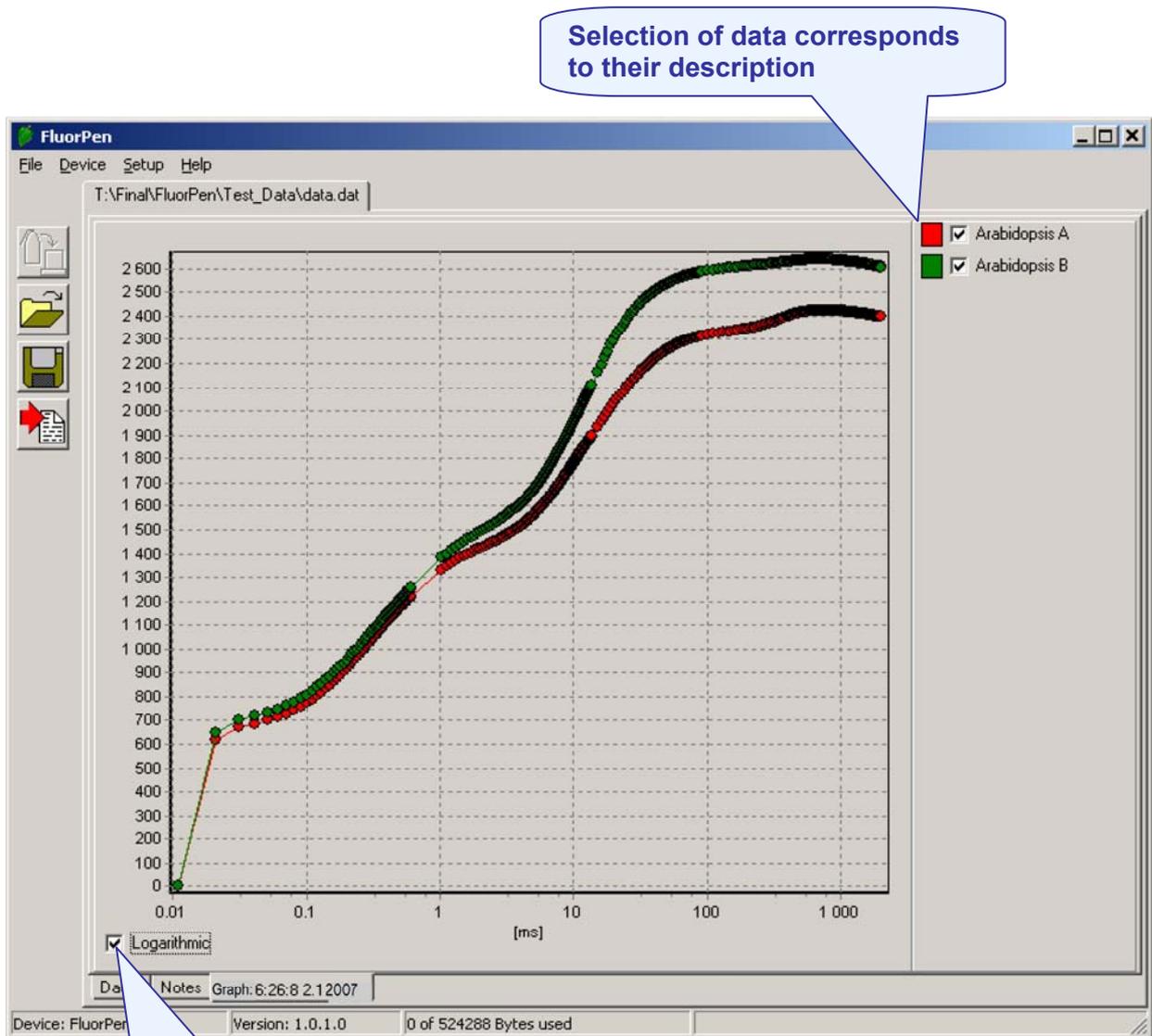
Choose logarithmic or non-logarithmic graph form

## 9.C. Explanation of OJIP Parameters

The AOM device offers the possibility to capture rapid fluorescence transient – OJIP, which occurs during exposure of photosynthesizing organisms to high irradiance. The FluorPen 2.0 software enables data downloading to a personal computer and subsequent OJIP analysis. The OJIP protocol includes the following extracted and technical parameters*:

| Formula Abbreviation | Formula Explanation |
|---|---|
| Bckg | Background |
| $F_0$ | $F_0 = F_{50\mu s}$, fluorescence intensity at 50 μs |
| $F_J$ | $F_J$ = fluorescence intensity at J-step (at 2 ms) |
| $F_i$ | $F_i$ = fluorescence intensity at i-step (at 60 ms) |
| $F_M$ | $F_M$ = maximal fluorescence intensity |
| $F_V$ | $F_V = F_M - F_0$ (maximal variable fluorescence) |
| $V_J$ | $V_J = ( F_J - F_0 ) / ( F_M - F_0 )$ |
| $V_i$ | $V_i = ( F_i - F_0 ) / ( F_M - F_0 )$ |
| $F_M / F_0$ | |
| $F_V / F_0$ | |
| $F_V / F_M$ | |
| $M_0$ or $(dV/dt)_0$ | $M_0 = TR_0 / RC - ET_0 / RC = 4 ( F_{300} - F_0 ) / ( F_M - F_0 )$ |
| Area | Area between fluorescence curve and $F_M$ (background subtracted) |
| Fix Area | Area below the fluorescence curve between $F_{40\mu s}$ and $F_{1s}$ (background subtracted) |
| $S_M$ | $S_M = Area / ( F_M - F_0 )$ (multiple turn-over) |
| $S_S$ | $S_S$ = the smallest $S_M$ turn-over (single turn-over) |
| N | $N = S_M . M_0 . ( 1 / V_J )$ turn-over number $Q_A$ |
| Phi_P0 | $Phi\_P_0 = 1 – ( F_0 / F_M )$ (or $F_V / F_M$) |
| Psi_0 | $Psi\_0 = 1 - V_J$ |
| Phi_E0 | $Phi\_E_0 = ( 1 – ( F_0 / F_M )) . Psi\_0$ |
| Phi_D0 | $Phi\_D_0 = 1 – Phi\_P_0 – ( F_0 / F_M )$ |
| Phi_Pav | $Phi\_Pav = Phi\_P_0 ( S_M / t_{FM} )$    $t_{FM}$ = time to reach $F_M$ (in ms) |
| ABS / RC | $ABS / RC = M_0 . ( 1 / V_J ) . (1 / Phi\_P_0 )$ |
| $TR_0$ / RC | $TR_0 / RC = M_0 . ( 1 / V_J )$ |
| $ET_0$ / RC | $ET_0 / RC = M_0 . ( 1 / V_J ) . Psi\_0$ |
| $DI_0$ / RC | $DI_0 / RC = ( ABS / RC ) – ( TR_0 / RC )$ |

*Formulas Derived From:*

*R.J. Strasser, A. Srivastava and M. Tsimilli-Michael (2000): The fluorescence transient as a tool to characterize and screen photosynthetic samples. In: Probing Photosynthesis: Mechanism, Regulation and Adaptation (M. Yunus, U. Pathre and P. Mohanty, eds.), Taylor and Francis, UK, Chapter 25, pp 445-483.*

## 9.D. Software Update

> **Very important!**
>
> **All data in the AOM memory are erased during the software update!**
>
> **Before starting any software update, export all your data from the AOM memory into your computer!**

### Step 1: Starting Update
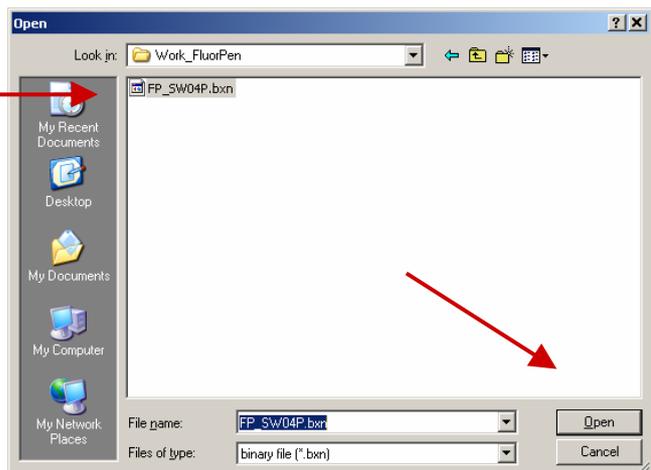
**Select:** Setup>Update Firmware

### Step 2: Selecting .bxn File

**Find:** Binary file (with the extension .bxn)

**Select:** Open

## Step 3: Finishing Upload

**Select:** "OK" to start uploading of the update.



The bottom bar indicates the upload progress.



**Press:** "OK" to finish upload.

# 10. Statement of Limited Warranty

- This Limited Warranty applies only to the AOM device and its accessories (excluding any batteries). It is valid one year from the date of shipment.

- If at any time within this warranty period the instrument does not function as warranted, return it and the manufacturer will repair or replace it at no charge. The customer is responsible for shipping and insurance charges (for the full product value) to PSI. The manufacturer is responsible for shipping and insurance on return of the instrument to the customer.

- No warranty will apply to any instrument that has been (i) modified, altered, or repaired by persons unauthorized by the manufacturer; (ii) subjected to misuse, negligence, or accident; (iii) connected, installed, adjusted, or used otherwise than in accordance with the instructions supplied by the manufacturer.

- The warranty is return-to-base only, and does not include on-site repair charges such as labor, travel, or other expenses associated with the repair or installation of replacement parts at the customer's site.

- The manufacturer repairs or replaces faulty instruments as quickly as possible; the maximum time is one month.

- The manufacturer will keep spare parts or their adequate substitutes for a period of at least five years.

- Returned instruments must be packaged sufficiently so as not to assume any transit damage. If damage is caused due to insufficient packaging, the instrument will be treated as an out-of-warranty repair and charged as such.

- PSI also offers out-of-warranty repairs. These are usually returned to the customer on a cash-on-delivery basis.

- *Wear & Tear Items* (such as sealing, tubing, padding, etc.) are excluded from this warranty. The term *Wear & Tear* denotes the damage that naturally and inevitably occurs as a result of normal use or aging even when an item is used competently and with care and proper maintenance.

*For customer support, please write to: support@psi.cz*