Walk-In FytoScope

Series

Operation Manual

Please read this Manual before operating this product

Photon Systems Instruments

PSI, spol. s r.o., Drasov 470, 664 24 Drasov, Czech Republic.
Fax: +420 511 440 901, Phone: +420 511 440 011, http://www.psi.cz

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Contents

1 Introduction

An integral part of the cultivation chamber is a computer with a touch screen. The computer is shipped with pre-installed operating system as well as with the *FytoScope* software. The *FytoScope* software automatically starts after the computer start. The *FytoScope* software is intended for the control of a cultivation chamber. It enables both, manual set up of cultivation conditions as well as creation of various protocols simulating diurnal changes of light intensity, spectral composition, changes of temperature and humidity. These quantities are continuously monitored and the data are saved to a disc. The *FytoScope* can be connected with a FluorPen device for on-line measuring of chlorophyll fluorescence.

The FytoScope program is functionally divided into several tabs:

- **Main** – enables manual set up of lights, temperature and relative humidity (only constant values, not day/night cycle) and a display of graphic data.

- **Protocol** – is intended for protocols creation. Protocols contain instructions for simulation of more elaborate cultivation conditions. As from a simple day/night cycle with constant temperature and humidity up to complicated diurnal cycles of all parameters.

- **Setting** – contains access to changes in graph setting and data saving.

- **Pen** – enables to control the FluorPen. This tab is active only when the device is connected and detected.

2 Main

There are actual and preset values of the following parameters displayed in **Main** (Figure 1): temperature, relative humidity, individual lights. Graph shows curves of all measured functions.

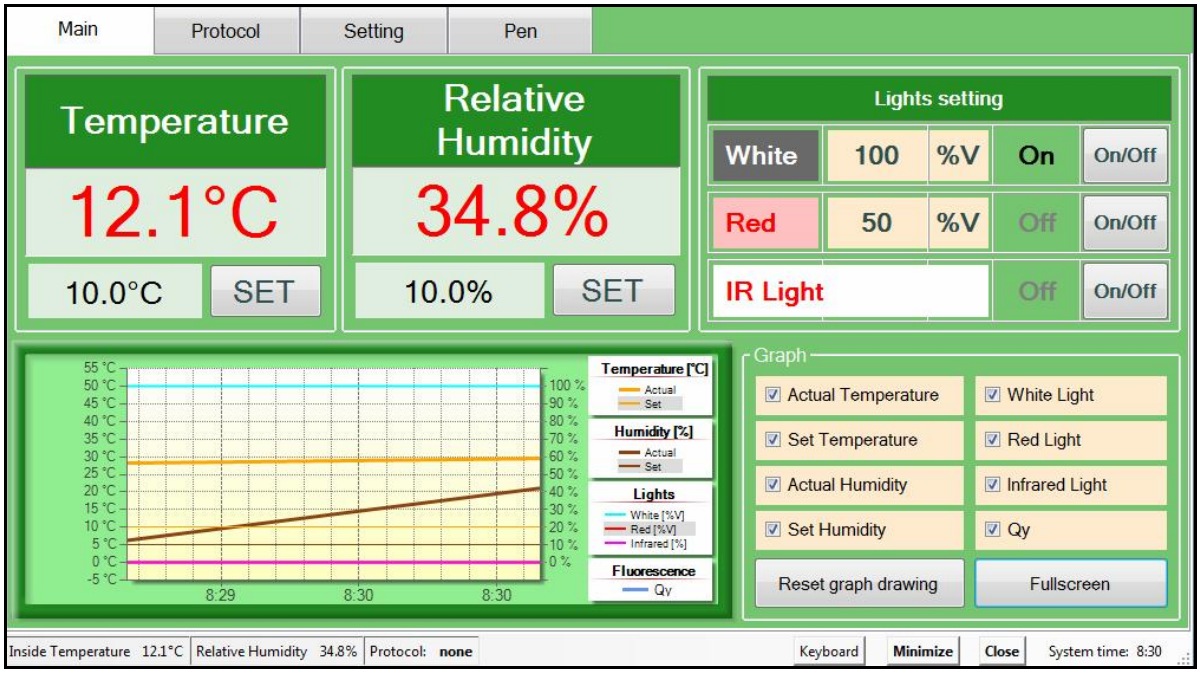

Figure 1 Main - online display of set and measured parameters

2.1 Graph

Graph depicts curves of all the quantities ranged from the last 30 minutes to 12 hours (depending on setup). Actual set temperature is plotted on the main Y axis. The secondary axis serves to dispaying relative humidity (actual and set) and light. Quantum yield (Q_Y) is presented at a detached axis on the left next to the temperature.

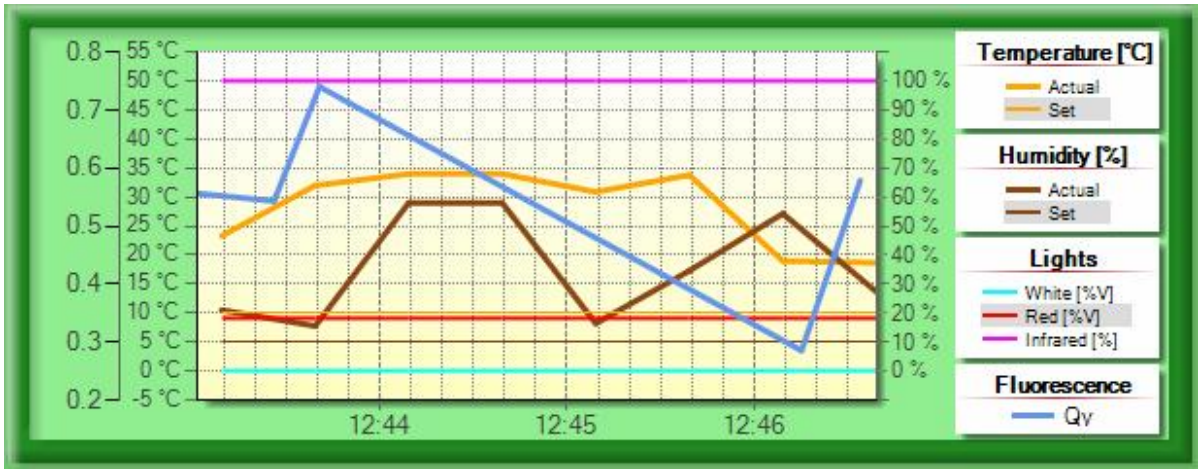

Figure 2 Courses of measured and set quantities are continuously displayed in the graph.

Graph control elements are in a frame Graph (on the right side, see Figure 3 for details). Individual parameters display can be turned on/off by ticking the check boxes. A *Reset graph drawing* button deletes all recorded curves in the graph. Since this moment, new curve projection starts. It will not affect saved data (deletes only curves, not the data)! A *Fullscreen* button switches the graph into a *Full-screen mode*.

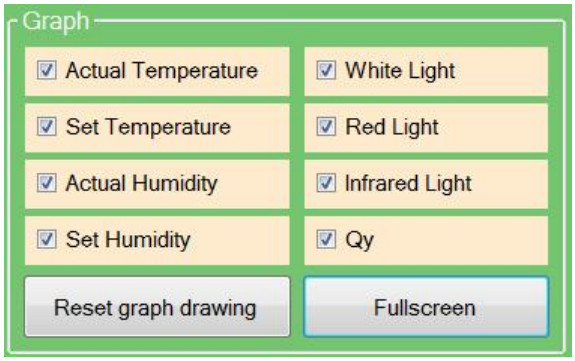

Figure 3 Graph **control elements**

Full-screen mode enables more detailed graph presentation. Data are divided into two graphs in order to make the orientation in them easier. The upper graph presents temperature course (set and actual) and relative humidity (set and actual). The bottom graph presents all lights setup and the course of fluorescence (QY), if measured.

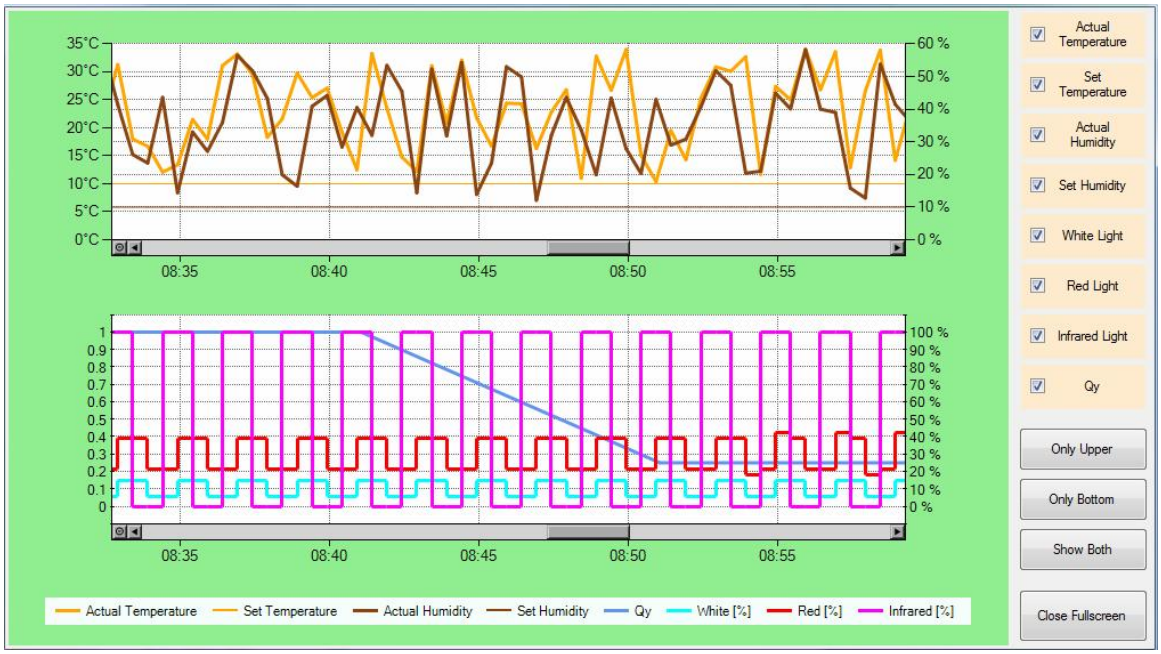

Figure 4 Full-screen mode display of the Graph

Control elements to the graph are on the right sight of this panel. The most important are the check boxes to turn on/off the individual courses. Furthermore, there is a group of buttons enabling to display only upper (*Only Upper*) or only bottom (*Only Bottom*) graph, or both of them (*Show Both)*. Full-screen mode can be left by touching *Close Fullscreen* button.

Another standard function to be used in the graph is zooming (zoom) of the time axis. To zoom in, touch the left edge in the area interested. A cursor will appear (red vertical line). Drag the cursor to the right margin of the area you want to display. The chosen area will go gray (Figure 5). Releasing the cursor will cause zooming in. A scroll bar will appear under the graph. The entire course can be seen in the same zoom through the use of the scroll bar. The upper and bottom graphs are linked together which results in zooming in the bottom graph when zooming in the upper graph and vice versa.

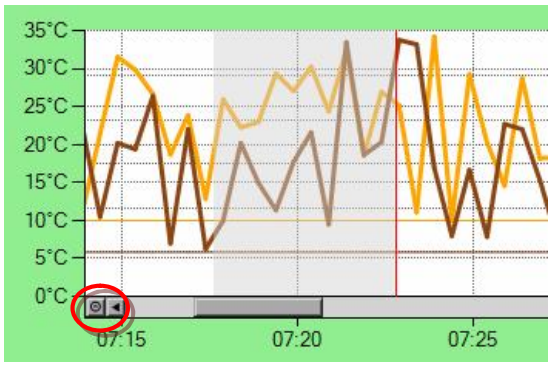

Figure 5 Graph zooming

If you want to get back to an original (not zoomed) display, touch the button with the circle, left from the scroll bar (marked red in Figure 5). It must be touched the same number of times as was the number of zooms-in.

2.2 Manual Setting of Readings

2.2.1 Setting Temperature and Relative Humidity

Panels *Temperature* and *Relative Humidity* show actual measured and preset readings of temperature and relative humidity. They also enable manual setup of these parameters.

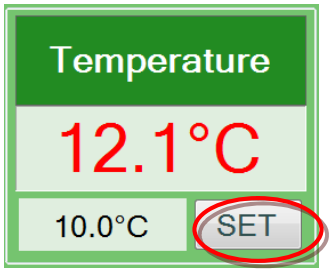

Figure 6 Temperature

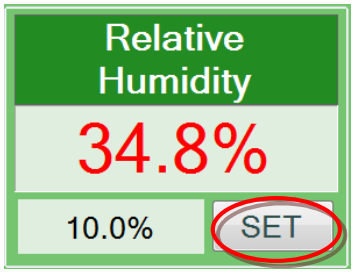

Figure 7 Relative Humidity

To set the parameter, touch the *SET* button in the desired parameter frame (Figure 6, Figure 7). A software keyboard for entering numeric values will appear (Figure 8). A scope of setting (reachable minimum *MIN* and maximum *MAX,* depending on the version of the cultivation chamber) and the last entered value (*CURRENT*) display red in the upper part of the window. A newly entered value displays black and bigger. In case the spot for the new value is empty, it has not been entered by the user yet.

Figure 8 Temperature setting

After entering the desired value, confirm it with *SET* button. To leave the setting without entering a new value, touch *Cancel* button. In case you want to enter different value and *SET* has not been touched yet, touch *Clear* button and enter the new value. *BackSpace* deletes entered characters step by step.

2.2.2 Lights Setting

The FytoScope is, based on the version, equipped with lights of various colors. Lights can be turned on/off and their intensity can be changed. An exception is the infrared light which can´t be regulated. It can only be turned on or turned off. Control of all the lights is available in the frame *Lights setting* (Figure 9).

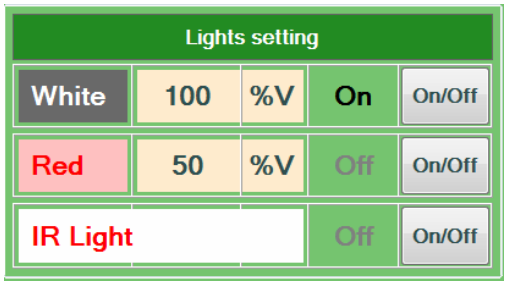

Figure 9 Lights setting

A particular light can be turned on or off by touching *On/Off* button. Current state is displayed next to the button.

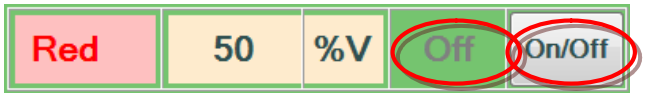

Figure 10 Manual lights control

Light intensity can be set by touching the actual value in the cell. Entering the value is similar to entering temperature or humidity via the software keyboard.

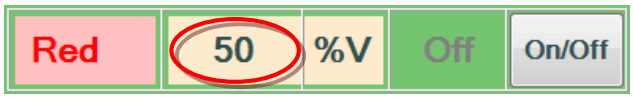

Figure 11 Lights intensity setting

Light intensity can be entered in light intensity percentage, in µE m^{-2} s^{-1}, or in percentage of supply voltage. The first two ways require light calibration (see later in the text). In case the light is not calibrated, just the percentage of supply voltage is available for use. To change a unit, touch the cell next to the set value.

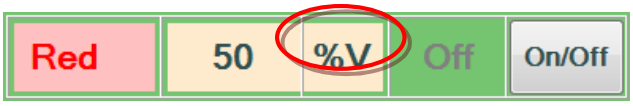

Figure 12 Unit selection

After touching the cell next to the set value a *Select Unit* window will appear (Figure 13).

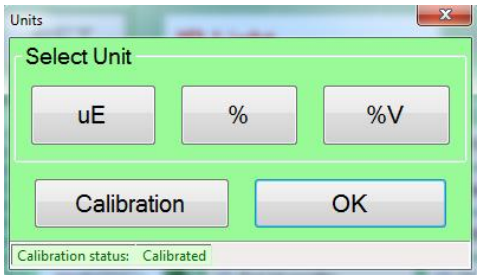

Figure 13 Unit selection

The unit can be chosen by touching respective button.

uE - µE
% - lights intensity percentage
%V - voltage percentage

Remark: If the light is not calibrated, the first two buttons are not available.

2.2.3 Lights Calibration

Lights can be calibrated through the use of a device for light intensity measurement (light meter) with PAR sensitivity. It measures in µE m^{-2} s^{-1} (= µmol (photons) m^{-2} s^{-1}). A light sensor of the device should be connected to a longer wire or should be connected wireless so that the sensor could be inside the FytoScope and measured values could be read outside the FytoScope. Light intensity measurement must be carried out with the chamber door closed to avoid interference with outside lightening. Position the sensor as far from lights as required – **calibration is valid just for this distance!** For other distance a new calibration must be done.

To calibrate a chosen light, touch the unit button of the light. A selection window will appear (see previous chapter). There is a button *Calibration* in its bottom part. When touched, the program switches off the other lights to avoid distortion of current calibration. A window for entering calibration points appears subsequently. A 5 point calibration is used. (Figure 14)

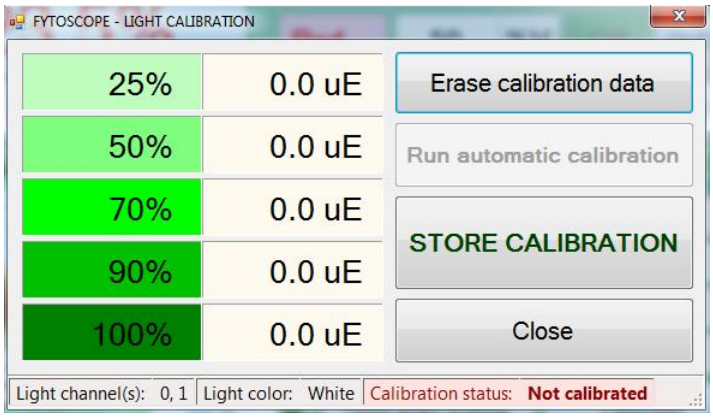

Figure 14 Calibration

Assign individual levels of voltage to measured levels of light intensity in µE m^{-2} s^{-1}. If your device measures in other units, values must be converted. Prior to the first calibration all levels are zero. In case the device has been calibrated previously and a new calibration is required, the old calibration must be first erased by touching *Erase calibration data* button (see Figure 14).

Touch the first value corresponding to 25%. The program will automatically set the voltage light level to 25% and will display a software keyboard to enter the measured light intensity value. Read the value from your device and enter it through the keyboard. Confirm by touching *SET*. Repeat the process for remaining calibration points (50%, 70%, 90%, 100%). It is not necessary to adhere to a strict order during entering calibration points. For example, all the points can be entered at one time, however there is a possibility to enter any point again afterwards. After entering all the points, they can be stored by touching *STORE CALIBRATION* button. A successful calibration is confirmed by a statement in a status bar: "Calibration status: Calibrated". The calibration is finished now. Close the calibration window by *Close* button. Now a unit of light intensity can be selected (µE, %, %V).

3 Protocol

A **Protocol** tab enables to simulate dynamic cultivation conditions. The protocol can be very simple: unchanging parameters during the whole experiment or it can simulate composite diurnal changes in light, temperature and humidity. The protocol itself can be saved to a file and opened again later.

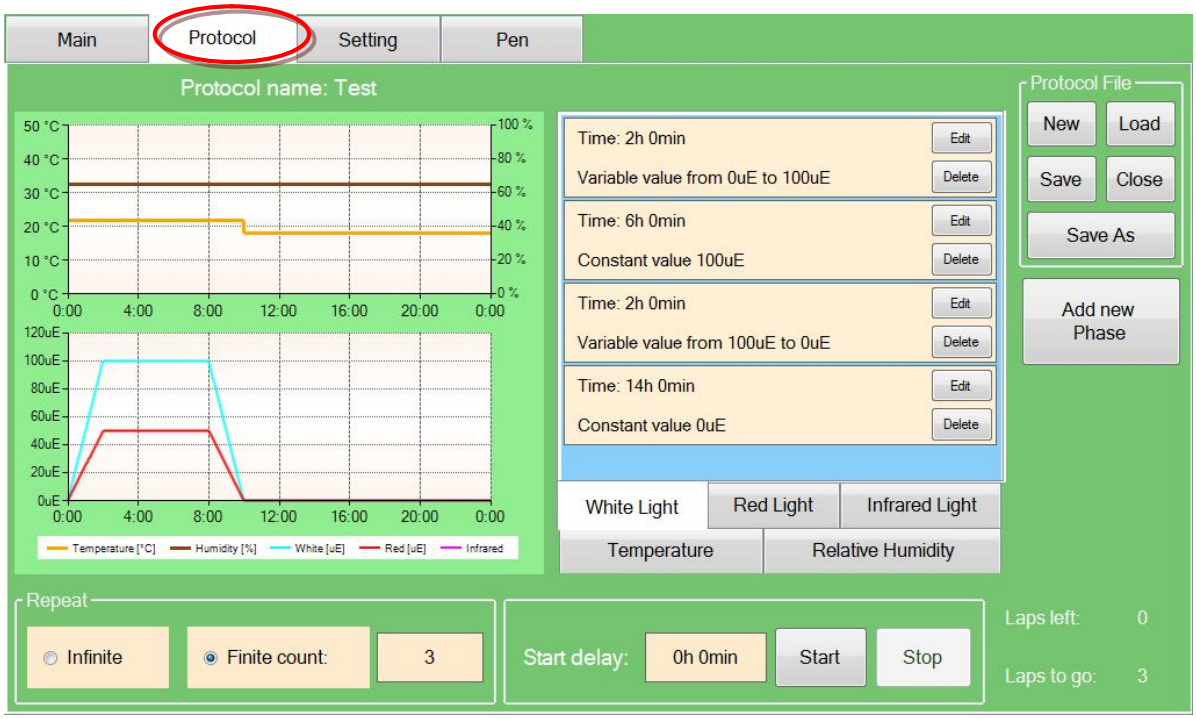

Figure 15 Protocol tab

Tab window is divided into following parts:

- Graphic presentation of a created protocol is on the left.
- List of individual phases of the protocol including edit buttons is in the middle of the window.
- A frame *Protocol File* is on the right. It consists of buttons *New, Load*, *Save*, *Close*, *Save As* assigned to work with protocol files.
- Furthermore, there is a button *Add new Phase* on the right allowing to add an additional phase into the protocol.
- A frame in the bottom part of the tab allows to set a rerun of the protocol (*Repeat)* in the framework of a single experiment. There are also buttons to start and stop the protocol or eventually to set a delayed start (*Start delay*) in the bottom part of the window.
- The right bottom corner presents information of a number of finished (*Laps left*) and remaining reruns *(Laps to go*).

3.1 Creation of a New Protocol

Touch button *New* – a window *Create New Empty Protocol* will appear (Figure 16).
Remark: If some protocol has already been loaded or created, close it first by *Close* button.

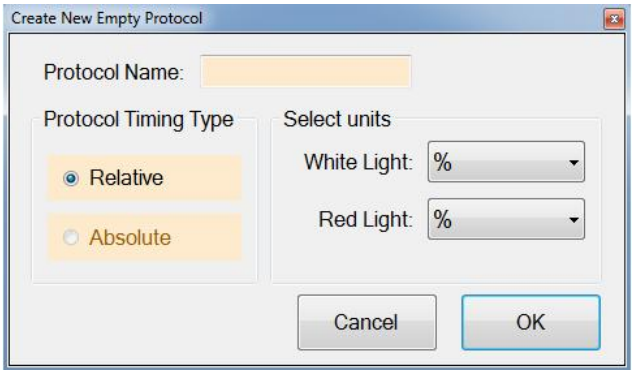

Figure 16 Creation of a new Protocol

Protocol Name – type in a name of the new Protocol (alphanumeric keyboard will appear when you touch an empty field where you want to write; when typing in is finished, close the keyboard and then continue).

Continue with *Relative timing* choice and choose a unit of light intensity. Confirm with *OK button*. A new empty protocol has been established.

3.1.1 Adding a New Phase to the Protocol

- Open the Protocol required for addition of a new phase or eventually create a new Protocol (see chapter 2.1).
- Choose a tab, containing the parameter to be added to a new phase, from the list of phases (Figure 17) .

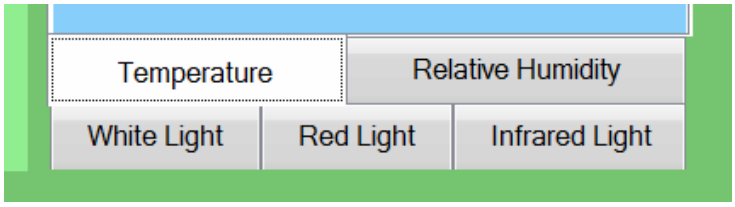

Figure 17 Tabs in the list of phases

- Touch *Add new Phase* button. An edit window for editing the new phase will appear (Figure 18).
- Select *Constant* or *Variable* function from the frame *Value progress.*
  - For constant progress of the phase choose *Constant* and enter its value (*Value*).
  - In case you want variable progress (such as for gradual dusk/switching lights on), mark *Variable* and set the lowest (*From*) and the highest (*To*) value of an interval.

- Set total time of the phase (*Phase duration)* in the *Time* frame: in *Set Time* window enter separately hours and minutes. Confirm time by touching *Set* button.
- Add the phase to the Protocol by touching *Add button*.

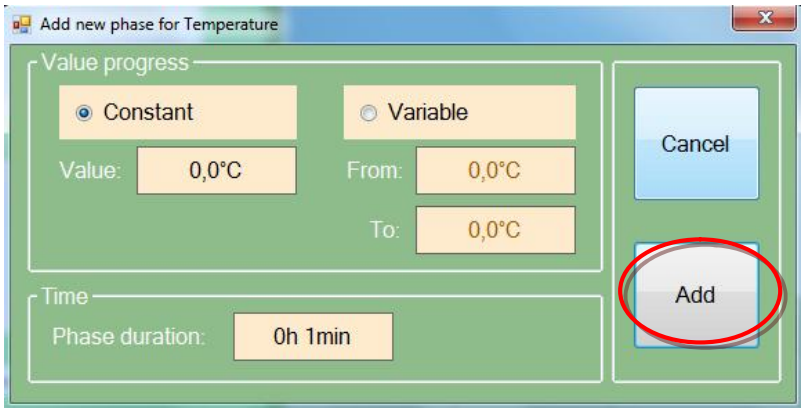

Figure 18 Addition of a new phase to the Protocol.

The new phase adds to a list of phases and at the same time its course is displayed in the graph (Figure 19).

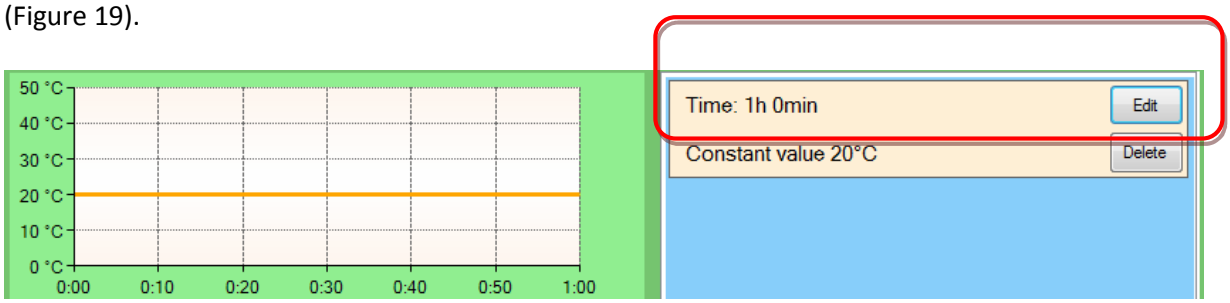

Figure 19 List of phases after addition of the first phase.

A Protocol example:

Specification:

Dynamic light regimen 10 hours light:

1. Phase: gradual lighting up of white light from zero value to 50 µE m^{-2} s^{-1} over the period of 2 hours.
2. Phase: constant light 50 µE m^{-2} s^{-1} over the period of 6 hours.
3. Gradual dusk over a period of 2 hours.

Procedure:

Select tab *White Light* from the list of phases and gradually add individual phases:

1. Touch *Add new Phase*. Set in editing window of the new phase: *Variable, From* 0.0µE, *To* 50.0µE, *Phase duration* 2 h. Confirm with *Add* button.
2. Touch *Add new Phase*. Set in editing window of the new phase: *Constant, Value 50*.0µE, *Phase duration* 6 h. => *Add*.
3. Touch *Add new* Phase. Set in editing window of the new phase: *Variable, From* 50.0µE, *To* 0.0µE, *Phase duration* 2 h. => *Add*.

Result:

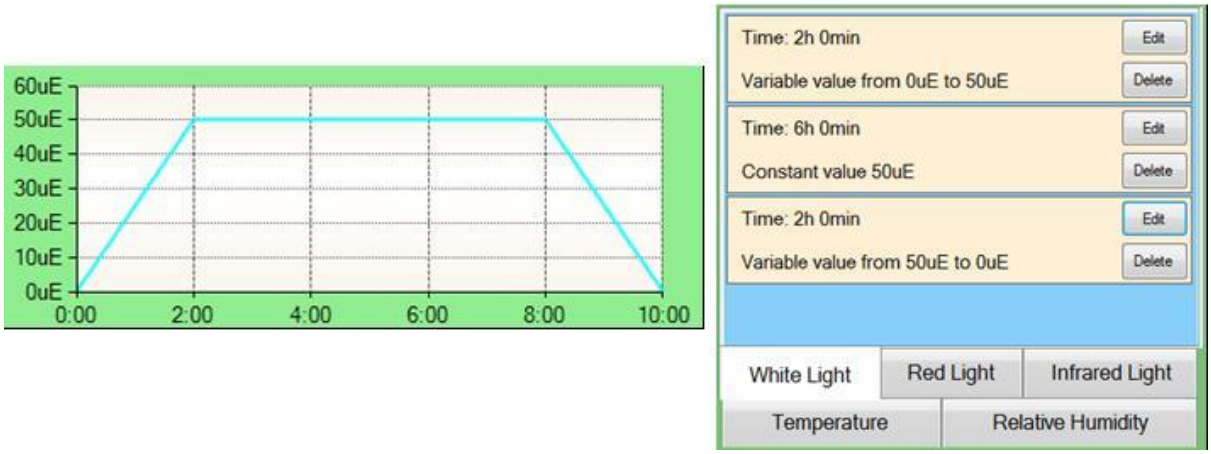

Figure 20 Graphic presentation of the example of the 3-phases protocol.

3.1.2 Phase Editing

Already existing phase can be modified.

- Choose the phase which you want to edit from the list and touch *Edit* button on the right in the phase cell.
- An editing window will appear (Figure 21). It consists of the same functions as the window for addition new phases.
- Make required changes and touch *Apply* button.

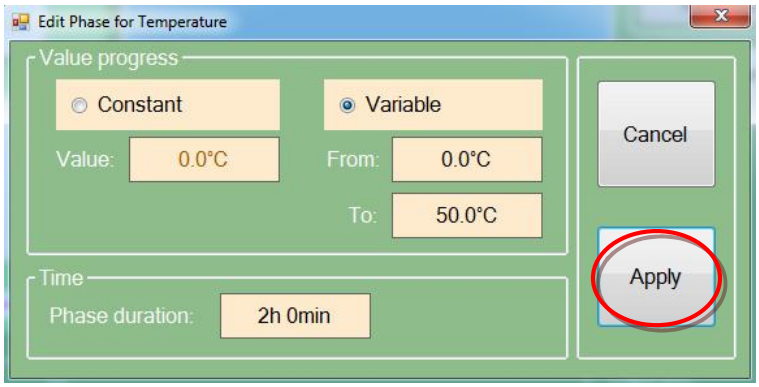

Figure 21 Phase editing window.

3.1.3 Phase Deleting

- Choose the phase you want to delete from the list of phases and touch *Delete* button (Figure 22).

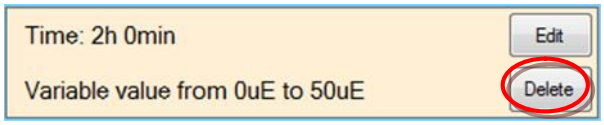

Figure 22 Deleting phase

3.2 Starting the Protocol

Created protocol can be started and stopped through *Start* and *Stop* buttons in the bottom area of the *Protocol* tab (Figure 23).

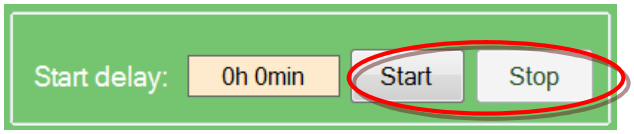

Figure 23 Starting and stopping Protocol

The frame *Repeat* enables setting various ways of Protocol rerun in *(*Figure 24*)*:

Infinite – to run Protocol repeatedly until stopped with *Stop* button or until the whole program is closed.

Finite count – indicates definite number of runs set by a user. In this case the Protocol automatically stops after the last run. The Protocol can be stopped sooner by touching *Stop* button.

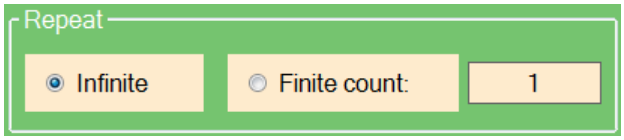

Figure 24 Window *Repeat*

4 Setting

Setting tab contains setup for data storing and displaying. *Setting* window (Figure 25), containing basic settings (*Basic Settings*), appears after touching an eponymous button. To save parameters touch *Apply* button. To save parameters and to close the *Setting* window at the same time touch *OK*.

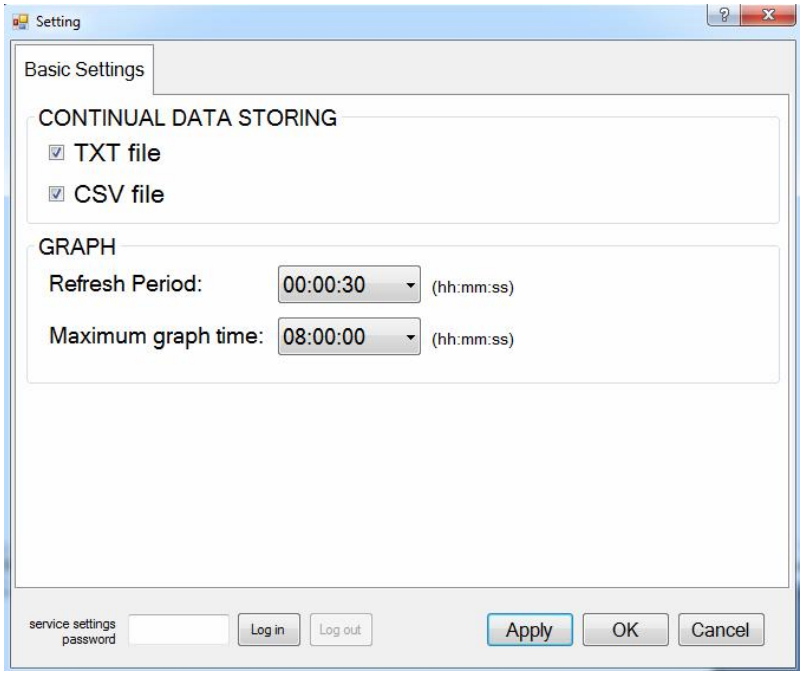

Figure 25 Setting window*:* setting a format of data to be saved and graph display parameters.

CONTINUAL DATA STORING - program enables continual storing of measured and set quantities into a file even if the protocol is not operating. Choose the storing format:

- *TXT file* – data are formatted in an easy to view format which can be edited in a standard text editor.
- CSV file – type of file suitable for work in a spreadsheet program (such as MS Excel).

GRAPH – this item presents parameters of the graph display set in **Main** tab.

Refresh Period – is a period of adding actual measured values and set quantities to the graph.

Maximum graph time – is a time range of displayed measured data (range of the X axis of the graph). Minimum is 30 minutes and maximum is 12 hours. Length of the range influences graph lucidity and time needed for depicting. Setting does not affect data storing!

5 Optional Fluorescence Measuring

An optional device to measure chlorophyll fluorescence – FluorPen – can be connected to the FytoScope. If the FluorPen is connected to the FytoScope and switched on during the program, it is recognized by the program and a tab **Pen** appears in the main menu (Figure 26). The FluorPen can measure only steady state of fluorescence (Ft) and quantum yield (Q_Y) when in on-line mode.

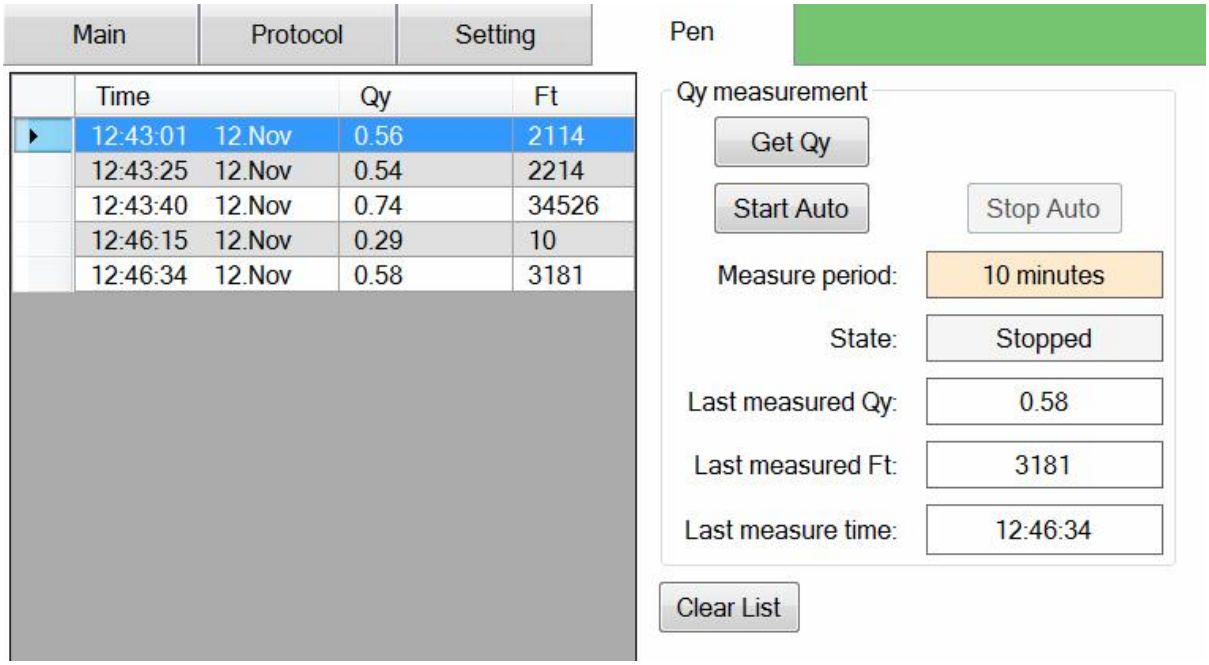

Figure 26 Pen tab

The **Pen** tab consists of control elements for the FluorPen use:

Get Qy – starts measuring fluorescence. The measurement itself takes several seconds. Afterwards measured values and measure time will appear in cells *Last measured Qy, Last measured Ft,* and *Last measure time*.

Start auto and *Stop auto* – measurements can be carried out continuously, regularly, and within a particular period. The period of an automatic measurement is set in cell *Measure period*. The period is entered in minutes. By touching *Start auto* and *Stop auto* buttons an automatic regimen of reading is started or stopped. Actual state of the automatic reading is displayed in the *State* cell.

Read values of Q_Y and F_T add to a list on the left in the **Pen** tab, both during automatic and manual measurement. Values display in the graph in the **Main** tab.

Clear List – erases the chart with measured values in the **Pen** tab (it does not affect stored data).

6 Data Storing

The program continuously stores monitored parameters to the computer hard disc. Data storing takes place regularly once a minute[1]. Data can be stored in two different versions (txt/csv) according to requirements for further work with them. For setting see chapter 3.

The program creates independent files for **every day** and **every version** (if turned on at the same time). The file name consists of "FytoValues", date of the relevant day and from the bak according to storing version. (FytoValues_yyyy_mm_dd.xxx, where *yyyy* is year, *mm* is month, *dd* is day and *xxx* is bak).

An example of stored data (version txt)

```
=======================================================================...
 FytoScope - stored data. File Created: 26. 1. 2011 0:00:11
=======================================================================...
        date                T          Tset       RH         RHset     ...
03.01.2011 07:58:21         31.00      10.00      10.70      10.00     ...
03.01.2011 08:47:27         21.40      10.00      30.80      10.00     ...
```

Headings of individual columns

date	date (dd.mm.yyyy hh:mm:ss)
T	measured temperature
Tset	set temperature
RH	measured relative humidity
RHset	set relative humidity
White*	white light intensity
Red*	red light intensity
Infra**	infrared light intensity
Q_Y***	quantum yield
F_T***	instantaneous fluorescence in light (steady state)

* Color of lights depends on the desired configuration (white + red, blue + red, ...)

**infrared light intensity can´t be regulated – it can only be turned on or off. When turned on, display shows 100. When turned off, display shows 0.

*** Q_Y a F_T are implicitly inscribed in the heading. However, measured values are read only in case that the device for their measurement is connected – FluorPen, see chapter 4.

Way to file location is "C:/PSI/Fytoscope/logs". Data can be transmitted through an external USB disc. Transmission of files is also possible via a local network (LAN)[2].

[1] The device for fluorescence measurement measures Q_Y a F_T values in periods preset by a user. For better data evaluation, for example in graphs, the other monitored values are recorded both, once a minute and together with Q_Y and F_T.

[2] Location of USB connector and LAN connector depends on the version of your device.