Mystrica™

colorimeter

- Simple, robust design
- Versatile use as stand-alone or through a computer
- Performance criteria that rival instruments many times the price
- Choice of three colours of light
- Readings displayed as absorbance or transmittance
- Long battery life
- USB link displays and stores results as tables and graphs
- Fully supported suggestions for practical activities at www.mystrica.com

Applications

The unit is intended primarily for applications in secondary science education, particularly for Biology and Chemistry.

Detailed suggestions for practicals can be found at www.mystrica.com and include:

- investigations with enzymes – effects of temperature, pH, inhibitors – enzyme kinetics
- quantitative determination of biological molecules – sugars, protein, vitamins, etc
- quantitative determination of inorganic ions – nitrate, phosphate, etc
- population growth of micro-organisms
- and others

The colorimeter is suitable for educational use. It is not intended for clinical, commercial or research applications.

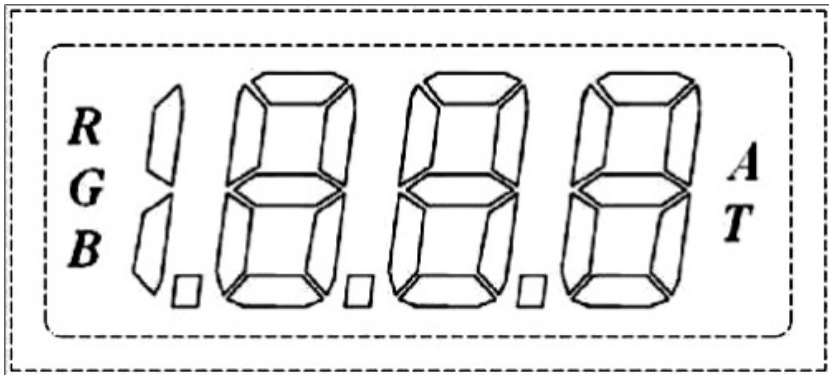
Controls

⏻ The **power** switch turns the unit on.

The unit switches off after 30 seconds to conserve battery power. It can be kept on indefinitely by holding the power switch down. When the unit is connected to a computer through the USB cable it stays on all the time so this switch does nothing.

- **CAL** calibrates the unit to 0.000 Absorbance or 100.0% Transmittance
- **RGB** switches between the red, green and blue light sources
- **A/T** switches display between Absorbance and Transmittance

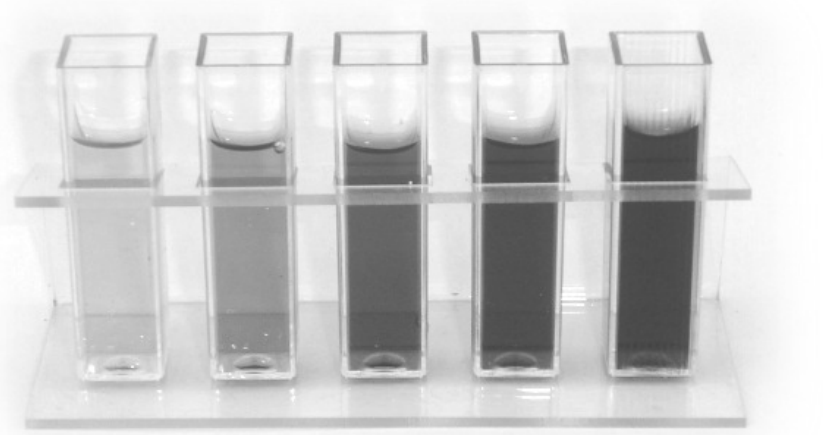
Display



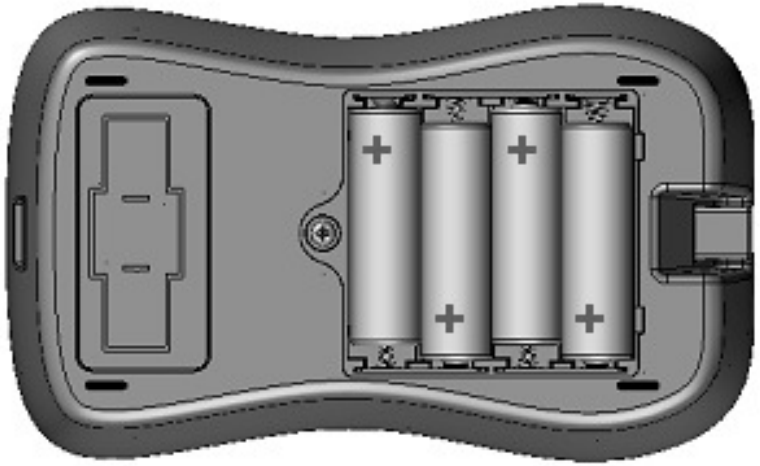
- Indicates which colour of light has been selected, ***R**ed, **G**reen or **B**lue*
- Indicates whether the unit is displaying values of ***A**bsorbance* or ***T**ransmittance*
- Displays values of absorbance between 0 and 1.999, and of transmittance between 0 and 100% Absorbance values below 0 or above 1.999 are out of range and indicated by the display showing **nEg** or ***Hi***. This would normally mean that the unit needs to be recalibrated, (press **CAL**), or that the absorbance of the solution is so high that it is beyond the meaningful working range.

Cuvettes

The samples to be measured are placed in standard 4.5ml glass or plastic cuvettes. The length of the light path is 10mm.
Satisfactory results can be obtained with volumes down to 1ml. For lower volumes semi-micro cuvettes can be used but the unit is not intended for semi-micro or micro applications.
Some cuvettes have four clear faces. Most have two clear faces and two frosted or ribbed faces. The clear faces must be aligned with the light path, (i.e. across the unit parallel to the display).
The unit is supplied with ten plastic cuvettes with lids and one cuvette stand. Additional cuvettes, lids and cuvette stands are available through www.mystrica.com



Power supply



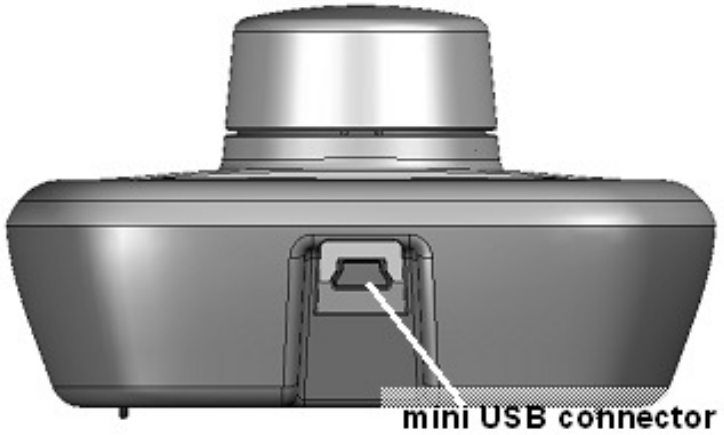
The unit uses 6V from four AA batteries. These are inserted by removing the screw on the battery holder.

When the batteries need to be replaced the display will show **bat** on startup.

Battery life for 1000mAh AA batteries is estimated at 100 hours of continuous use. Since this would be 36,000 readings of 10 seconds each, battery replacement should be a very rare event.

When connected to a computer through the USB link the unit draws its power through the link and is permanently on.

Connecting to a computer



The unit connects to a computer through the mini USB connector shown. In this mode the unit is always on and the power switch ⏻ has no function.

The USB link allows data from the unit to be displayed on the computer as tables or graphs using the software provided.

Data can be displayed and stored as separate events or as a continuous data stream.

How the colorimeter works

The light source is one of three light emitting diodes, (LEDs), which provide Red (~630nm), Green (~525nm) or Blue (~465nm) light.
The light passes through the sample in the cuvette and is detected by a photodiode.

Transmittance is a measure of the intensity of light passing through the sample, or an indication of the amount of light energy passing through. There is a simple linear relationship between transmittance and intensity which can be expressed as:

$$T = I / I_o$$

where I_o is the intensity of the light entering the sample and I is the intensity of light coming out of the sample. This value is usually given as a percent.

Absorbance is defined as $\log_{10}(I_o / I)$, or $2 - \log_{10}T\%$
There is a linear relationship, (Beer's Law or the Beer-Lambert Law), between absorbance and the concentration of the light-absorbing substance in the sample. In fact absorbance is determined by concentration and by the length of the light path through the sample. For most experiments in biology and chemistry the linear relationship with concentration makes absorbance the measurement of choice.

How to use the colorimeter

Calibration

This sets the value of a predetermined solution, (the blank), to 100% transmittance, or an absorbance of 0.
The blank would usually be pure water though this is not necessarily the case.

- Press the **power** switch ⏻ , (unless you are using the USB link), and select the colour of light you want to use by pressing **RGB.**
- Select absorbance or transmittance by pressing **A/T**
- Insert a cuvette containing the blank in the colorimeter. Make sure the clear faces are aligned with the light path.

  Press **CAL.** The display will show CAL for a few seconds, then either .000 (A), or 100.0 (T).

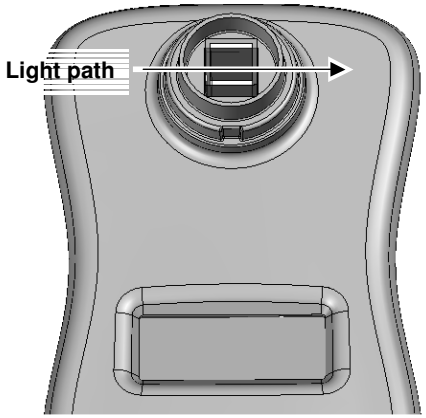
Taking readings

- **Replace the blank** with a cuvette containing the liquid you want to measure, **close the cap,** press the power switch, (if the unit has switched off) and **read the value** from the display.

The colorimeter will switch off automatically after 30 seconds to conserve battery power.

The settings are retained so when you want to take a reading you just need to press the power switch, there is no need to recalibrate or to try to rush through all the operations before the unit switches off.
This does not apply when the unit is connected to a computer through the USB link, in this case it will stay switched on indefinitely.

Cuvette alignment



Cuvettes may have four clear faces, but many have two clear and two frosted or ribbed faces.

If the cuvette has two clear faces these must be aligned in the same direction as the light path, i.e. across the unit parallel to the display.

Make sure the clear faces are clean and remove bubbles that may interfere with the light path by tapping the cuvette.

Warming up

Temperature changes will cause variations in readings, though these are small and will be insignificant for most uses. Avoid using the unit in direct sunlight.
When the colorimeter is connected through the USB link it is permanently on and will gradually warm up over the first ten minutes. This is likely to cause a small drift in the calibration value, typically about 2% T, 0.001A
To minimise the effect of temperature frequent recalibration is advisable:

- when working in an environment where the temperature is not constant
- when there is a lengthy interval between readings
- when measuring small changes at low absorbance, (high transmission).

Software

The software is FREE to DOWNLOAD

see **www.mystrica.com**

Using the colorimeter connected to a computer by the USB link you can:

- set up project and experiment files to collect and store results
- display and store data as tables and graphs
- collect data as a continuous stream or as separate events
- carry out simple data manipulations such as calculating rates of reaction and lines of best fit
- copy data into more sophisticated data analysis applications such as Excel or Autograph

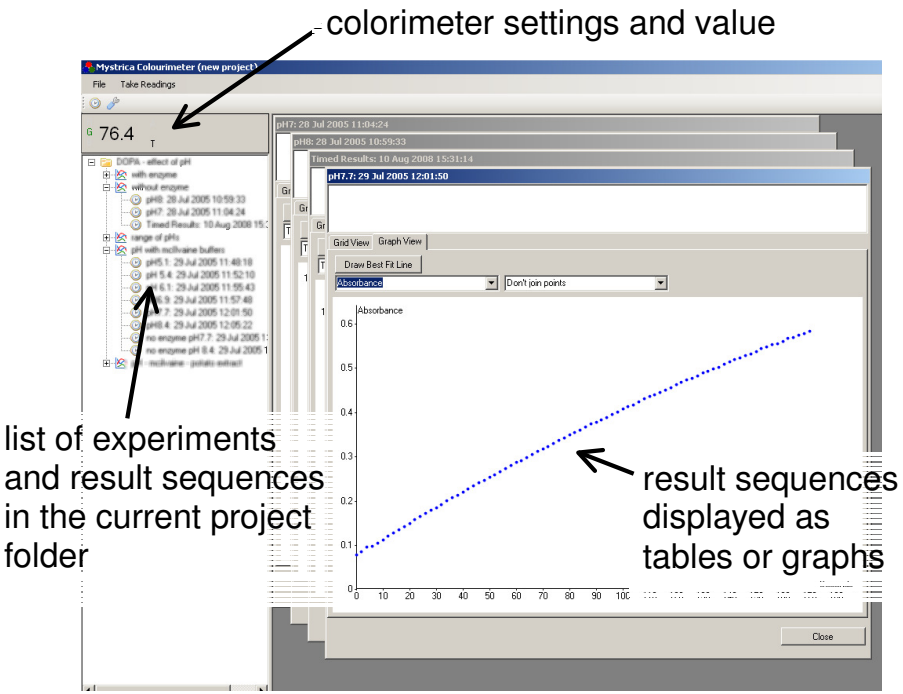
System requirements

- **Windows 2000, XP,Vista, Windows 7 or 8 with the .NET Framework 2.0 or later installed**

To install the software follow the on-screen instructions.

[The driver USBUART.inf for the colorimeter is included with the software and should install automatically. If it does not install use the Browse option in the Found New Hardware Wizard to locate it in the folder *Program Files/Mystrica Ltd/Mystrica Colourimeter/Driver*.]

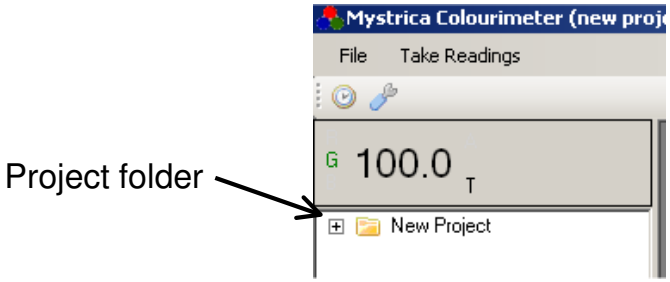
The programme screens display information as shown below.



Creating a new project

A project folder contains a set of related experiments. Each experiment can contain any number of sequences of data. The name of a project could be for example the name of the person whose work this is or a general title for a set of related experiments.

The first time you start the programme an empty project folder is opened, (called 'Colorimeter Project' - right click on this folder to rename it). Subsequently the programme will always open with the project folder that was last used. The 'Files' option on the menu bar can be used to create a new project, to select and open an existing project, and to save the current project.

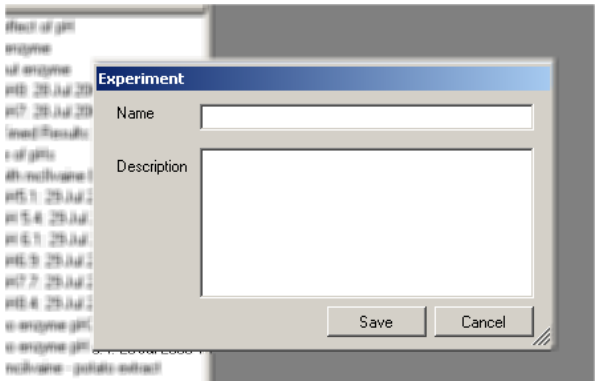


The left side of the screen displays, below the current readings and settings from the colorimeter, a list of the experiments and data sequences contained in the project folder, (double click the project folder and experiment files to view these).

Creating a new experiment

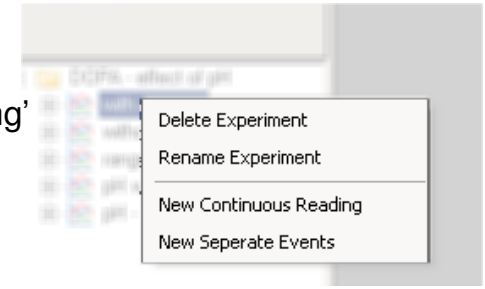
Right click on the project folder and click 'New Experiment'. The box shown below will appear and you can enter a title and any other information.

The experiment file can contain any number of sequences of results collected from the colorimeter.



Preparing to collect data

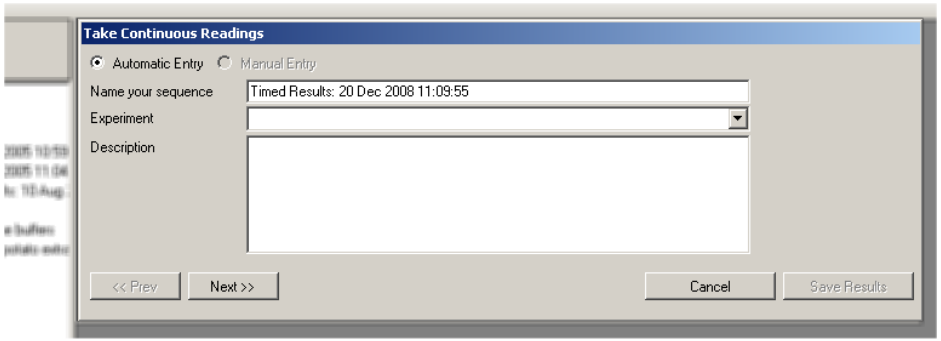
Right click the experiment file. The box shown below will appear.



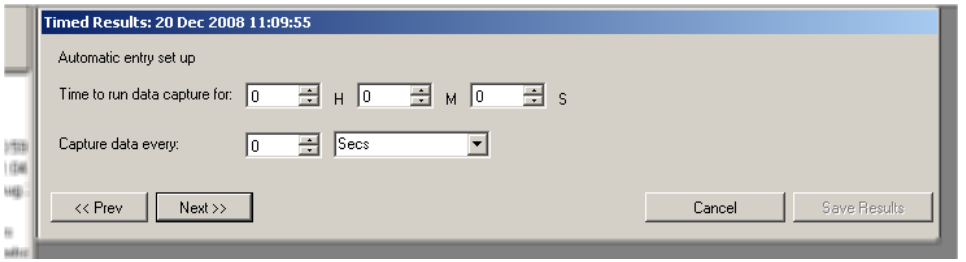
If you select 'New Continuous Reading' you will be able to collect data in a continuous stream for however long you set. 'New Separate Events' allows you to capture and store only the current value from the colorimeter.

Continuous readings

When you select 'New Continuous Reading' the box show below appears. You can enter a name for the sequence of results you are about to collect, the data and time are optional but it is usually good practice to leave these.
The 'Description' box can be used to give details of the sequence, concentrations of reactants, temperature, pH, etc.



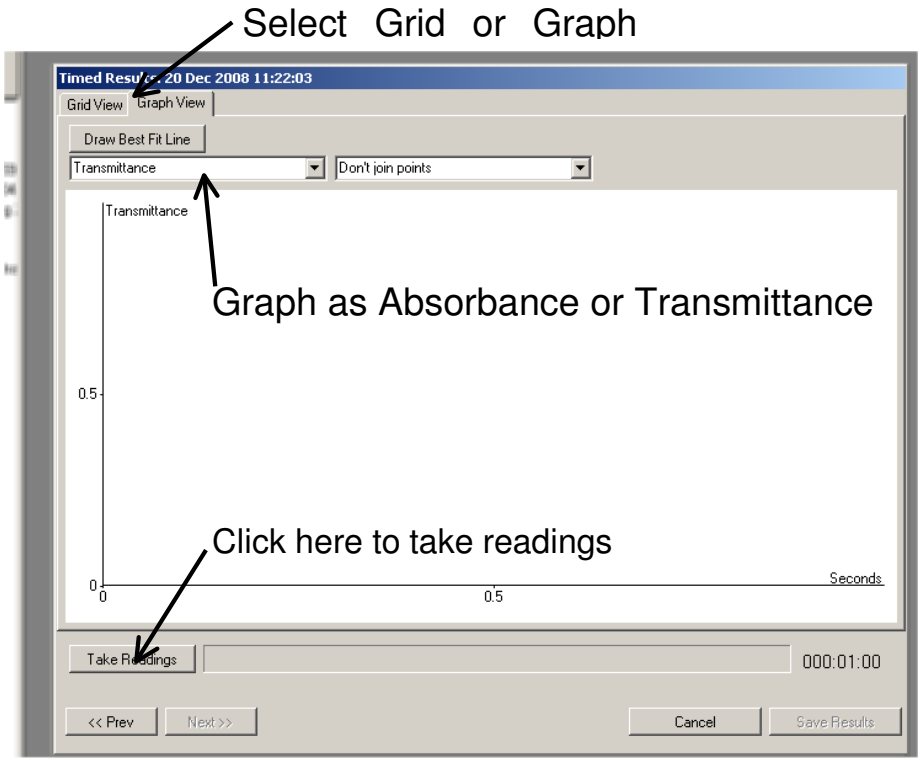
When you click 'Next' the box show below appears. Use this to enter the length of time you want to collect data for, (**H**ours/**M**inutes/**S**econds), and the interval between data points.



Click 'Next' then on the next page click 'Take Readings' to start collecting data.

Displaying results as Tables or Graphs

The data can be displayed as a table or graph, (except when text is entered using Separate Events). In graph view you can select to display the y-axis as either Transmittance or Absorbance and to join the points with straight lines, curves or not at all. Data collection can be stopped prematurely, discarded or saved by clicking the labelled buttons.



Separate Events

The procedure for Separate Events is similar to that for Continuous Readings except that you will be asked to select whether the readings should be associated with a numerical value or with text. If numeric the data captured can be displayed as a graph with the numeric values on the x-axis. If text the readings will only appear as a table. When you click 'Take Readings' only the current value from the colorimeter will be recorded as a single, discrete entry.

Drawing lines of best fit

A straight line of best fit can be drawn through any number of points on a graph. Select the points by clicking them then click 'Draw Best Fit Line'. The equation will be displayed in the form **y = ax + b** where **a** is the slope of the line and **b** is the intercept of the line on the y axis.

More information about using the software can be found at

www.mystrica.com/Software

Non-numeric readings

The liquid crystal display can only show absorbance values between 0.000 and 1.999 and transmittance between 0.0 and 160%. Values outside this range will be indicated by the non-numeric displays described below.
When the colorimeter is connected to a computer through the USB link the software can display a wider range of values, eg negative absorbance values and absorbance up to 2.999

- nEG – the absorbance is negative i.e. less than the absorbance of the solution used for calibration. Recalibrate using the least absorbent solution (usually water).
- HI – the absorbance is higher than 1.999
- HI – transmittance is higher than 160%. Recalibrate using the least absorbent solution (usually water).
- bAt – the batteries are low and should be replaced. This should be a very rare occurrence.

Mystrica Ltd

www.mystrica.com

CE

email: enquiries@mystrica.com

FCC statements:

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.