NEULOG COLORIMETER LOGGER SENSOR GUIDE

NeuLog colorimeter logger sensor
NUL-219

The colorimeter sensor can be used for any science experiment where liquid samples of different colors and concentrations are utilized such as in the fields of Chemistry, Biology, Pharmacology, Biochemistry, Environmental Science, Physics, or even just to study the behavior of light waves.

Colorimeters are used to determine absorbance or transmittance of given wavelengths (generally red, green, and blue) in a liquid solution. Absorbance and transmittance are directly related to the concentration of known solutes in the solution which is calculated using the Beer-Lambert law. One parameter can be calculated from the other.

The sensor comes pre-calibrated so you can start experimentation right out of the box using this guide.

Hundreds of possible experiments that can be performed with the NUL-219 sensor are: Analyzing chemical reactions, studying Beer's Law, water quality testing, monitoring of ecological systems, study of photosynthesis, studying light waves. The colorimeter could take the place of a spectrophotometer in many experiments.
The NeuLog colorimeter sensor's measurement units are:

- % Transmittance: The amount of light that passes through a sample
- Absorbance: The amount of light which is absorbed by a sample

Cuvette usage and handling:

It is important to maintain a standard for cuvette usage as their quality will directly impact the results of your experiments. If the cuvette has fingerprints, smudges, or cracks the sensor will detect them and give off an improper colorimeter reading. Smudges left from handling can easily be wiped off with tissue paper.

Proper usage:

1. Carefully remove the cuvettes from their packaging.
2. Load your liquid sample into the cuvette before placing it into the sensor to prevent spilling and damaging the sensor.
3. Plug the cap into the cuvette and gently invert a few times. Shaking will create air bubbles which will be detected by the sensor and give an incorrect reading.
4. Before placing the cuvette in the sensor; hold it as far towards the top as you can and wipe off the bottom with a tissue. Do not touch the bottom of the cuvette again as this will leave a residue which could affect the results of the experiment.
5. If you have a cuvette with four clear sides, place it in the colorimeter sensor.
   If you have a cuvette with two opaque sides:
   a. Determine which sides of the cuvette are clear and which sides have an opaque finish.
   b. The clear opposing sides must be positioned facing the front and back of the sensor (they won't fit the other way) while the glossy sides face either side.
   c. If the cuvette does not fit with a gentle push, rotate 90° in either direction and try again.

6. After experimentation, empty your samples, gently rinse out the cuvettes with distilled water and let them air-dry.

Selecting a wavelength:

Selecting the correct wavelength is important to get the best data and can easily be determined using one of two different methods. There is no incorrect wavelength, just some which are more informative than others. Lab experiments often come with a predetermined wavelength to use. If your experiment does not, follow one of these methods for best results:

- Knowing that the color we see solutions is based on the color reflected from them (and not absorbed): Choose a color you know will be absorbed. For example, if the solution is red try the blue LED option.

- Once the sensor is connected and the NeuLog software is open (follow one of the guides below for more instruction) click the “Module setup” button in the module box and try the different LED color options to determine which has the highest absorbance (it will appear in real time on the sensor’s module box). Select the color which has the highest absorbance reading.

Included with the sensor:

- NeuLog General Guide
- Three plastic cuvettes with three lids

Sensor's specifications		
	Transmittance	**Absorbance**
Range and operation modes	0-100% Red, green, blue, and orange	0-4 Red, green, blue, and orange
ADC resolution	14 bit	
Resolution	0.02%T	0.01 abs.
Max sample rate (S/sec)	100	

Experiment Duration: 1 second to 31 days.

Sensor's features:

- Fully digital data
- Rugged plastic ergonomic case
- Push button switch for Start/Stop experiments in off line mode
- Red, green, blue and orange LEDs for four different wavelength tests.
- Testing in both transmittance and absorbance
- Internal photodiode for detecting light

Note: NeuLog products are intended for educational use.

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Videos and experiment examples:

- Videos, literature and other probes can be found at www.NeuLog.com.
- In order to access the colorimeter sensor's page, choose "Products" on the main menu and then "Colorimeter logger sensor".
- In order to access the coloriemeter sensor's experiments, choose "Example Labs":
    - Beer-Lambert law (C-28)
    - Color Absorption (C-31)

Technical background:

The philosophy behind NeuLog's plug and play technology is based on each sensor's ability to store its own data due to an internal flash memory chip and micro-controller in each plastic NeuLog body. This technology allows the sensor to collect and then store the digital data in the correct scientific units (°C, °F, Lux, %, ppm, for example).

The sensor is pre-calibrated at the factory. The built-in software in the logger can be upgraded for free at any time using the provided firmware update.

Inside the sensor's plastic body there are four LED lights (red, green, blue and orange) to test various wavelengths.

Light is transmitted from four different colored LEDs inside the sensor's body, one color at a time, passed through the cuvette containing a solution and then detected at the other end to determine the absorbance or transmittance of light at a specific wavelength.

The sensor works off of Beer's Law which is explained in the section "Beer's Law" below.

The four wavelengths emitted are:

- Red: 634 - 662 nm
- Blue: 452 - 476 nm
- Green: 500 - 530 nm
- Orange: 595 - 625 nm

Beer's Law:

Beer's Law is an extremely useful concept for solution concentration testing in the fields of Chemistry and Biology.

Standard curves are created by using solutions of known concentrations which are analyzed in a colorimeter to determine the absorbance and then plot a graph. The absorption for unknown samples can easily be tested and plotted on the standard curve to determine their concentration.

The law states that there is a logarithmic dependence between the transmission T of light through a substance, the product of the absorption coefficient of the substance α, and the distance the light travels through the material l.

For liquids, these relations are usually written as:

$$T = I/I_0 = 10^{-\alpha l}$$

where I_0 and I are the intensity of the incident light and the transmitted light, respectively.

The transmission (or transmittance) is expressed in terms of absorbance which, for liquids, is defined as

$$A = -\log_{10}(I/I_0) = -\log_{10}(T)$$

This implies that the absorbance becomes linear with the concentration (or number density of absorbers) according to $A=\alpha l$

Maintenance and storage:

- Never submerge the NeuLog plastic body in any liquid.
- Never place anything in the colorimeter sensor's opening on the faceplate except the approved cuvettes.
- Do not allow liquid into the NeuLog plastic body.
- After using the probe wipe off all excess material, liquid or residue from the colorimeter probe.
- Store in a box at room temperature out of direct sunlight.
- The cuvette handling and storage guide can be found at the beginning of this document.

Warranty:

We promise to deliver our sensor free of defects in materials and workmanship. The warranty is for a period of 3 years from the date of purchase and does not cover damage of the product caused by improper use, abuse, or incorrect storage. Sensors with a shelf life such as ion selective probes have a warranty of 1 year. Should you need to act upon the warranty, please contact your distributor. Your sensor will be repaired or replaced.

Thank you for using NeuLog!

NeuLog

Flexible, simple, fast, forward thinking.

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