

## NEULOG TURBIDITY LOGGER SENSOR GUIDE



### NeuLog turbidity logger sensor NUL-231

The NeuLog turbidity sensor can be used for any science experiment which uses samples with suspended particles in liquids such as in the fields of Chemistry, Biology, Microbiology, Earth Science, Environmental Science, Biochemistry, etc.

Turbidity is a measurement of the concentration of suspended particles in a solution. The particles could be anything from sand and non-dissolved nutrients to bacterial cells. A turbid liquid is often referred to as cloudy or hazy. This sensor measures turbidity by sending a beam of light through a cuvette and sensing the scattered light from the beam.

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

Three cuvettes with lids are included with the sensor, which load directly into the opening on the sensor's faceplate.

Among hundreds of possible experiments that can be done with the NUL-231 sensor are: Monitoring of ecological systems, bacteria or yeast culturing, studying colonies of Protozoa, environmental health testing, water quality testing, etc.

The turbidity sensor's measurement unit is:

- NTU – Nephelometric Turbidity Unit

### Cuvette usage and handling:

It is important to maintain a standard for cuvette usage as their quality will directly make an impact on the results of your experiments. If the cuvette has fingerprints, smudges or cracks, the sensor will detect them and give off an improper turbidity 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. Do not shake since this could create air bubbles which would be detected by the sensor and give an incorrect reading.
4. Before placing the cuvette in the sensor, hold it as far toward the top as you can and wipe the bottom part of the cuvette with a tissue. Be careful not to touch the bottom of the cuvette again as this could leave residues which could affect the results of the experiment.
5. Load the cuvette into the square hole on the sensor's faceplate and press down gently to slide the cuvette into place.
6. After experimentation, empty your samples, gently rinse out the cuvettes with distilled water and then let them air-dry.

### Quick start procedure:

#### PC or Mac Computer

#### Materials needed:

- NUL-231 Turbidity Sensor
- Cuvettes + Cuvette Lids
- USB-200 USB Module
- USB to mini USB cable (included with the USB-200 module)

Your turbidity sensor needs to be connected to a USB-200 module. The USB-200 module then connects to a computer via a USB to mini-USB cable. Please note that you cannot plug the turbidity sensor directly into the computer.

The browser based application can be downloaded for free at [www.NeuLog.com](http://www.NeuLog.com) as well as a full application user guide. Choose "Downloads" on the main menu and then choose "Software and Application".

#### Procedure:

1. Install the NeuLog application.
2. Connect the USB-200 module to the PC or Mac.
3. Connect the turbidity sensor to the USB-200 module (they directly plug together). Please note that there is no calibration required for this sensor.
4. Open the NeuLog application by clicking on the shortcut on the screen.
5. Once a turbidity sensor module box appears on the left side of the screen the probe has been automatically identified and you can begin experimentation.
6. If the turbidity sensor is not automatically identified, click the "Search for sensors" icon to find the sensor.
7. Click on the "On-line experiment" icon; this will open a graph below.

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- Click on the "Module setup" button located in the turbidity sensor module box to change the sensor's settings if need be.
- Click on the "Experiment set up" icon to change the experiment settings if need be (experiment duration for example).
- The turbidity sensor will give a live reading in its module box to the left of the screen while plugged in.
- To run an experiment and collect data click the "Run experiment" icon.
- To end data collection early, click the "Stop experiment" icon.

### **Tablet, smart phone device**

#### **Materials needed:**

- NUL-231 Turbidity Sensor
- Cuvettes + Cuvette Lids
- WIFI-201 WiFi Module
- BAT-200 Battery Module

Your turbidity sensor needs to be connected to a WIFI-201 module. The WIFI-201 module will create a closed NeuLog WiFi network which will stream the NeuLog data to a device of your choosing. Once your device is wirelessly connected to the NeuLog network, you can run experiments and collect data through a browser of your choosing.

#### **Procedure:**

- Connect the turbidity sensor directly to the left side of a WIFI-201 (no wires required).
- Connect a BAT-200 module to the right side of the WIFI-201 module.
- Although not required, we recommend plugging the BAT-200 to an outlet using a USB to mini USB charger (such as a typical cell phone charger). The WIFI-201 module will run for 60-90 minutes (depending on the sensor) without being plugged in.
- The WIFI-201 module can be powered directly using a mini to USB cord and plugging it into your computer or a wall charger. Please note this function is only available on WIFI-201 modules with the USB icon on the cover.
- For further WIFI-201 instructions or the WIFI-201 quick start guide please visit: [www.NeuLog.com](http://www.NeuLog.com); Choose "Products" on the main menu, then choose "WiFi Communication module".
- The WIFI-201 indicator lights will flash; take no action until the LED to the far left turns blue; this can take up to one minute.
- Take your tablet or smart phone, go to the WiFi settings and select the NeuLog network (NeuLog0184 for example) which matches the ID found on the back of the WIFI-201 module (0184 for example).
- Give your device about 20 seconds to connect to the WIFI-201 module.

- Once the device is connected, go to your browser and type the website **wifi201.com** into the URL bar, then wait for 30-60 seconds.
- You will see a "Control mode" icon in the application, click on it.
- The application will then load a new screen and begin to auto detect the sensor(s); this can take a minute. (You can stop the search when the sensor is found.)
- If the application does not auto detect the sensor(s), select "Search for sensors".
- Once the sensor is found you will see a module box on the left side of the screen for the turbidity sensor. In this box, real time data will be displayed.
- Click on the "Module setup" button located in the turbidity sensor module box to change the turbidity probe settings if need be.
- Click on the "Experiment setup" icon to change the experiment settings if need be (Experiment duration for example).
- To run an experiment and collect data, click on the "On-Line experiment" icon, then click on the "Run experiment" icon.
- If you have a newer generation WIFI-201 module (with the USB icon on the cover) this can be used as a USB-200, meaning you can tether the probes directly to the computer using the WIFI-201. To engage operation in this fashion, press 3 times on the panel button. Repeating this operation will return the module to WiFi mode.

### **Operation with NeuLog Graphic Display Module (viewer)**

#### **Materials needed:**

- NUL-231 Turbidity Sensor
- Cuvettes + Cuvette Lids
- VIEW-101 Viewing Module
- BAT-200 Battery Module

#### **Procedure:**

- Connect the turbidity sensor to the left side of the viewer.
- Connect the BAT-200 module to the right side of the viewer.
- The VIEW-101 will auto detect the sensor and you will see it appear on the left side of the screen.
- Once the sensor appears it will be monitoring data in real time.
- To run an experiment and collect data press the run icon (little green person).

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### Off-line experiments

(Off-line experiments are when you do not have a sensor connected directly to a computer, tablet, smartphone, or NeuLog viewer).

#### Materials needed:

- NUL-231 Turbidity Sensor
- Cuvettes + Cuvette Lids
- BAT-200 Battery Module

#### Materials needed to configure your offline experiment:

- USB-200 Module, WIFI-201 module or VIEW-101 Module
- USB to mini USB cable (included with the USB-200 module).

#### Procedure:

1. To determine the experiment settings, first connect to your chosen device (PC, Mac, tablet, smart device) and click on the "Off-line experiment" icon after the sensor search has ended. (For more information on how to change the experiment settings, view the quick start procedure section for your chosen device in this document.)
2. Connect the turbidity sensor directly to the left side of a charged BAT-200 module.
3. When ready to collect data press the "Start/Stop" button on the turbidity sensor, a red light will turn on for the duration of the experiment.
4. After the experiment has concluded (the "Start/Stop" button is pressed again or the data collection period ends) connect the sensor to your chosen device (you can find full instructions in each device's quick start procedure section).
5. Open NeuLog application.
6. Click the "Off-line experiment" icon.
7. Click the "Load data from sensors" icon.
8. Select which experimental data to upload (5 experimental runs can be stored at one time on the NUL-231 turbidity sensor).

#### Restoring sensor's factory default settings:

#### Procedure:

1. Connect the USB-200 to a PC, Mac, tablet, or smart device.
2. Connect the turbidity sensor to a USB-200 module (they directly plug together).
3. Open the NeuLog application.
4. Click the "Tools" icon.
5. Click the "Restore sensor's factory defaults" on the menu.

#### Included with the sensor:

- Three plastic cuvettes with three lids
- NeuLog NUL-231 Turbidity Sensor Guide (this document)

#### Sensor's specifications

Range and operation modes	0 to 200 NTU
ADC resolution	16 bit
Resolution	0.20 NTU
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
  - LED indicator of experiment status (blinks while collecting data)
  - Internal photodiode for collecting scattered infrared light
  - Pre-calibrated sensing equipment
- Note:** NeuLog products are intended for educational use.

#### Videos and experiment examples:

- Videos, literature and other probes can be found at [www.NeuLog.com](http://www.NeuLog.com).
- In order to access the turbidity sensor's page, choose "Products" on the main menu and then "Turbidity logger sensor".
- In order to find the science experiments, choose "Experiments" on the main menu of the NeuLog website, then choose "Physics", "Chemistry", "Biology" or "Environmental Science".
- Biology Experiment:
  - Monitoring Yeast Growth (B-38)

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### 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.

Samples are poured into cuvettes which are then placed inside the turbidity sensor for analysis. An infrared light is directed at the cuvette and it is scattered off by any suspended particles present in the sample.

A photodiode positioned perpendicular to the light source loses free electrons (photoelectrons) when the scattered photons hit it, creating a readable voltage.

The amount of light being scattered and then detected, is directly proportional to how many solid particles are present in the sample. Turbidity is calculated in Nephelometric Turbidity Units (NTU) based on the voltage reading.

### Maintenance and storage:

- Never place anything into the turbidity sensor opening other than the cuvettes.
- Never submerge the NeuLog plastic body in any liquid.
- Do not allow liquid into the NeuLog plastic body.
- After using the probe, wipe off all excess material liquid or residue from the turbidity sensor.
- Store in a box at room temperature out of direct sunlight.
- The cuvette usage 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!



Flexible, simple, fast, forward thinking.

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