

## NEULOG TURBIDITY LOGGER SENSOR GUIDE



### NeuLog turbidity logger sensor NUL-231

The NeuLog Turbidity Sensor can be used for any science experiment or activity using 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. When a liquid is turbid, it is often referred to as cloudy or hazy. This sensor measures turbidity by measuring sending a beam of light through a cuvette and measuring the unselected light from the beam.

The sensor comes pre-calibrated so you can start experimentation right out of the box using any of the following guides. Three cuvettes with lids come packaged with the sensor, which load directly into the opening on the sensor's faceplate.

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

The turbidity sensor can take measurement with the following units of measure:

- 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. 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 the cuvette as far toward the top as you can and wipe the bottom portion of the cuvette off with a tissue. Do not touch the bottom of the cuvette again as this will leave a residue which will affect the results of the experiment.
5. Load the cuvette into the square hole located on the sensor's faceplate and press down gently to slide the cuvette into place.
6. After experimentation, empty your samples and gently rinse out the cuvettes with distilled water and then let the cuvettes air-dry.

### Quick start procedure:

#### PC or Mac Computer

#### Materials needed:

- NUL-231 Turbidity Sensor
- Cuvettes + Cuvette Lids
- USB-200 USB Module
- A USB to mini USB cable (which comes with the USB-200)

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.

Resident PC software and browser based software can be downloaded for free at [www.NeuLog.com/download](http://www.NeuLog.com/download) as well as a full software user guide. **Note:** Make sure not to download and install both types of software, they will conflict on the computer.

#### Procedure:

1. Install the NeuLog software
2. Connect the USB-200 module to the PC or Mac

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3. Connect the turbidity sensor to the USB-200 module (they directly plug together). Please note there is no calibration required for this sensor.
4. Open the NeuLog software.
5. Once a turbidity sensor logo 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 then click the "Search for sensors" icon to find the sensor.
7. Select the "On-line experiment" button; this will open a graph below.
8. Click on the "Module setup" button located on the turbidity sensor icon in the module window to change the sensor settings if need be.
9. Click on the experiment set up button to change the experiment settings if need be (experiment duration for example).
10. The turbidity sensor will give a live reading in the box to the left of the screen while plugged in.
11. To run an experiment and collect data click "Run experiment".
12. To end data collection early, click "Stop experiment".

### Tablet, smart phone device

#### Materials needed:

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

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:

1. Connect the turbidity sensor directly to the left side of a WIFI-201 module (no wires required).
2. Connect a BAT-200 module to the right side of the WIFI-201 module.
3. Although not required, we recommend plugging the BAT-200 to an outlet using a USB to micro USB charger (such as a typical cell phone charger).

The WIFI-201 module will run for 15-75 minutes (depending on the sensor) without being plugged in.

4. For further WIFI-201 instructions or the WIFI-201 quick start guide please visit [www.NeuLog.com/download](http://www.NeuLog.com/download).
5. The WIFI-201 indicator lights will flash; take no action until the LED to the far left turns blue.
6. Take your tablet or smart phone and go to the Wi-Fi settings and select the NeuLog network which matches the WIFI module ID found on the back of the WIFI-201 device. (NeuLogXXXX for example)
7. Give your device 1-2 minutes to connect to the WIFI-201 network.
8. Once the device is connected go to your browser and type in the website [wifi201.com](http://wifi201.com) into the URL bar, then wait for 30-60 seconds.
9. You will see a "Control mode" icon in the browser, click on this icon.
10. The browser will then load a new screen and begin to auto detect the sensors, this can take a few minutes.
11. If the browser does not auto detect, select "Search for sensors"
12. Once the sensor is found you will see an icon on the left side of the screen for the turbidity sensor. The icon will display data in real time.
13. To set the turbidity sensor's settings click on "Module setup" button located on the turbidity sensor icon on the left side of your screen.
14. To change the experimental settings click the "Experiment setup" button (experiment duration for example).
15. To run an experiment and collect data click "Run experiment".

### Operation with NeuLog viewer

#### Materials needed:

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

#### Procedure:

1. Connect the turbidity sensor to the left side of the viewer.
2. Connect the BAT-200 module to the right side of the viewer.

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3. The VIEW-101 will auto detect the sensor and you will see it appear on the left side of the screen.
4. Once the sensor appears it will be monitoring data in real time.
5. To run an experiment and collect data click the run button (little green person).

### Off-line experiments

(Off-line experiments are for 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

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

- USB-200 USB Module or WIFI-201 WIFI module or VIEW-101 Viewing Module
- A USB to mini USB cable (which comes with the USB-200)

#### Procedure:

1. Connect the turbidity sensor directly to the left side of a charged BAT-200 module.
2. 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.
3. To change the experiment settings first connect to your chosen device (PC, Mac, tablet, smart device) and select the "Module setup" button. (For more information on how to change the experiment settings view quick start procedure section for your chosen device in this document.)
4. After the experiment has concluded (when the "Start/Stop" button is pressed again or the data collection period ends) connect the sensor to your chosen device. (full instructions in each device's quick start procedure section)
5. Open NeuLog software.
6. Click the "Off-line experiment" button.
7. Click the "Load data from sensors" button.

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). Please note there is no calibration required for this sensor.
3. Open the NeuLog software.
4. Click the "Tools" icon.
5. Click "Restore sensor's factory defaults" icon.
6. If prompted to clear the graph, click either the "Off-line experiment" or "On-line experiment" (whichever you are using).
7. Click "Clear experiment results".
8. Resume from step 4.

#### Included with sensor:

- Three plastic cuvettes with three lids.
- Neulog NUL-231 Turbidity sensor Guide (This Document)

Sensor specifications	
Range and operation modes	0-200 NTU
ADC resolution	10 bit
Resolution	0.08 NTU
Max sample rate (S/sec)	100

#### Sensor features:

- Fully digital data
- Rugged plastic ergonomic case

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- 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)
- <http://www.NeuLog.com/Products/TurbidityloggerSensor.aspx>
- Monitoring Yeast Growth  
<http://www.NeuLog.com/Portals/3/Users/Experiment%20B-38%20Monitoring%20Yeast%20Growth%20Ver%203.0.2.pdf>

### 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 and never will require future calibration. The built-in software in the logger can be upgraded for free at any time using the provided firmware updates on the NeuLog website.

Samples are poured into cuvettes which are then placed inside the Turbidity Sensor for analysis. Infrared light is directed at the cuvette and is scattered off of any suspended particles present in the sample. The amount of light being scattered, and then detected, is directly proportional to how many solid particles are 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. Turbidity is calculated in Nephelometric Turbidity Units (NTU) based on the voltage reading.

### Beer's Law:

Beer's Law is an extremely useful concept in solution concentration testing in the fields of Chemistry and Biology. Standard curves are created by using solutions of known concentrations which analyzed in a turbidity to determine the absorbance then graphed. The absorption for unknown samples can easily be tested and plotted on the standard curve to determine their concentration.

### 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.
- Cuvette usage guide can be found in the beginning of this document

### Warranty:

We promise to deliver our sensor free of defects in materials and workmanship for a period of 3 years from the date of purchase. Our warranty 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.

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Thank you for using NeuLog!



Flexible, simple, fast, forward thinking.

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