

## NEULOG NITRATE LOGGER SENSOR GUIDE



### NeuLog nitrate logger sensor NUL-241

The NeuLog nitrate ion sensor can be used for any science experiment which utilizes nitrate concentration readings such as in the fields of Environmental Science, Ecology, Chemistry, Biology, etc.

Among hundreds of possible experimental subjects that can be studied with the NUL-241 sensor are: chemical reactions, water quality, environmental health, small animal behavior, ecological studies, and many more.

The nitrate sensor's measurement units are:

- Milligrams per liter (mg/L): SI measurement unit for density of a solid dissolved in a liquid.
- Parts per million (ppm): The total amount of a specific molecule (nitrate for example) per million molecules in a sample.

### Nitrate sensor usage:

The nitrate sensor's electrode uses a PermaFil (non-refillable), ion-selective electrode. The reference chamber is gel filled and sealed; therefore, no reference filling solution is required.

### Usage guide:

<b>Concentration range</b>	1M to $7 \times 10^{-6}$ M 0.1 to 14,000 ppm as N
<b>pH range</b>	2.5 to 11 pH
<b>Temperature range</b>	0 to 50°C
<b>Minimum sample size</b>	3mL in a 50 mL beaker
<b>Reproducibility</b>	$\pm 4\%$
<b>Electrode resistance</b>	1 to 4 megaohms

### Equipment required:

- Wash bottle with distilled or deionized water
- Several clean beakers
- 1 mL, 10 mL and 50 mL pipettes (a 50 ml graduated cylinder can also be used).

### Technical notes:

- All standard solutions should be prepared fresh.
- The standard solutions should be at the same temperature as the sample.
- Use ISA in all solutions.  
**Note:** ISA is added to all solutions to ensure the samples and standard solutions have the same ionic strength; the ratio is 1:50.

### Electrode preparation:

1. Remove the protective cap encasing the nitrate probe's electrode. **CAUTION: Do not touch the PVC membrane at the end of the probe with your fingers.**
2. Rinse the electrode with deionized water and blot dry. Be sure not to rub as this will harm the sensor.
3. Soak the electrode in deionized water for 10 minutes, then in a diluted nitrate standard solution (0.0001 M or 1 ppm) for two hours until ready for use.
4. For preparing the 1 ppm standard solution, mix one drop of the 1000 ppm standard solution with 20 drops of ISA and add deionized water up to a total of 40 ml solution (assuming one drop equals 0.04 ml). It is also possible to use a micropipette if available.

### Offsetting the sensor:

Be sure to offset the nitrate sensor once daily during periods of regular usage.

1. Prepare the electrode as described in the "Electrode preparation" guide above. If you have already prepared the electrode in the last three days and stored it as described in the "Electrode storage" section then you do not have to repeat it before offsetting the sensor.
2. Prepare the offsetting solution: Mix 1 ml of the ISA solution with 0.5 ml of the 1000 ppm standard solution. Add deionized water up to a total of 50 ml. You will get a 10 ppm solution.
3. Rinse the electrode with deionized water, blot dry and place in the beaker.
4. After a stable reading has been reached, press the "Start/Stop" button located on the sensor's faceplate for 4 seconds.
5. Rinse the electrode once more with deionized water and blot dry.
6. The nitrate sensor is now ready for use.

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### Electrode storage:

#### Short term (overnight or weekend):

Rinse the electrode thoroughly with deionized water and place the tip in a diluted standard solution (around 10 ppm) between measurements.

#### Long term:

Rinse the electrode thoroughly with deionized water and blot dry. Attach the hard plastic protective electrode cap again to protect the sensing element. Follow procedures in the "Electrode preparation" section when using the electrode again.

### Quick start procedure:

#### PC or Mac Computer

#### Materials needed:

- NUL-241 Nitrate Sensor
- USB-200 USB Module
- A USB to mini USB cable (included with the USB-200 module)

Before use, please review the "Nitrate sensor usage", "Electrode preparation", "Electrode storage" and "Offsetting the sensor" sections of this document to ensure a proper use and longevity of the NeuLog nitrate ion sensor.

Your nitrate 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 nitrate 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 nitrate sensor to the USB-200 module (they directly plug together).
4. Open the NeuLog application by clicking on the shortcut on the screen.
5. Once a nitrate 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 nitrate sensor is not automatically identified then click the "Search for sensors" icon to find the sensor.
7. Click on the "On-line experiment" icon; this will open a graph below.
8. Click on the "Module setup" button located in the nitrate sensor module box to change the sensor's settings if need be.
9. Click on the "Experiment set up" icon to change the experiment settings if need be (experiment duration for example).
10. The nitrate sensor will give a live reading in its module box while plugged in.
11. To run an experiment and collect data click the "Run experiment" icon.
12. To end data collection early, click the "Stop experiment" icon.

#### Tablet, smart phone device

#### Materials needed:

- NUL-241 Nitrate Sensor
- WIFI-201 WiFi Module
- BAT-200 Battery Module

Before use, please review the "Nitrate sensor usage", "Electrode preparation", "Electrode storage" and "Offsetting the sensor" sections of this document to ensure the proper use and longevity of the NeuLog nitrate ion sensor.

Your nitrate 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 nitrate 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 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.
4. The WIFI-201 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.

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- 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 nitrate sensor. In this box, real time data will be displayed.
- Click on the "Module setup" button located in the nitrate sensor module box to change the nitrate 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-241 Nitrate Sensor
- VIEW-101 Graphic display Module
- BAT-200 Battery Module

Before use, please review the "Nitrate sensor usage", "Electrode preparation", "Electrode storage" and "Offsetting the sensor" sections of this document to ensure the proper use and longevity of the NeuLog nitrate ion sensor.

#### **Procedure:**

- Connect the nitrate 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).

#### **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-241 Nitrate Sensor
- BAT-200 Battery Module

Before use, please review the "Nitrate sensor usage", "Electrode preparation", "Electrode storage" and "Offsetting the sensor" sections of this document to ensure the proper use and longevity of the NeuLog nitrate ion sensor.

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

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

#### **Procedure:**

- 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.)
- Connect the nitrate sensor directly to the left side of a charged BAT-200 module.
- When ready to collect data, press the "Start/Stop" button on the nitrate sensor; a red light will turn on for the duration of the experiment.

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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 the 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-241 nitrate sensor).

### Restoring sensor's factory default settings:

#### Procedure:

1. Connect the USB-200 module to a PC, Mac, tablet, or smart device.
2. Connect the nitrate 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:

- NeuLog NUL-241 Nitrate Sensor Guide (this document)
- NeuLog nitrate ( $\text{NO}_3^-$ ) sensor electrode.
- Nitrate ( $\text{NO}_3^-$ ) Ionic Strength Adjuster (ISA)
- Nitrate ( $\text{NO}_3^-$ ) 1000 ppm standard

Sensor's specifications		
	mg/L	ppm
<b>Range and operation modes</b>	0.1 to 14,000	0.1 to 14,000
<b>ADC resolution</b>	15 bit	
<b>Resolution</b>	<b>0.1</b> at 0.1 to 1,000 mg/L <b>98</b> at 1,000 to 14,000 mg/L	<b>0.1</b> at 0.1 to 1,000 ppm <b>98</b> at 1,000 to 14,000 ppm
<b>Max sample rate (S/sec)</b>	100	

**Experiment Duration:** 1 second to 31 days.

### Sensor's features:

- Fully digital data
  - Rugged plastic ergonomic case
  - PermaFil ion selective electrode
  - Nitrate probe connected to the sensor's body by a flexible rubber-coated wire
  - Protective hard-plastic storage cap
  - Push button switch for Start/Stop experiments in off line mode
  - LED indicator of experiment status (blinks while collecting data)
- 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 nitrate sensor's page, choose "Products" on the main menu and then "Nitrate 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:
  - Ammonium and Nitrate in an Aquarium (B-45)

### 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 ( $^{\circ}\text{C}$ ,  $^{\circ}\text{F}$ , 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.

The nitrate sensor uses a permanently filled ion selective electrode to accurately measure the amount of nitrate ion in a solution.

The Ionic Strength Adjustor (ISA) is used to standardize the strength of the ions in various solutions to give the most accurate readings.

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### Maintenance and storage:

Before use, please review the “Nitrate sensor usage”, “Electrode preparation”, “Electrode storage” and “Offsetting the sensor” sections of this document to ensure the proper storage and longevity of the NeuLog nitrate ion sensor.

- Never submerge the NeuLog plastic body in any liquid
- Do not allow liquid into the nitrate sensor’s body
- After use, gently wipe away any foreign material from the nitrate sensor
- Store in a box at room temperature out of direct sunlight.

### 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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