

NEULOG TEMPERATURE LOGGER SENSOR GUIDE



NeuLog temperature logger sensor NUL-203

The NeuLog temperature sensor can be used to make temperature measurements in solids, liquids, or gases for any science experiment where a thermometer is required. It is used in the fields of Chemistry, Physics, Biology, Earth Science, Environmental Science, etc.

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

Among hundreds of possible experiments that can be performed with the NUL-203 sensor are: monitoring of ecological systems, study of photosynthesis, effect of temperature on enzymes, endothermic and exothermic reactions, heat and energy transfer, weather studies, insulation studies and ideal gas law studies.

This sensor is capable of measuring both in Celsius and Fahrenheit.
Celsius ($^{\circ}\text{C}$): The SI (International System of Units) unit of temperature.
Fahrenheit ($^{\circ}\text{F}$): The temperature measurement unit of the English System commonly used in the United States.

Quick start procedure:

PC or Mac Computer

Materials needed:

- NUL-203 Temperature Sensor
- USB-200 USB Module
- USB to mini USB cable (included with the USB-200 module)

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

The browser based application can be downloaded for free at 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 temperature 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 temperature 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 temperature 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.
8. Click on the "Module setup" button located in the temperature 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 temperature 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-203 Temperature Sensor
- WIFI-201 WiFi Module
- BAT-200 Battery Module

Your Temperature 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 the 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 Temperature 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.

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- 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 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; 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 temperature sensor. In this box, real time data will be displayed.
- Click on the "Experiment setup" icon to change the experiment settings if need be (Experiment duration for example).
- Click on the "Module setup" button located in the temperature sensor module box to change the units of the data (Celsius or Fahrenheit for example).
- To run an experiment and collect data, click on the "On-Line experiment" icon, then click 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-203 Temperature Sensor
- VIEW-101 Graphic Display Module
- BAT-200 Battery Module

Procedure:

- Connect the temperature sensor to the left side of the viewer.
- Connect the BAT-200 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-203 Temperature Sensor
- 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:

- 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 temperature sensor directly to the left side of a charged BAT-200 module.
- When ready to collect data, press the "Start/Stop" button on the temperature 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-203 temperature 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 temperature sensor to the 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:

- Stainless steel temperature sensor connected permanently to the NeuLog connection block
- NeuLog NUL-203 Temperature Sensor Guide (this document)

Sensor's specifications	
Range (Celsius)	-40 to +140°C
Range (Fahrenheit)	-40 to +284°F
Resolution	12 Bits
Accuracy (Celsius)	± 1°C
Accuracy (Fahrenheit)	± 2°F
Resolution (Celsius)	0.1°C
Resolution (Fahrenheit)	0.2°F
Maximum sampling rate	100 samples/second
Probe dimensions	180 mm long, 3.2mm in diameter

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)
 - Stainless Steel tube
- Note:** NeuLog products are intended for educational use.

Videos and experiment examples:

- Videos, literature and other probes can be found at www.NeuLog.com.
- In order to access the temperature sensor's page, choose "Products" on the main menu and then "Temperature 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".
- Physics Experiment:
 - Thermal Conductivity (P-38)
- Biology Experiment:
 - Enzyme Activity (B-7)
- Chemistry Experiments:
 - Gay-Lussac's Law (C-14)
 - Distillation – part 1 (C-15)
 - Distillation – part 2 (C-15)
 - Evaporation (C-17)
 - Endothermic and Exothermic reactions – part 1 (C-18)
- Environmental Science Experiments:
 - Measuring Dew Point (E-5)
 - Microclimates and GPS (E-7)
 - Temperature and Relative Humidity (E-9)

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).

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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 of the stainless steel probe is a thermistor which is a variable resistor that varies significantly with temperature. The resistance increases nonlinearly with a decreasing temperature. During calibration, the sensor's internal controller creates the conversion formula from resistance to temperature.

No calibration is needed ever for this sensor because the probe is permanently connected to the controller and there is no need to change the conversion formula.

The stainless steel rod contains a 10K Ω NTC thermistor (Negative Temperature Coefficient variable resistor) glued in its bottom by temperature conductor special glue.

Maintenance and storage:

- Never submerge the NeuLog plastic body in any liquid.
- Do not allow liquid into the NeuLog plastic body where the temperature tether enters the body.
- After using the probe, wipe off all excess material, liquid or residue from the temperature probe.
- Store in a box at room temperature out of direct sunlight.
- Do not put the plastic case or cord of the temperature probe in an acid or base.

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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