

NEULOG FORCE LOGGER SENSOR GUIDE



NeuLog force logger sensor NUL-211

The NeuLog force sensor can be used for any science experiment which involves both constant and changing forces such as in the fields of Physics, Physiology, Mechanics, Biomechanics, Biology, etc.

With the ability to hang the sensor using a stand and rod, an attached hook to hang weights, as well as two directional measurement capabilities that work by applying force on either side of the probe, the NeuLog force sensor can easily be set up to your specific requirements to give quick, easy, accurate, and reliable data.

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

The sensor can easily be reset to zero at any time.

Among hundreds of possible experimental subjects that can be studied with the NUL-211 sensor are: Applied forces and energy, friction, Newton's Laws of Motion, physiological concepts, collisions, harmonic motion, and many more.

This sensor measures force in both the push and pull directions.

The unit of measurement that the force sensor collects data in is the newton:

Newton (N): The SI unit of force.
 $1 \text{ N} = 1 \text{ kg} \cdot \text{m/s}^2$
 ($\pm 10 \text{ N}$ or $\pm 50 \text{ N}$)

Reset to zero:

The force sensor comes pre-calibrated, however, after use you may find that the sensor is slightly off because of changes in its position; or you may want to run an experiment that requires you to zero the sensor with a constant applied force on it.

To zero the sensor:

1. Connect the NUL-211 force sensor to a computer/tablet/smart device following one of the guides below.
2. Open the NeuLog application.
3. When your sensor has been detected, click on the "Module setup" button located in the force sensor module box (on the left side of your screen).
4. Remove all force from the sensor and click "reset" to zero your force sensor.
5. You can also reset the sensor to zero by pressing and holding the sensor push button for 3 seconds.
6. Your force sensor is now reset to zero.

Note: You can zero the scale with a constant force being applied to it to set that value as your new "zero".

Negative and positive forces:

1. Connect the NUL-211 force sensor to a computer/tablet/smart device following one of the guides below.
2. Open the NeuLog application.
3. When your sensor has been detected, click on the "Module setup" button located in force sensor module box (on the left side of your screen).
4. In order to set that an applied push force appears as a negative value and an applied pull force appears as a positive value, click on the "Push=Negative" icon.

In order to set that an applied push force appears as a positive value and an applied pull force appears as a negative value, click on the "Push=Positive" icon.

Quick start procedure:

PC or Mac Computer

Materials needed:

- NUL-211 Force Sensor
- USB-200 USB Module
- USB to mini USB cable (included with the USB-200 module)

Your force 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 force sensor directly into the computer.

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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 force sensor to the USB-200 module (they directly plug together). Please note that no calibration is required for this sensor.
4. Open the NeuLog application by clicking on the shortcut on the screen.
5. Once a force 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 force sensor is not automatically identified, click the "Search for sensors" icon to find the sensor.
7. Click the "On-line experiment" icon; this will open a graph below.
8. Click on the "Module setup" button located in the force sensor module box to change the sensor's settings if need be.
9. Click on the "Experiment setup" icon to change the experiment settings if need be (experiment duration for example).
10. The force sensor will give a live reading in its module box to the left of the screen 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-211 Force Sensor
- WIFI-201 WiFi Module
- BAT-200 Battery Module

Your force 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 force 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 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.
5. 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".
6. 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.
7. 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).
8. Give your device about 20 seconds to connect to the WIFI-201 module.
9. 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.
10. You will see a "Control mode" icon in the application, click on it.
11. 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.)
12. If the application does not auto detect the sensor(s), select "Search for sensors".
13. Once the sensor is found you will see a module box on the left side of the screen for the force sensor. In this box, real time data will be displayed.
14. Click on the "Module setup" button located in the force sensor module box to change the force probe settings if need be.
15. Click on the "Experiment setup" icon to change the experiment settings if need be (Experiment duration for example).
16. To run an experiment and collect data, click on the "On-Line experiment" icon, then click the "Run experiment" icon.

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17. 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-211 Force Sensor
- VIEW-101 Graphic Display Module
- BAT-200 Battery Module

Procedure:

1. Connect the force sensor to the left side of the viewer.
2. Connect the BAT-200 module to the right side of the viewer.
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 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-211 Force 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:

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 force 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 force 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 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-211 force 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 force sensor to a USB-200 module (they directly plug together).
3. Open the NeuLog application.
4. Click the "Tools" icon.
5. Click "Restore sensor's factory defaults" on the menu.

Included with the sensor:

- NeuLog NUL-211 Force Sensor Guide (this document)
- Utility probe with hook attached to the sensor by a durable rubber-coated wire. Screw for easy attachment to a lab stand.

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Sensor specifications		
	10 N range	50 N range
Range and operation modes	± 10 N	± 50 N
ADC resolution	16 bit	
Resolution	0.02 N	
Max sample rate (S/sec)	3000	3000

Experiment Duration: 50 milliseconds to 31 days.

Sensor 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)
- Pre-calibrated sensing equipment
- Strong plastic force utility sensor with hook attached to the sensor's plastic body by a durable rubber-coated wire
- The force sensor takes measurements in two directions for both pushing and pulling experiments and can measure applied forces on either side of the probe.

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 force sensor's page, choose "Products" on the main menu and then "Force 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 Experiments:
 - Friction Force (P-6)
 - Pulley System (P-8)
 - An Inclined Plane (P-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 ($^{\circ}\text{C}$, $^{\circ}\text{F}$, Lux, %, ppm, for example).

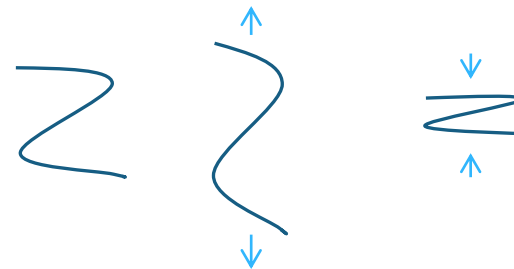
The sensor is pre-calibrated at the factory. The built-in software in the logger can be upgraded for free at any time using the provided firmware update.

The force sensor is based on a metal rod connected at both sides to the force sensor hooks in a special shape called 'S' shape. A strain gauge is attached to the metal rod and connected to a very sensitive operational amplifier.

No force is applied

Pull force

Push force



Pulling or pushing the hooks bends very little the metal rod, changes the strain gauge resistances and the amplifier output voltage. This voltage is converted into force (N) by the sensor's controller.

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Maintenance and storage:

- 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 sensor.
- Store in a box at room temperature out of direct sunlight.
- Avoid storing with weight applied directly to the sensor.
- Do not apply more than 250 Newtons of force to the sensor.

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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V11042014