

NEULOG BLOOD PRESSURE LOGGER SENSOR GUIDE



NeuLog blood pressure logger sensor NUL-222

The NeuLog blood pressure sensor can be used for any science experiment which involves blood pressure measurements such as in the fields of Exercise Science, Biology, Physiology, Human Health, etc.

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

Among hundreds of possible experimental subjects that can be studied with the NUL-222 sensor are: exercise studies, human health studies, athlete comparisons, blood pressure abnormalities, and many more.

The blood pressure sensor's measurement units are:

- Millimeters of mercury (mm Hg): A standard non-SI pressure measurement unit
- Analog arbitrary units (Arb): An arbitrary value used to demonstrate waveforms without a unit
- Millimeters of mercury and analog arbitrary units (mm Hg + Arb): A combination of both units

The blood pressure sensor measures the gas pressure in a cuff attached to a person's arm. This pressure is equal to the pressure operated on the subject's arm.

The heart beats affect the subject's pressure and thus create very small fluctuations in the gas pressure in the cuff. These fluctuations are what doctors hear when they perform a blood pressure check.

The sensor's hardware and firmware separate the average pressure and the pressure fluctuations. They amplify the fluctuations and then add these amplified fluctuations to the average pressure, creating a signal that enables the calculation of the MAP, the systolic and diastolic pressures.

The three ranges of the sensor show the real measured pressure (with very small fluctuations in mm Hg), only the pressure amplified fluctuations (Arb) and the combined signal of both of them.

In the "mm Hg + Arb" mode you can calculate these parameters:

MAP:

MAP (Mean Arterial Pressure) is the pressure where the fluctuations are maximal.

The firmware starts by checking first the average pressure where the largest fluctuations are.

Systolic:

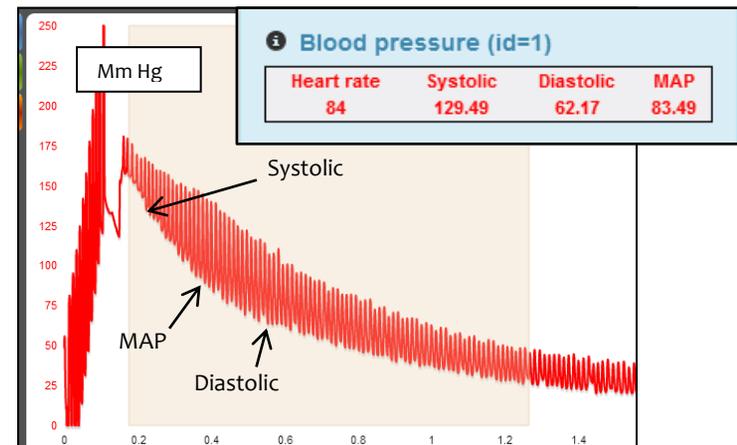
The pressure exerted by the blood on the arterial walls while the heart is beating (maximum pressure achieved). Ideally this value should be in the 90 to 120 mm Hg range for adults and roughly 100 mm Hg for children aged 6 to 9.

This is the average high pressure where the fluctuations' magnitude is 54% of their magnitude at the MAP.

Diastolic:

The pressure exerted by the blood on the arterial walls while the heart is relaxed, between beats (the minimum pressure achieved). Ideally this value should be in the 60 to 80 mmHg range for adults and around 65 mmHg for children aged 6 to 9.

This is the average low pressure where the fluctuations' magnitude is 72% of their magnitude at the MAP.



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Use of the blood pressure cuff:

To accurately record blood pressure rates, you must first properly attach the blood pressure cuff to the subject being tested.

Note: The cuff works through clothing, however, try to minimize layers for the best readings possible.

1. Unwrap the blood pressure cuff and find the Velcro connection pads.
2. Situate the blood pressure cuff with the Velcro pads facing outwards.
3. Wrap the blood pressure cuff tightly, but without causing discomfort, around the subject's upper arm.
4. Ensure that the rubber tubing (connected directly to the blood pressure cuff) is situated only a couple of centimeters above the inner elbow.
5. Close the air pressure release valve by twisting the metallic knob until it tightens.
6. Using the hand-pump, fill the blood pressure cuff's bladder until it forms a snug but not uncomfortable fit (around 170 mm Hg should be enough).
7. Run an experiment following one of the following guides.
8. Loosen the pressure valve to allow a pressure decrease of about 3 to 4 mm Hg per second.

Calculating heart rate, systolic, diastolic, and mean arterial pressure (MAP):

Using the NeuLog software, the systolic, diastolic, and MAP blood pressure values can easily be calculated:

1. Conduct an experiment following the "Using the blood pressure cuff" guide and one of the guides for setup (use the "mm Hg + Arb" mode").
2. After data collection, click the "Select Zone" icon underneath the graph.
3. Highlight the region of the data that has a steady decline with visible heart beats by clicking and dragging on the graph.
4. Click on the "Show Functions" icon.
5. Select the sensor you wish to calculate for.
6. Click on the "Functions" icon.
7. Click on "Blood Pressure" to open an information box on the right hand side of the graph.

Quick start procedure:

PC or Mac Computer

Materials needed:

- NUL-222 Blood pressure Sensor
- USB-200 USB Module
- USB to mini USB cable (included with the USB-200 module)

Your blood pressure 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 blood pressure sensor directly into 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 blood pressure 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 blood pressure 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 blood pressure sensor is not automatically identified, click the "Search for sensors" icon to find the sensor.
7. Select the "On-line experiment" icon; this will open a graph below.
8. Click on the "Module setup" button located in the blood pressure sensor module box to change the sensor's settings if need be.
9. Click on the "Experiment setup" button to change the experiment settings if need be (experiment duration for example).
10. The blood pressure sensor will give a live reading in the 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.

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Tablet, smart phone device

Materials needed:

- NUL-222 Blood Pressure Sensor
- WIFI-201 WIFI Module
- BAT-200 Battery Module

Your blood pressure 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 blood pressure 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.
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.
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 blood pressure sensor. In this box, real time data will be displayed.
14. Click on the "Module setup" button located in the blood pressure sensor module box to change the blood pressure 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 the "On-Line experiment" icon, then click the "Run experiment" icon.
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-222 Blood Pressure Sensor
- VIEW-101 Viewing Module
- BAT-200 Battery Module

Procedure:

1. Connect the blood pressure 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-222 Blood Pressure Sensor
- BAT-200 Battery Module

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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 blood pressure 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 blood pressure 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-222 blood pressure sensor).

Restoring sensor's factory default settings:

Procedure:

1. Connect the USB-200 to a PC, Mac, tablet, or smart device.
2. Connect the blood pressure 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-222 Blood Pressure Sensor Guide (this document)
- Blood pressure cuff attached directly to the sensor by flexible rubber tubing

- Hand pump with pressure release valve attached directly to the blood pressure cuff

Sensor's specifications			
	mm Hg	Arb	mm Hg + Arb
Range and operation modes	0 to 250	0 to 820	0 to 250
ADC resolution	13 bit		
Resolution	0.12	0.1	0.02 mm Hg
Max sample rate (S/sec)	100		

Experiment Duration: 1 second to 31 days.

Sensor's features:

- Fully digital data
 - Rugged plastic ergonomic case
 - Blood pressure cuff attached to the sensor's body by a flexible rubber hose
 - Hand pump with pressure valve for increasing and decreasing pressure, attached directly to the blood pressure cuff by a flexible rubber hose
 - Push button switch for Start/Stop experiments in off line mode
 - LED indicator of experiment status (blinks while collecting data)
 - 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.
- In order to access the blood pressure sensor's page, choose "Products" on the main menu and then "Blood pressure 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:
 - Blood Pressure (B-1)

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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 ($^{\circ}\text{C}$, $^{\circ}\text{F}$, 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 blood pressure sensor uses the piezoresistive effect. The transducer is made of two metal foils separated by silicon; when pressure is applied on the transducer its resistance changes. One side of it is at complete vacuum which enables the measurement of the absolute pressure on its other side.

This transducer is built as a strain gauge with a Wheatstone bridge circuit. Its voltage's output depends on the absolute pressure.

When the user pumps, a pressure is applied directly to the blood pressure monitor cuff's bladder and it is detected by an internal sensing unit. The pressure in the cuff is equal to the pressure operated on the subject's arm.

The heart beats affect the subject's pressure and thus create very small fluctuations in the gas pressure in the cuff. This gives an AC signal reading on a DC signal.

The pressure is converted into an electrical signal which separates into DC (mm Hg) and AC (Arb.) signals. The AC signal is amplified and added back to the DC signal to create the mm Hg + Arb. signal.

Maintenance and storage:

- Never submerge the NeuLog plastic body in any liquid.
- Do not allow liquid into the blood pressure sensor's body.
- After use, gently wipe away any foreign material from the blood pressure 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!



Flexible, simple, fast, forward thinking.

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