NEULOG PANDA MULTI-SENSOR GUIDE

NeuLog Panda Multi-Sensor
PANDA-1

The NeuLog Panda multi-sensor can be used for any science experiment which utilizes Room Temperature, Light, Barometric pressure, Altitude, Sound, Relative Humidity, Dew-Point, Magnetic Field and G-Acceleration readings.

Panda is used for environmental data collection and other experiments in Natural Science, Biology, Physics and Chemistry.

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

Hundreds of possible experimental subjects can be performed with the Panda multi-sensor. Examples are: Light, relative humidity and temperature at different environments, Qualitative and quantitative description of nature, Sound intensity levels, Sound and distance, Rate of heating and cooling, Barometric pressure and altitude measurements at different heights, Barometric pressure and weather, Magnetism – positive and negative poles, Compass experiments, Acceleration in an elevator or car, Acceleration and harmonic motion, Dew point and dew formation.

The internal sensors' measurement units are:

Temperature sensor:

- Celsius (^{0}C): The SI (International System of Units) unit of temperature.
- Fahrenheit (^{0}F): The temperature measurement unit of the English System commonly used in the United States.

Light sensor:

The measurement unit for all four data collection ranges (low, medium, high) is the lux. Lux (lx, or lux): The SI unit of light intensity

Barometer sensor:

The barometer sensor can collect data using four different units of measurement:

- Kilopascal (kPa): The SI unit of pressure
- Atmospheres (atm): A pressure unit equal to one Earth atmosphere at sea level (101.325 kPa)
- Inches of mercury (in Hg): A non-SI unit of atmospheric pressure
- Millimeters of mercury (mm Hg): A non-SI unit of atmospheric pressure

Altitude sensor:

The altitude sensor's units are Meters (M), the SI base unit of length.

Sound sensor:

The sound sensor's measurement unit is*:*

Decibel (dB): A measurement unit that shows intensity (loudness of sound). This is a logarithmic unit.

Relative humidity sensor:

Data is presented as a percentage which is the ratio of the amount of water vapor in the air versus the maximum amount that could be allowed at a given temperature.

Dew point sensor:

The NeuLog dew point temperature is presented in the following units of measurement:

- Celsius: The SI (International System of Units) unit of temperature.
- Fahrenheit: The temperature measurement unit of the English System commonly used in the United States.

Magnetic field sensor:

The magnetic field sensor's measurement units are:

- Micro Tesla (µT): The SI unit of magnetic flux density (magnetic field).
- Angle degrees (^{o}).

G-Acceleration sensor:

The acceleration sensor's measurement unit is:

Meters per second squared (m/s^2): The SI unit of acceleration or change in velocity over time.

The Panda enables to zero offset the G-acceleration value in order to turn it to acceleration sensor.

Included with sensor:

- NeuLog General Guide
- USB to mini USB cable
- 9 Internal sensors
- Internal rechargeable battery that can be charged by the cable (battery level is shown on screen).

Sensor specifications		
Range and operation modes	**ADC resolution**	**Resolution**
Temperature Sensor		
–25 to 60 ^{o}C	12 bit	0.1 ^{o}C
–13 to 140 ^{o}F	12 bit	0.2 ^{o}F
Light Sensor		
1,000 lx	16 bit	1 lx
6,000 lx	16 bit	1 lx
60,000 lx	16 bit	1 lx
240,000 lx	18 bit	6 lx
Barometer Sensor		
66 to 110 kPa	24 bit	0.1 kPa
0.65 to 1.08 atm	24 bit	0.01 atm
19.49 to 32.48 in Hg	24 bit	0.01 in Hg
495 to 825 mm Hg	24 bit	0.1mm Hg
Altitude Sensor		
-722 to 3000 m	24 bit	0.9 m
Sound Sensor		
40 to 110 dB	12 bit	0.1 dB
Humidity Sensor		
0 to 100 %	16 bit	0.1 %
Dew-Point Sensor		
-114 to 109 ^{o}C	12 bit	0.1 ^{o}C
-182 to 228 ^{o}F	12 bit	0.2 ^{o}F
Magnetic Field Sensor		
X Axis -200 to 200 µT	16 bit	0.1 µT
Y Axis -200 to 200 µT	16 bit	0.1 µT
Z Axis -200 to 200 µT	16 bit	0.1 µT
0^{o} to 360^{o}	16 bit	1^{o}
Acceleration Sensor		
X Axis -20 to 20 m/s^2	16 bit	0.01 m/s^2
Y Axis -20 to 20 m/s^2	16 bit	0.01 m/s^2
Z Axis -20 to 20 m/s^2	16 bit	0.01 m/s^2

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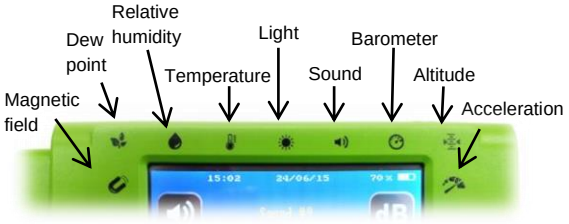
NeuLog Panda can work with external sensors (up to 5 at a time) as well (these are not included in the Panda package).

Part No.	Sensor
NUL-201	Voltage sensor
NUL-202	Current sensor
NUL-203	Temperature Sensor
NUL-204	Light Sensor
NUL-205	Oxygen sensor
NUL-206	pH sensor
NUL-208	Heart rate & pulse sensor
NUL-209	Photo gate sensor
NUL-210	Pressure sensor
NUL-211	Force sensor
NUL-212	Sound sensor
NUL-213	Motion sensor
NUL-215	Conductivity sensor
NUL-218	Electrocardiogram sensor
NUL-219	Colorimeter sensor
NUL-220	CO_2 sensor
NUL-222	Blood pressure sensor
NUL-230	UVB sensor
NUL-232	UVA sensor
NUL-243	GPS position sensor

Panda's features:

- Fully digital data.
- Rugged plastic case.
- Push button switch that powers the multi-sensor on and off.
- Sensor icons that show the internal sensors.



- Sensors are pre-calibrated.
- 3.2" (320X240 pixels) Color display touch screen that turns off after 2 minutes without use (4 minutes until full device turns off).
- Has the ability to save 20 experiments in the internal memory (no matter what the experiment parameters are).

Note: NeuLog products are intended for educational use.

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 is also true for the Panda Multi-sensor. This technology allows the multi-sensor to collect and then store the digital data in the correct scientific units (^{o}C, ^{o}F, Lux, %, for example).

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

The viewer's screen uses resistive touchscreen technology which reacts to a pressure being applied to the screen – opposed to the more common capacitive screen which requires an electrical conductor to operate. This allows for students to operate the screen even while wearing gloves.

Temperature:
Inside the Panda device 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.

Light:
Inside the hard plastic casing, lies a photodiode which reacts with photons to release free electrons (photoelectrons). The amount of light striking the sensor is directly proportional to the voltage generated by the photoelectrons released. The sensor measures the general voltage released and thus calculates the light intensity.
If the light readout is very low, try changing the sensor's mode to a higher sensitivity.

Barometer:
The barometer 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.

Altitude:
The altitude reading is based on the barometric pressure which is translated to meters.

Sound:
The sound sensor uses an internal microphone with a series of circuits, filters, and amplifiers to best isolate a specific sound source. Sound waves enter through the hole at the top of the sensor's plastic body so you should point it directly towards the sound source for best readings.

Relative humidity:
The relative humidity sensor's casing houses a capacitive polymer which reacts with water vapor present in the air. The reaction with the polymer produces a voltage which is relative to the concentration of water vapor in the air.

Dew point:
Dew point is calculated using both the environmental temperature and relative humidity values.

Magnetic field:
The magnetic field sensor utilizes the Hall Effect to generate a voltage relative to the magnetic field. The Hall Effect is a natural phenomenon where a magnetic field exerts a force on charge carriers if an electrical current flows through the magnetic field. The charge differential is measured and can easily be converted into the magnetic field strength because of the direct relationship.

G-Acceleration:

The G-acceleration IC sensor houses three small thin silicon accelerometers. Each accelerometer is oriented along a different axis (X, Y, or Z) connected to a weight and based on piezoresistive technology. When an accelerometer experiences force along its axis, the silicon changes its resistance proportionally to the force it is experiencing.

These resistor changes are converted into voltage by a Wheatstone bridge circuit and read by the IC internal controller. The IC converts the force into acceleration and transmits, upon request, the 3D accelerations in a digital form.

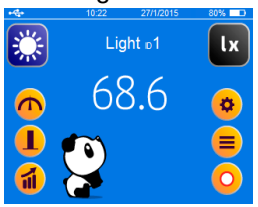
Making measurements with NeuLog Panda:

Panda is operated by independent internal firmware for performing experiments and data collection.

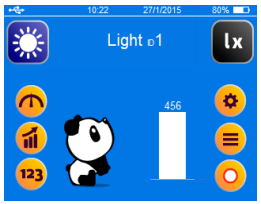
The Panda firmware is specially designed for elementary school level, is unique, super friendly and very intuitive.

In **normal mode**, Panda displays the value measured of one of its internal or external sensors in one display option:

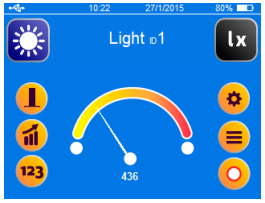
Digital



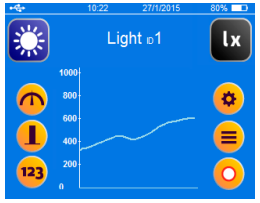
Bar



Analog meter



Accumulative graph

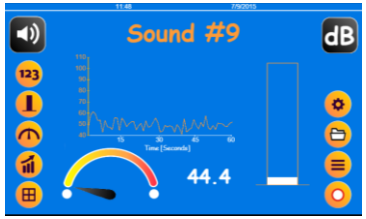


In **experiment record** mode, Panda displays the sampled values of up to two sensors at a time. It records, in its flash memory, the measurements of all its internal sensors (and also external if connected while the measurement is performed). These values can be displayed at any time.

Application:

Panda's application (for PC, MAC or tablets) has the same features as the internal Panda software along with the following ones:

1. Full view option (displays all 4 options together):



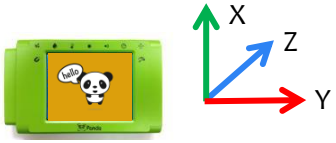
2. Saving experiments as CSV files after recording.
3. Opening CSV files.
4. After recording an experiment, a cursor can be added to focus a certain point.
5. Tools: Sync date and time (synchronizes the data and time from the computer to the top of the screen).

Acceleration sensor orientation:

The NeuLog acceleration sensor (an accelerometer) measures static acceleration due to gravity and dynamic acceleration due to the sensor's motion. By measuring static acceleration, one can find out the angle the sensor is tilted with respect to the Earth. By measuring dynamic acceleration, one can find out how the velocity of the sensor changes with time.

When the sensor is not moving and is facing upwards, the reading is 9.8 m/s^2 (because it includes static acceleration). When the sensor is at free fall and is facing upwards, the reading is 0 m/s^2. If we are interested only in the vertical axis (Z axis) and in the dynamic acceleration, we can zero it by pressing the zero button. This zero offset is canceled when turning the Panda off and on.

The Panda acceleration sensor has the ability to measure acceleration in three different axes (X, Y and Z). The figure below demonstrates the axes.



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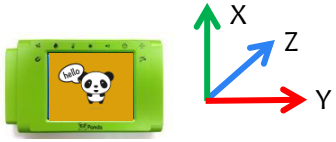
Magnetic sensor orientation:

When pointing the positive side to east or west, the value should be close to 0 µT.
When pointing the positive side to the north, the value should be close to 30 µT.
When pointing the positive side to the south, the value should be close to -30 µT.
The Panda magnetic field sensor has the ability to measure magnetic field in three different axes (X, Y and Z). The figure below demonstrates the axes.



It is important to work in an environment with minimal metals, since they can influence the sensor's value.

Using Panda with WiFi:

Materials needed:

- NeuLog Panda Multi-sensor
- WIFI-201 or WIFI-202 WiFi Module

Your Panda Multi-sensor needs to be connected to a WiFi module. The WiFi module will create a closed NeuLog WiFi network which will stream the NeuLog data to the device of your choosing (tablet, smartphone, or computer). Once your device is wirelessly connected to the NeuLog network, you can run experiments and collect data through a browser of your choosing.

Procedure (follow these steps in this exact order):

1. The WiFi module should be off at this point (not connected to anything).
2. Take you panda and press on the settings icon (on the right side of the Panda screen).
3. Press on WiFi mode.
4. Connect the Panda multi-sensor directly to the WiFi module (no wires required).
5. Although not required, we recommend plugging the Panda to an outlet using a USB to mini USB charger (such as a typical cell phone charger).
6. The WiFi module 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 module (0184 for the example).
8. Give your device about 20 seconds to connect to the WiFi module.

9. Once the device is connected, go to your browser and type the website **panda201.com** into the URL bar, then wait for 30-60 seconds.
10. The Panda multi-sensor will give a live reading and you can begin experimentation.

Maintenance and storage:

- Never submerge the NeuLog plastic body in any liquid.
- Do not allow liquid into the Panda multi-sensor body.
- After use, gently wipe away any foreign material from the 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.

W: www.neulog.com
E: info@neulog.com
A: 850 St Paul Street, Suite 15, Rochester, NY 14605
P: 1.866.553.8536

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