

## NEULOG PHOTO GATE SENSOR GUIDE



### NeuLog photo gate logger sensor NUL-209

The NeuLog photo gate sensor can be used for any science experiment or activity which involves taking accurate velocity and/or acceleration measurements especially in the field of Physics.

The sensor comes pre-calibrated so you can start experimentation right out of the box using any of the following guides.

Just a few of the thousands of possible experimental subjects that can be done with the NUL-209 sensors are: velocity/acceleration/distance relationships, impulse, collisions, conservation of energy, force, momentum, and many more.

The photo gate sensor uses an infrared beam which detects if an object is passing through it. Therefore the sensor actively reads out as “open” or “blocked”. While collecting data however there are several parameters to truly customize your experiment:

- Velocity with a single gate
- Velocity with two gates
- Acceleration with a single gate
- Acceleration with two gates
- Change in time between two gates
- Velocities with timing cards.

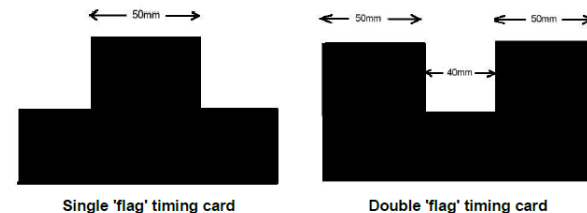
### Experiment customization:

The NeuLog photo gate sensor offers several different experimental customization options. To access them; click on the “Experiment Setup” button after your photo gate sensor has been detected. **Note:** Refer to the guides below for more information on using NeuLog sensors

#### Timing cards:

Making timing cards is a unique option to further customize any experiment with the NeuLog photo gate sensor. To make timing cards we recommend cutting your desired shapes out of black plastic for the most accurate readings though even plain paper will work just fine.

For example:



#### Velocity with a single gate:

Velocity with a single gate is the very basic velocity measurement using only one photo gate sensor and any object with a known width.

## NEULOG PHOTO GATE SENSOR GUIDE



1. Click the “Experiment Setup” button in the NeuLog software and select “Velocity with a single gate”.
2. The graphic demonstrates the basic idea of what your experimental setup should look like.
3. Measure and input the object width (in millimeters) into the text field labeled “X[mm]”
4. Click “Save” and then you are ready to begin data collection.

### Velocity with two gates:

The velocity with two gates option is ideal for experiments which examine collisions between two objects of known width and mass.

1. Click the “Experiment Setup” button in the NeuLog software and select “Velocity with two gates”.
2. The graphic demonstrates the basic idea of what your experimental setup should look like.
3. Measure and input the width and mass for both of the objects passing through the photo gate.
4. Assign each of your photo gate sensors to both the “Sensor A” and “Sensor B” position.
5. Be sure to space the photo gates far enough apart to allow for a collision between the two objects before they rebound back through the photo gates.
6. Click “Save” and then you are ready to begin data collection

### Acceleration with a single gate:

Acceleration with a single gate requires an object (or timing card) with two flags (example shown above) with known widths.

1. Click the “Experiment Setup” button in the NeuLog software and select “Acceleration with a single”.
2. The graphic demonstrates the basic idea of what your experimental setup and timing card/object should look like.
3. Measure and input the width for both flags.
4. Click “Save” and then you are ready to begin data collection.

### Acceleration with two gates:

Acceleration with two photo gates requires two NeuLog photo gate sensors and an object or timing card with a known width.

1. Click the “Experiment Setup” button in the NeuLog software and select “Acceleration with two gates”.
2. The graphic demonstrates the basic idea of what your experimental setup should look like.
3. Measure and input the width of your object (in millimeters) into the text field labeled “X[mm]”.
4. Assign each of your photo gate sensors to both the “Sensor A” and “Sensor B” position.
5. Click “Save” and then you are ready to begin data collection.

## NEULOG PHOTO GATE SENSOR GUIDE



### Change in time between two gates:

Change in time between two photo gates requires two NeuLog photo gate sensors and an object or timing card with a known width.

1. Click the “Experiment Setup” button in the NeuLog software and select “Change in time between two gates”.
2. The graphic demonstrates the basic idea of what your experimental setup should look like.
3. Measure and input the width of your object (in millimeters) into the text field labeled “X[mm]”.
4. Assign each of your photo gate sensors to both the “Sensor A” and “Sensor B” position.
5. Click “Save” and then you are ready to begin data collection.

### Velocities with timing card:

Using a timing card with two equal width flags in the “Velocities with a timing card” mode will measure the velocities without any more setup. This mode is very useful for quick experiments with timing cards.

### Quick start procedure:

#### PC or Mac Computer

#### Materials needed:

- NUL-209 Photo Gate Sensor
- USB-200 USB Module
- A USB to mini USB cable (which comes with the USB-200)

Your photo gate 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 photo gate sensor directly into the computer.

Resident PC software and browser based software can be downloaded for free at [www.NeuLog.com/download](http://www.NeuLog.com/download) as well as a full software user guide. **Note:** Make sure not to download and install both types of software, they will conflict on the computer.

#### Procedure:

1. Install the NeuLog software
2. Connect the USB-200 module to the PC or Mac
3. Connect the photo gate sensor to the USB-200 module (they directly plug together). Please note there is no calibration required for this sensor.
4. Open the NeuLog software.
5. Once a photo gate sensor logo appears on the left side of the screen the probe has been automatically identified and you can begin experimentation.
6. If the photo gate sensor is not automatically identified then click the “Search for sensors” icon to find the sensor.
7. Select the “On-line experiment” button; this will open a graph below.
8. Click on the “Module setup” button located on the photo gate sensor icon in the module window to change the sensor settings if need be.
9. Click on the experiment set up button to change the experiment settings if need be (experiment duration for example).

## NEULOG PHOTO GATE SENSOR GUIDE



10. The photo gate sensor will give a live reading in the box to the left of the screen while plugged in.
11. To run an experiment and collect data click “Run experiment”.
12. To end data collection early, click “Stop experiment”.

### Tablet, smart phone device

#### Materials needed:

- NUL-209 Photo Gate Sensor
- WIFI-201 WIFI module
- BAT-200 Battery

Your photo gate 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 photo gate 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 micro USB charger (such as a typical cell phone charger). The WIFI-201 module will run for 15-75 minutes (depending on the sensor) without being plugged in.
4. For further WIFI-201 instructions or the WIFI-201 quick start guide please visit [www.NeuLog.com/download](http://www.NeuLog.com/download).
5. The WIFI-201 indicator lights will flash; take no action until the LED to the far left turns blue.
6. Take your tablet or smart phone and go to the Wi-Fi settings and select the NeuLog network which matches the WIFI module ID found on the back of the WIFI-201 device. (NeuLogXXXX for example)
7. Give your device 1-2 minutes to connect to the WIFI-201 network.
8. Once the device is connected go to your browser and type in the website [wifi201.com](http://wifi201.com) into the URL bar, then wait for 30-60 seconds.
9. You will see a “Control mode” icon in the browser, click on this icon.
10. The browser will then load a new screen and begin to auto detect the sensors, this can take a few minutes.
11. If the browser does not auto detect, select “Search for sensors”
12. Once the sensor is found you will see an icon on the left side of the screen for the photo gate sensor. The icon will display data in real time.
13. To set the photo gate sensor’s settings click on “Module setup” button located on the photo gate sensor icon on the left side of your screen.
14. To change the experimental settings click the “Experiment setup” button (experiment duration for example).
15. To run an experiment and collect data click “Run experiment”.

## NEULOG PHOTO GATE SENSOR GUIDE



### Operation with NeuLog viewer

#### Materials needed:

- NUL-209 Photo Gate Sensor
- VIEW-101 Viewing Module
- BAT-200 Battery

#### Procedure:

1. Connect the photo gate 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 click the run button (little green person).

### Off-line experiments

(Off-line experiments are for when you do not have a sensor connected directly to a computer, tablet, smartphone, or NeuLog viewer).

#### Materials needed:

- NUL-209 Photo Gate Sensor
- BAT-200 Battery

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

- USB-200 USB Module or WIFI-201 WIFI module or VIEW-101 Viewing Module

- A USB to mini USB cable (which comes with the USB-200)

#### Procedure:

1. Connect the photo gate sensor directly to the left side of a charged BAT-200 module.
2. When ready to collect data press the “Start/Stop” button on the photo gate sensor, a red light will turn on for the duration of the experiment.
3. To change the experiment settings first connect to your chosen device (PC, Mac, tablet, smart device) and select the “Module setup” button. (For more information on how to change the experiment settings view quick start procedure section for your chosen device in this document.)
4. After the experiment has concluded (when the “Start/Stop” button is pressed again or the data collection period ends) connect the sensor to your chosen device. (full instructions in each device’s quick start procedure section)
5. Open NeuLog software.
6. Click the “Off-line experiment” button.
7. Click the “Load data from sensors” button.
8. Select which experimental data to upload. (5 experimental runs can be stored at one time on the NUL-209 photo gate sensor)

## NEULOG PHOTO GATE SENSOR GUIDE



### Restoring sensor's factory default settings:

#### Procedure:

1. Connect the USB-200 to a PC, Mac, tablet, or smart device.
2. Connect the photo gate sensor to a USB-200 module (they directly plug together). Please note there is no calibration required for this sensor.
3. Open the NeuLog software.
4. Click the "Tools" icon.
5. Click "Restore sensor's factory defaults" icon.
6. If prompted to clear the graph, click either the "Off-line experiment" or "On-line experiment" (whichever you are using).
7. Click "Clear experiment results".
8. Resume from step 4.

### Included with sensor:

- NeuLog NUL-209 Photo Gate Sensor Guide (this document).
- Infrared transmitter and receptor housed in the photo gate unit.
- Threaded rod for easy connection to retort stands or other labware.

#### Sensor specifications

ADC resolution	16 bit
Accuracy	100 $\mu$ s
Resolution	100 $\mu$ s
Max sample rate (S/sec)	10,000

### Sensor features:

- Fully digital data.
- Rugged plastic ergonomic case.
- Internally housed infrared transmitter and detector.
- Photo gate handle with three threaded holes to customize your experimental setup.
- 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](http://www.NeuLog.com)
- <http://www.NeuLog.com/Products/PhotoGateLoggerSensor.aspx>
- **Velocity of Free Falling Objects** - [http://www.neulog.com/Portals/3/Users/Experiment P-35 Velocity of Free Falling Objects Ver 3.0.2.pdf](http://www.neulog.com/Portals/3/Users/Experiment%20P-35%20Velocity%20of%20Free%20Falling%20Objects%20Ver%203.0.2.pdf)

### 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 ( $^{\circ}$ C,  $^{\circ}$ F, Lux, %, ppm, for example).

## NEULOG PHOTO GATE SENSOR GUIDE



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 NeuLog photo gate sensor uses an infrared beam to determine when an object has passed through the photo gate. Every point that there is a break in the infrared beam, a 1 is registered in the program. The infrared detector is very sensitive to rapid fluctuations in infrared light which allows for both very slow and very quick objects to pass through the photo gate. The NeuLog software can calculate velocities and accelerations based on the record of 1's and 0's as well as the experimental inputs.

### Maintenance and storage:

- Never submerge the NeuLog plastic body in any liquid.
- Do not allow liquid into the photo gate sensor's body.
- After use, gently wipe away any foreign material from the photo gate 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 for a period of 3 years from the date of purchase. Our warranty 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.

W: [www.neulog.com](http://www.neulog.com)

E: [info@neulog.com](mailto:info@neulog.com)

A: 850 St Paul Street, Suite 15, Rochester, NY 14605

P: 1.866.553.8536

V04302013

## NEULOG PHOTO GATE SENSOR GUIDE

