

Drop Counter Sensor

DT293



The Drop Counter sensor can be connected to the Nova5000, MultiLogPRO or TriLink data loggers.

The Drop Counter is an optical sensor that accurately records the number of drops of titrant added during a titration. The Drop Counter software can automatically convert the number of drops into volume. It will also record pH and temperature values and calculate the first and second derivatives of the pH for easy equivalence point determination.

The Drop Counter can also be used for conductimetric or potentiometric titrations using our Conductivity Probe or Ion-selective Electrodes.

Typical Experiments

- Simple count activities
- Collecting pH vs. Volume data in a typical acid–base titration
- Collecting Conductivity vs. Volume data in a typical conductimetric titration
- Collecting Temperature vs. Volume data or monitoring temperature simultaneously with pH

How it Works

The Drop Counter sensor has an optical-path slot that is 5.7 cm (2.25 inches) in length. When the infrared beam between the source and the detector is blocked by a drop of titrant, a digital signal is sent to the data logger, and the data collection program records a drop. The drops can be converted to volume units (milliliters), using a calibration feature in the MultiLab software.



Sensor Specification

Range: Volume Range: Drop Counter	0 – 4095 * volume of one drop 0 - 4095
Detector Rise Time:	< 70 ns
Detector Fall Time:	< 70 ns
Resolution (12-bit) - Drop Counter:	1
Resolution (12-bit) - Volume:	1 * volume of one drop
Sampling Rate for Titration:	Up to every second
Infrared Source:	Peak at 890 nm
Used Data Logger Port:	Digital

Technical Notes

The Drop Counter sensor must connect to the data logger's digital inputs only, which are the first or second inputs on the MultiLogPRO or TriLink and all of the inputs on the Nova5000.

Technical Notes using the Drop Counter Sensor for the Titration

Experiment

- It is recommended to use a magnetic stirrer. As an alternative to using the magnetic stirrer, students can use a stirring rod to stir manually (this is not recommended as a standard method).
- It is important to remind students that a slow drip is important. This provides enough time for the drop to be added to the solution and be mixed thoroughly, as well as for the pH sensor (or other sensor) to respond.
- Using the Micro-stirrer supplied with the Drop Counter sensor helps deliver the solution directly to the pH bulb, increasing response to a fresh drop.
- It is also helpful if the amount of titrant in the beaker is minimized. Less liquid means faster mixing. It is recommended to use a 100 mL beaker instead of a 250 beaker whenever possible.
- Using the plastic reagent reservoir supplied with the Drop Counter sensor, instead of a standard burette, provides a wider diameter and less change in the hydrostatic pressure per unit volume of titrant above the two-way valve.



- The plastic reagent reservoir has a pair of two-way valves, using one for drop rate adjustment, and the other as an on-off valve. This eliminates the need for a fine adjustment during the initial readings.
- If you want to allow for more thorough mixing when you are near the equivalence point, you can also manually release drops at a lower rate for that region of data.

Equipment List

- Drop counter
- Plastic reagent reservoir
- Plastic valve with double stopcock fitting
(Screws onto the base of the reagent reservoir, with a gentle half turn)
- Micro-stirrer


Using the Drop Counter Sensor as a Drop Counter with the Nova5000 and MultiLab Software

1. Launch the MultiLab CE software.
2. Connect the Drop Counter sensor to the Nova5000's digital sensor input (starting from I/O-1).
3. Click **Logger** on the main tool bar and select **Preferences** from the drop-down menu. Ensure that **Drop Counter** is selected in the **Counter Sensor** drop-down menu. Click **OK**.
4. Click **Setup** on the main toolbar and unselect the **Auto Detect Sensors** checkbox. Select the **Drop Counter** sensor from the drop-down menu. Program the data logger's sample rate and number of samples. Click **OK**.
5. Click **Run** on the main toolbar to start the measurement.


Using the Drop Counter Sensor as a Volume Sensor with the Nova5000 and MultiLab Software

1. Launch the MultiLab CE software.
2. Connect the Drop Counter sensor to the Nova5000's digital sensor input (starting from I/O-1).




3. Click **Logger** on the main tool bar and select **Preferences** from the menu.
4. Select **Volume** in the **Counter Sensor** drop-down menu.
5. Click **OK**.
6. Click **Setup** on the main toolbar and unselect the **Auto Detect Sensors** checkbox. Select the **Volume** sensor from the drop-down menu.
7. Click **Sensor properties**  next to the **Volume** sensor input. Select the **Calibration** tab and enter the drop volume of the rain drop in the **Drop Volume (mL)** field.
8. Click **OK**.
9. Click **Setup** on the main toolbar and program the data logger's sample rate and number of samples.
10. Click **Run** on the main toolbar to start the measurement.
11. Click **OK**.

Using the Drop Counter Sensor as a Drop Counter with the MultiLogPRO or TriLink and MultiLab Software

1. Launch the MultiLab software.
2. Connect the Drop Counter sensor to the data logger's digital sensor input (starting from I/O-1). The sensor is automatically recognized by the MultiLab software as a Rain Collector sensor.
3. Click **Properties**  next to the **Rain Collector** sensor input.
4. Uncheck the checkbox next to **Rain (mm)**.
5. Check the checkbox next to **Drop Counter**.
6. Click **OK**.
7. Click **Setup** on the main toolbar and program the data logger's sample rate and number of samples.
8. Click **Run** on the main toolbar to start the measurement.

Using the Drop Counter Sensor as a Volume Sensor with the MultiLogPRO or TriLink and MultiLab Software

1. Launch the MultiLab software.
2. Connect the Drop Counter sensor to the data logger's digital sensor input (starting from I/O-1). The sensor is automatically recognized by the MultiLab software as a Rain Collector sensor.
3. Click **Properties**  next to the **Rain Collector** sensor input.
4. Uncheck the checkbox next to **Rain (mm)**.
5. Check the checkbox next to **Volume (mL)**.
6. Click the **Calibration** tab.
7. Insert in the dialog box the volume of one drop in mL.
8. Click **OK**.
9. Click **Setup** on the main toolbar and program the data logger's sample rate and number of samples.
10. Click **Run** on the main toolbar to start the measurement.

Calibrating the Volume of One Drop in mL

1. Place a 10 mL graduated cylinder below the slot of the drop counter.
2. Tighten the turn screw of the drop counter to the stand, to hold it firmly in place.
3. Tighten the reagent reservoir to the stand, to hold it firmly in place.
4. Fill the reagent reservoir with titrant.
5. Connect the **Drop Counter** to the first input of the data logger.
6. Setup the Drop Counter to count the drops (see instructions above).
7. Program the data logger's **sample rate** – 1 sample per second.
8. Set the number of **samples** – 100 samples.
9. Click **Run** on the main tool bar.
10. Open the bottom two-way (on-off) valve to begin releasing drops from the reagent reservoir through the Drop Counter.

Note: No data will be collected until the first drop falls through the drop counter slot.

11. Close the bottom valve when the titrant volume in the graduated cylinder is about 9 mL.
12. Stop recording.
13. Type in your note book the volume of the titrant in the graduated cylinder.
14. Read from the graph (using the **First cursor**) or from the table the number of the drops corresponding to the 9 mL of titrant.
15. Divide the known titrant volume by the number of the drops to find the volume of one drop.

An Example of using the Drop Counter

Acid–Base Titration

Acids and bases neutralize, or reverse, the action of one another. By adding a known amount of acid to a basic solution, until it completely reacts with it, the amount of the base can be determined. This procedure is called: Acid-Base Titration.

In this experiment we measure the pH changes versus the acid volume.

Additional Required Equipment (not included)

- Magnetic stirrer
- Ring stand
- 100 mL beaker
- Utility clamp
- pH sensor
- Temperature sensor

Equipment Setup

1. Arrange the magnetic stirrer on the base of the ring stand. Place a 100 mL beaker on the center of the stirrer.
2. Insert the pH sensor body through the large hole on the drop counter.
3. Slip the Microstirrer onto the bottom of the pH sensor. Slide the drop counter down the ring stand to a level such that the Microstirrer is very close to the bottom of the beaker. Tighten the turn screw of the drop counter to hold firmly in place (see Figure 1).
4. Connect the spout and two two-way valves to the plastic reservoir. The bottom valve is used as an on-off valve and the top valve as an adjustment valve, to deliver drops at a slow consistent rate.

5. Making sure that both two-way valves are in the closed position (horizontal), add about 30 mL of titrant to the plastic reagent reservoir. For your first run, we recommend using a 0.1 M NaOH solution.
6. Tighten the turn screw of the drop counter to the stand, to hold it firmly in place.
7. Tighten the reagent reservoir to the stand, to hold it firmly in place.
8. Before collecting data or calibrating the drops, you should adjust the flow rate of the two valves of the reagent reservoir. Temporarily, place another beaker below the spout of the reagent reservoir. First, completely open the bottom two-way valve; then slowly open the top valve until a very slow drip is achieved at a rate of one drop per second. Now close the bottom valve.

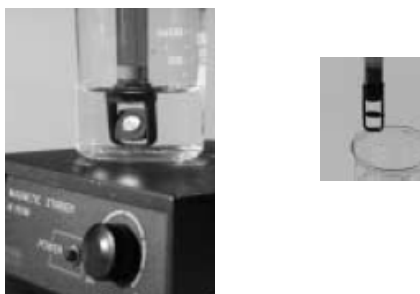


Figure 1

Titration Experiment

1. Calibrate the volume of one drop in mL (see instructions above).
2. Add the solution to be titrated to the 100 mL beaker. For the first run, we recommend using about 5 mL of 0.1 M HCL solution. Add enough distilled water so the solution level covers the bulb of the pH sensor (about 35-40 mL). If you are going to use a small magnetic stirring bar, or use a stirring rod, less distilled water will be required (about 15- 20 mL).
3. *Optional:* Add two drops of phenolphthalein indicator.
4. Connect the Temperature sensor to the **first** input (I/O-1) of the data logger to compensate the temperature changes on the measured pH.
5. Connect the Drop Counter sensor to the second input (I/O-2) of the data logger.

Note: The Drop Counter sensor has to be connected to a digital input.

6. Connect the pH sensor to the third input (I/O-3) of the data logger.
7. Set up the data logger to measure volume at the rate of one sample per second.
8. Turn on the magnetic stirrer.
9. Click **Run** on the main tool bar to start recording.



The Graph of pH vs. Volume is displayed below.

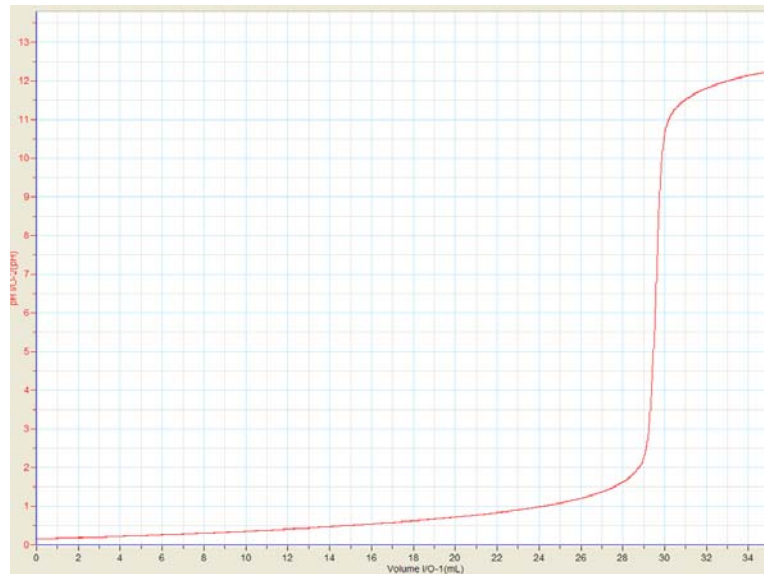


Figure 2: pH vs. Volume

Technical Support

Please contact Fourier technical support as follows:

Web: http://www.fourier-sys.com/support_support.html

Email: support@fourier-sys.com

Consult the FAQs before contacting technical support:

http://www.fourier-sys.com/support_faq.html

Copyright and Warranty

All standard Fourier Systems sensors carry a one-year warranty, which states that for a period of twelve months after the date of delivery to you, it will be substantially free from significant defects in materials and workmanship.

This Warranty does not cover breakage of the product caused by misuse or abuse.

This Warranty does not cover Fourier Systems consumables such as electrodes, batteries, EKG stickers, cuvettes and storage solutions or buffers.