DROP COUNTER W13

USER GUIDE

cma-science.com

Short description

The CMA Wireless Drop Counter W13 is a sensor designed to count liquid drops during experiments such as titrations. As droplets pass through the sensing area, the sensor detects and records each drop automatically using an infrared detection system.
The sensor is delivered together with the following accessories:

- a plastic 100-mL syringe with Luer-lock, by removing the piston the syringe becomes a titrant solution reservoir,
- two 3-way valves with Luer-lock connectors,
- 1.6 mm drop tip,
- USB-A to USB-C cable.

The power button is used to turn the sensor on and off. A brief press turns the sensor on, while holding the button for about 5 seconds turns it off. A short press (while the sensor is ON) also resets the display to zero. The sensor features a color OLED display that shows sensor information and measured values, allowing it to be used as a standalone measuring instrument.
The sensor can be used wirelessly via Bluetooth or wired via USB with the Coach 7 or Coach 7 lite programs/apps on computers (Windows and Mac), Chromebooks and mobile devices (Android and iOS).

How the sensor works

A sensing opening is located on the right side of the sensor display. Inside this opening, the drop counter uses an infrared emitter and receiver that are positioned approximately 12 mm apart. When a liquid droplet passes through the sensing area, it breaks the infrared beam, allowing the sensor to detect and count the droplet automatically. Each detected droplet increases the count by one, making it possible to accurately monitor the amount of liquid added during an experiment.
The sensor is also equipped with additional openings for inserting, for example, a pH probe and a temperature sensor. It can also be mounted onto a stand using a screw.

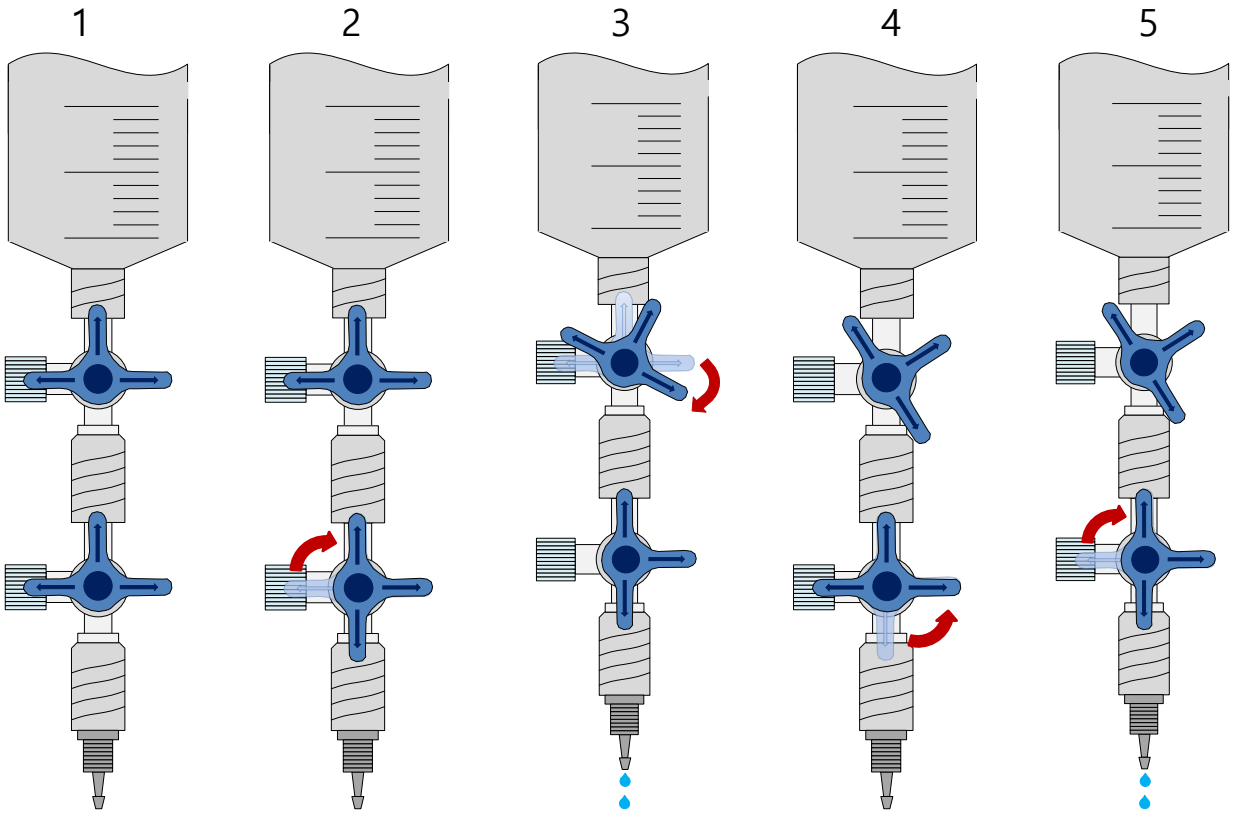
Assembly and control of droplet dispensing rate

The drop dispenser is assembled by connecting two 3-way stopcock valves in series to a reservoir consisting of a syringe without a piston. A drop tip is attached to the second valve. One of the valves is used as an on/off control (either fully open or fully closed), while the other is used to adjust the flow to a slow and steady rate.

To control the flow rate during titration:

1. Close both valves.
2. Open the lower valve by turning it 90°.
3. Slowly open the upper valve until the desired drop rate is reached.

4. Close the lower valve until the experiment begins.
5. Once the experiment begins, open the lower valve again to start the titration.



This method allows steady and precise control of how fast the drops fall.

Calibration

The tip provided with the drop counter produces drops of approximately ≈ 0.04 mL. The Coach software includes a standard volume calibration, which makes use of this drop size volume.

However, for more accurate results, the drop volume can be calibrated manually by measuring how many drops are needed to dispense a known volume. The volume per drop is calculated by dividing the total collected volume by the number of drops. To perform your own drops-per-mL calibration:

- Mount the drop counter on a stand.
- Position the drop dispenser (syringe) above the opening of the drop counter, ensuring that each drop passes through the infrared beam of the photogate. The LED indicator will flash when a drop is detected.
- Before calibrating, adjust the flow rate of the two valves as described above.
- Fill the drop reservoir with a known volume, for example 10 mL.
- Count the number of drops released until the reservoir is empty.
- Calculate the drop volume by dividing the total volume by the number of counted drops. For example, if 10 mL produces 278 drops, the drop volume is 10 ÷ 278 ≈ 0.036 mL.

Software

You can use the Drop Counter W13 with Coach 7 or Coach 7 Lite (free) program on computers (Windows and Mac) or Coach 7 and Coach 7 Lite (free) app on mobile devices (Android and iOS). For Chromebooks, we offer a special Android app. The support for this wireless sensor is added starting from Coach version 7.13.

Check the CMA website for the latest installations. https://cma-science.com/downloads_en

Measurement Ranges in Coach 7

Coach 7 provides two ranges for working with the drop counter:

- **Counter:** when using this range, each drop is counted, and the total number of drops is displayed.
- **Volume:** when using this range, a default volume calibration is applied, and each count is converted into a volume of 0.04 mL.

To select the range in Coach 7

Connect the drop-counter, then right-click its icon in the Wireless Sensors panel. Choose **Input Range** and select the desired range from the list.

You can also add your own volume calibration. To do this, go to the **Wireless Sensors** panel, right-click the drop-counter icon, select the **Volume** range, and then choose the **Calibrate** option. The graph shows a linear relationship between volume and the number of drops. By default, the coefficient *a* is set to 0.04. If your estimated drop volume is, for example, 0.036 mL, the coefficient *a* should be adjusted to 0.036 mL.

Important: Please note that to **reset** the drop counter, you need to briefly press the power button. Otherwise, the counting will continue even if you start a new measurement in Coach.

Collecting data without software connection

- Turn the Drop Counter on by pressing its power button.
- The sensor briefly displays its Bluetooth identification code. This ID code is also printed on the sticker located on the bottom side of the sensor box.
- Then the display shows:
  - the Bluetooth mode, ‘Mobile’ or ‘PC’.
    Mobile indicates Bluetooth Low Energy mode which should be used when working with mobile devices (Android, iOS), Chromebook and Apple computers.
    PC indicates Bluetooth Classic which should be used for Windows computers.
  - the battery level, and
  - the current measured value.
- Now you can use the sensor as an independent measuring instrument.

- To turn the sensor off press and hold its power button for a few seconds. To save its battery the sensor automatically turns off after a few minutes of inactivity (no connection to power, no communication).

Collecting data via the Bluetooth connection

Mobile devices, Chromebooks, and Apple computers

For mobile devices (Android, iOS), Chromebooks and Apple computers Bluetooth Low Energy technology is used for wireless communication. For these devices **do not pair** the sensor just use it directly in the Coach software.

- Turn the photogate on by pressing its power button.
- Ensure your sensor is set to Mobile mode.
  If the display shows in the top-left corner 'PC' first you must set the sensor to the Mobile mode. Turn off the sensor. Then press and hold the power button until the text 'Bluetooth mode Change Mobile' is shown, then release the button. The mode is set to 'Mobile' which means that Bluetooth Low Energy is used.
- Start the Coach 7 or Coach 7 Lite program/app.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- On opening of the Activity Coach starts searching for sensors which are turned on and in the Mobile discovery mode. The found Bluetooth sensors appear in the list.
- Select the Radiation sensor you want to connect to. If needed check the sensor's Bluetooth ID which is located on the sensor's bottom label.
- When the connection is established the Bluetooth symbol appears in the top-left corner of the sensor's display and the icon of the sensor appears showing the measured values.
- Now you are ready to use the Drop Counter for your measurement.

Windows computers

For Windows computers, Bluetooth Classic technology is used for wireless communication. Before you start to use the sensor for measurement in Coach **you have to pair it**.

- Turn the Drop Counter on.
- Ensure your sensor is set to PC mode.
  If the display shows in the top-left corner 'Mobile' first you must set the sensor to the PC mode. Turn off the sensor. Then press and hold the power button until the text 'Bluetooth mode Change PC' is shown, then release the button. The mode is set to 'PC' which means that Bluetooth Classic is used.
- Pair your sensor.
  - Go to the Windows Settings **Bluetooth and other devices** and select **Add Bluetooth or other devices**. Select **Bluetooth device**.
  - Windows looks for Bluetooth devices and after a while lists discovered devices. The wireless sensors are listed with their Bluetooth IDs.

  - Select the sensor you want to connect to. If needed check the sensor's Bluetooth ID which is located on the bottom label of your sensors.
  - When the connection is successfully established Windows indicates that the sensor is paired and ready to go.
  - Click **Done** to accept it. The sensor appears in the list of paired Bluetooth devices.
- Start the Coach 7 or Coach 7 Lite program.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- Coach starts searching and displays the list with detected sensors, even if they are not paired.
- Select the Photogate you want to connect to. If needed check the sensor's Bluetooth ID which is located on the sensor's bottom label. If the sensor was not paired yet Coach will force you to pair the sensor first via Windows Settings.
- When the connection is established the Bluetooth symbol appears in the top-left corner of the sensor's display and the icon of the sensor appears showing the measured values.
- Now you are ready to use the Drop Counter for your measurement.

Collecting data via the USB connection

For computers (Windows and Mac) the Drop Counter can also be used as USB sensor.

- Turn the Drop Counter on.
- Use the provided USB cable to connect the sensor to a USB port.
- Start the Coach 7 or Coach 7 Lite program.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- The connected USB sensor should be detected automatically, and its icon appears on the first empty sensor position in the Wireless sensors panel.
- When the connection is established the USB symbol appears in the top-left corner of the sensor's display and the icon shows measured data.
- Now you are ready to use the Drop Counter for your measurement.

Charging a battery

An internal rechargeable battery (Li-Poly 3.7 V, 700 mAh) powers the sensor. The battery symbol located in the top-right corner of the sensor's display shows the battery level. When the battery level becomes critical, the battery gauge shows an empty battery. Use the provided cable to connect the sensor to a USB port for charging. A fully discharged battery requires up to 2 hours of charge time to become fully charged again. To prolong battery life, automatic power down turns the sensor off after 5 minutes of inactivity.

To replace the battery, use **only** the approved rechargeable batteries provided by CMA.

Suggested experiments

The Wireless Drop Counter W13 can be used together with wireless pH, conductivity, temperature or ORP sensors in various experiments such as:

- pH titrations
- Conductivity titrations
- ORP titrations
- Temperature monitoring during titrations.

Practical Information

- Accurate results depend on proper stirring and mixing of the solution, the response time of the pH electrode (approximately one second), and the reaction rate of the chemicals involved. Strong acids generally react faster than weak acids. If drops are added faster than about one every 1.5 seconds, the pH reading may not accurately reflect the actual chemistry in the solution.
- Keep the solution volume as small as possible while ensuring that the sensor is fully immersed. Only add enough distilled water to cover the glass bulb of the pH sensor (or other sensor); excess dilution is unnecessary and may reduce measurement sensitivity. Larger volumes require more time to mix and may require a slower drop rate to ensure accurate measurements.

Technical Specifications

Range	0 .. 10 drops / second
Resolution	1 drop
Detection Hole Size *Electrode Hole Size* *Temperature sensor Hole size*	Ø 11.5 mm Ø 13mm Ø 4 mm
Operating conditions	0 ~ 60℃, ~85%RH
Battery	700mAh Li-Polymer rechargeable
Battery life *after full charge*	Approximately 7 hours Battery life varies by use, configuration, temperature, and many other factors; actual results will vary.
Connection	Bluetooth 5, Low Energy (Mac, Android, iOS) Bluetooth 2.1, Classic (Windows) USB 2.0 (type C)
Bluetooth ID	W13DRCN-xxx

Warranty

The Drop Counter W13 is warranted to be free from defects in materials and workmanship for a period of 3 years from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

The sensor battery is consumable and is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase.

Discard batteries according to local regulations.

Note: *This product is designed for educational purposes only.*
It is not intended for industrial, medical, research, or commercial applications.

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