WATTCRAFTS

Precision Tools for Powerful Ideas

User Manual

Thickness Sensor Module

Wattcrafts Engineering Ltd. 19/11/2025 Version 1.2

Disclaimer

The information contained in this manual is provided for the purpose of operating and maintaining this Product. While every effort has been made to ensure the accuracy and completeness of this manual, Wattcrafts Engineering Ltd. assumes no responsibility for errors, omissions, or inaccuracies.

This product is designed for use by qualified personnel who are trained in its proper handling and application. Users are responsible for understanding and following all safety guidelines and instructions provided in this manual. Failure to adhere to these instructions may result in damage to the product, property, or personal injury.

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All specifications and features of the product are subject to change without prior notice. The user is responsible for ensuring that they are using the most up-to-date version of this manual.

By using this product, the user agrees to the terms of this disclaimer.

Manufacturer and customer service

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1. Product description

Thickness Sensor Module for battery swelling measurement

The Thickness Sensor Module is a precision measurement attachment designed to complement our Pouch Cell Holder, offering unprecedented accuracy in tracking battery cell volume changes during electrochemical testing. The module delivers ultra-precise displacement measurements with a resolution of 0.1 µm and an accuracy of 1 µm across a 5 mm measurement range. This level of precision allows getting insights into single layer prototypes, and up to multilayer commercial cells.

Smart assembly of the module enables detaching sensor during measurement and re-attaching it later, without losing thickness measurement accuracy (error < 2 µm). This function enables using one Thickness Sensor Module for several holders and is particularly useful in long term cycling, such as ageing tests.

Battery dilatation monitoring is crucial for understanding complex phenomena such as electrode expansion, gas generation, gel- or solid-electrolyte deformation, Lithium (or Sodium) metal plating and mechanical deformation during battery charge and discharge processes. It can also be applied in investigation of cell swelling in prolonged ageing tests.

Its USB-PC connection provides streamlined data acquisition, allowing researchers to log and analyse thickness data in real-time. The provided software allows logging data from thickness probe in standardised format, making it extra easy to integrate with data from Force Sensor Module and electrochemical data for analysis and presentation.

2. Specification

- Measurement range: 5 mm
- Resolution: 0.1 µm
- Accuracy: 1 µm
- Operating temperature: 0 to +50 °C (no condensation)
- Storage temperature: -20 to +60 °C (90 %RH or less)
- Output: USB-PC connection (USB2.0FS)
- Power supply: DC5 V±5%
- Power consumption: 120 mA Max.
- Cable length: Sensor⇔Interpolation box : 2 m Interpolation box⇔USB : 0.5 m
- System requirements:
    - CPU : Intel Core i3 or higher recommended
    - RAM : 1 GB or higher recommended
    - OS : Windows10 or newer (32bit/64bit)

Product includes:

- Thickness Sensor
- Mounting assembly
- Target plate
- Integrated 2.5m USB cable
- Data Acquisition Software

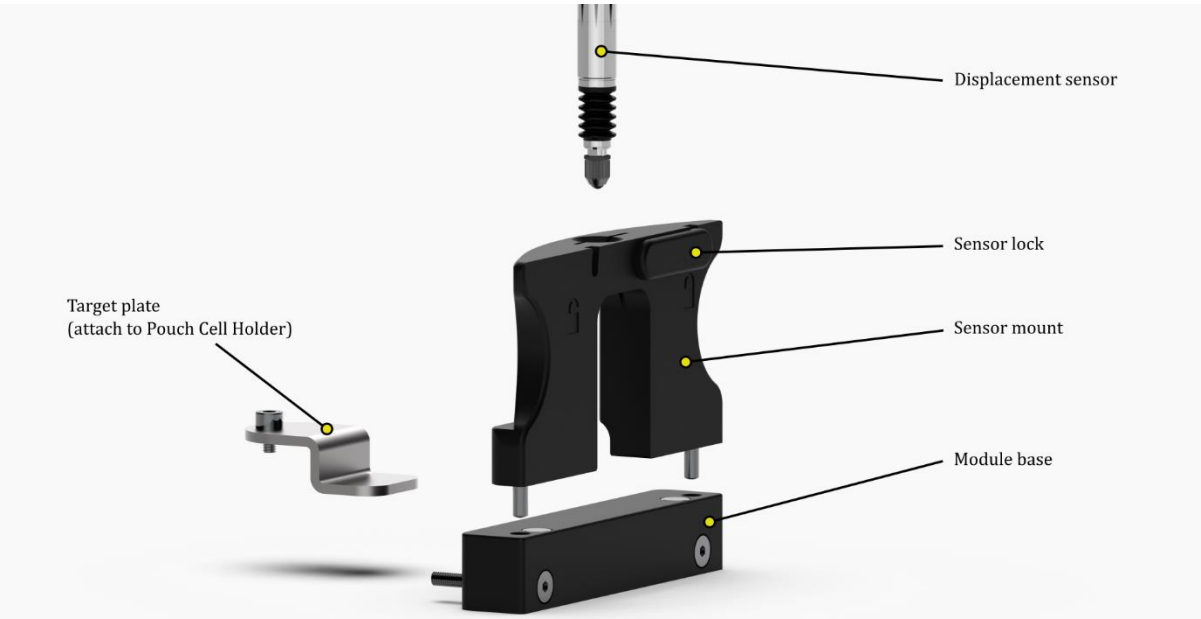
3. Safety precautions

Use proper safety precautions when working with batteries in pouch cell format. The pouch seal may break due to various causes, such as defect, internal pressure increase, heat etc. This can cause release (including rapid release) of hazardous substances. Wear protective glasses and gloves to protect you against substances that may be accidentally released. Beware that battery cells subject to high currents can heat up to high temperatures, particularly the electrical contacts.

4. Operation

4.1 Assembly

For assembly of the holder follow the procedure described in the Pouch Cell Holder User Manual.

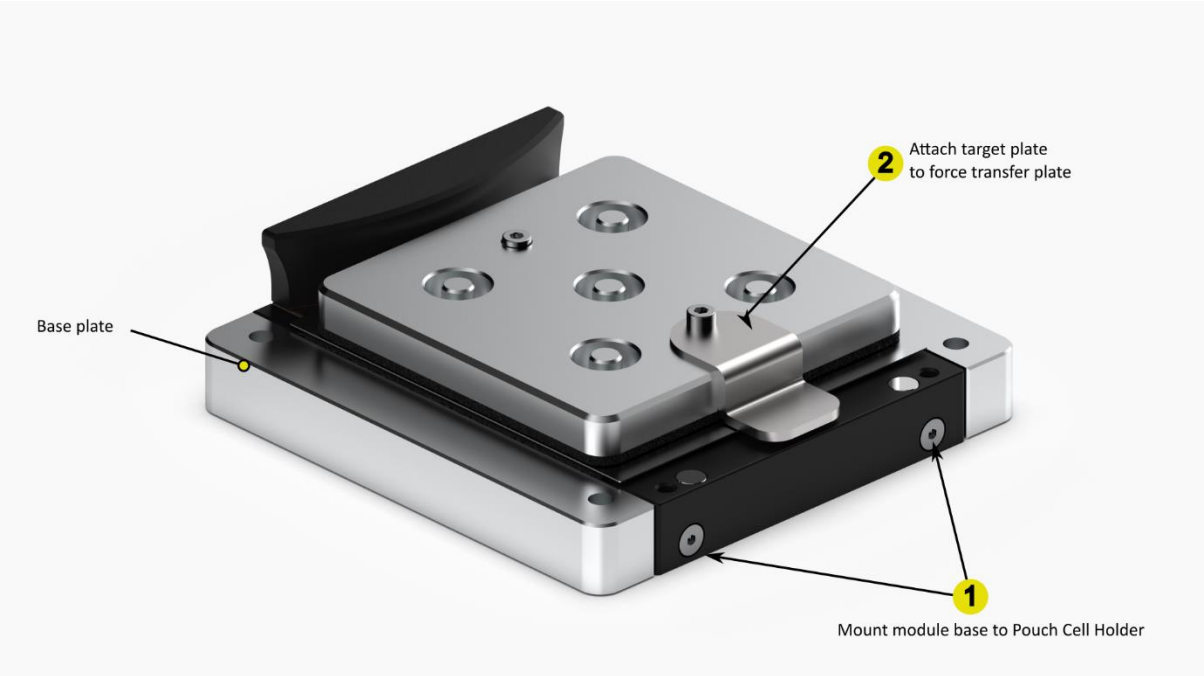


The Thickness Sensor Module is mounted on the back of the Pouch Cell Holder, opposite the electrical contacts. It replaces the back guiding element normally mounted there. The module consists of 4 main elements: target plate, base, sensor mount and displacement sensor. For best results the Thickness Sensor Module should be used in the 'fixed pressure' mode, i.e. with springs (see Pouch Cell Holder manual).

Note:

For most accurate measurements and/or if it takes long time for thickness measurement to stabilize before starting cycling the cell – remove flexible pads from holder.

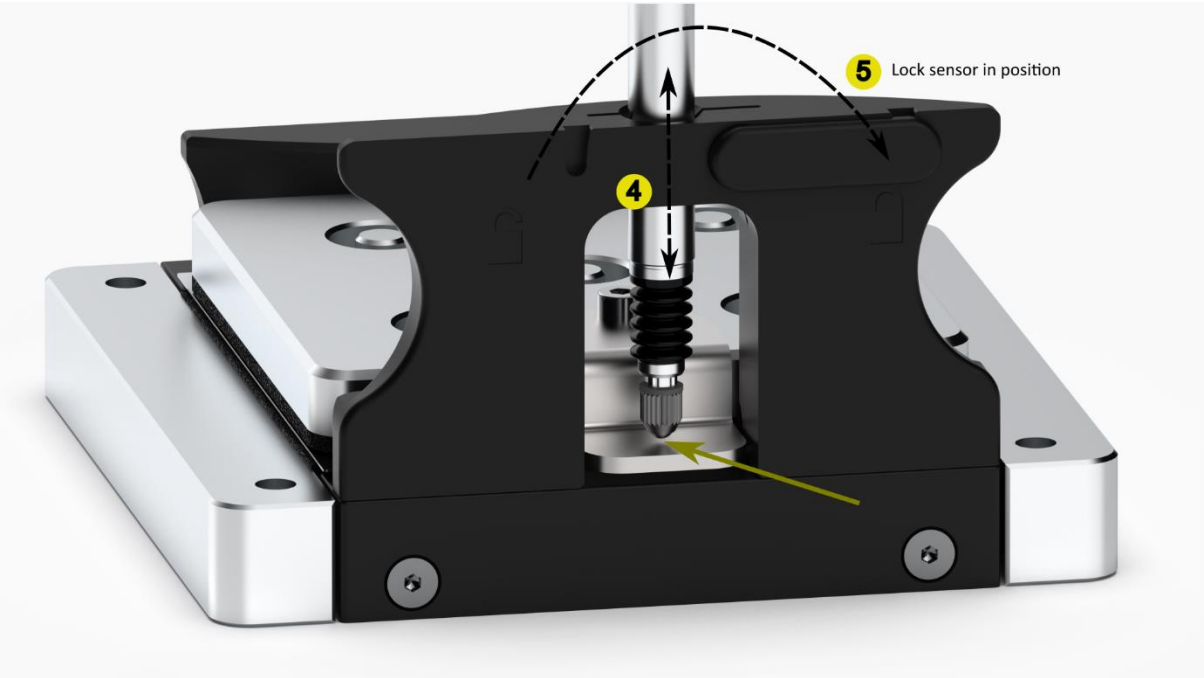
To use Thickness Sensor Module follow these assembly steps:



1. Unscrew two screws of the back guiding element on the pouch cell holder base and use them to attach module base in the same place.
2. Attach target plate to the force transfer place of pouch cell holder using one of the screws.

3. Place sensor mount on top of the module base. The magnets will snap it into place, make sure it is stable.
    - Check if the sensor lock is in open position

- At this stage rest of the assembly of pouch cell holder should follow. For simplicity it is not presented on figures here, but it is important that the cell is already placed in the holder before step ‘4’, so the initial placement of sensor is correct.



4. Insert the displacement sensor into sensor mount and adjust its placement, so it touches the target plate and is compressed by about 1mm.
5. When ready, rotate the sensor lock clockwise into lock position to secure sensor in place.

The system is ready for measurements.

Assembly with opposite tabs module

In case of using Pouch Cell Holder with opposite tabs module the assembly process differs slightly. Instead of using Thickness Sensor Module base, the opposite tabs electrical contact base is used (6). It is already designed to accommodate this module. Additionally, included magnetic tabs clamp (7) has to be used instead of black clamp provided with opposite tabs module. For the rest of the assembly process follow the steps above.

Connecting the module

This measuring unit uses an interface that is compliant with the USB (Universal Serial Bus) 2.0 FS (Full speed) standard and can be connected directly to a personal computer or hub.

The data logging software is available on the Wattcrafts website. Refer to the software instruction manuals available on the Wattcrafts website for the installation and operation methods. Website: www.wattcrafts.com/shop/pch-s-ts-a-thickness-sensor-module-pouch-cell-holder-7

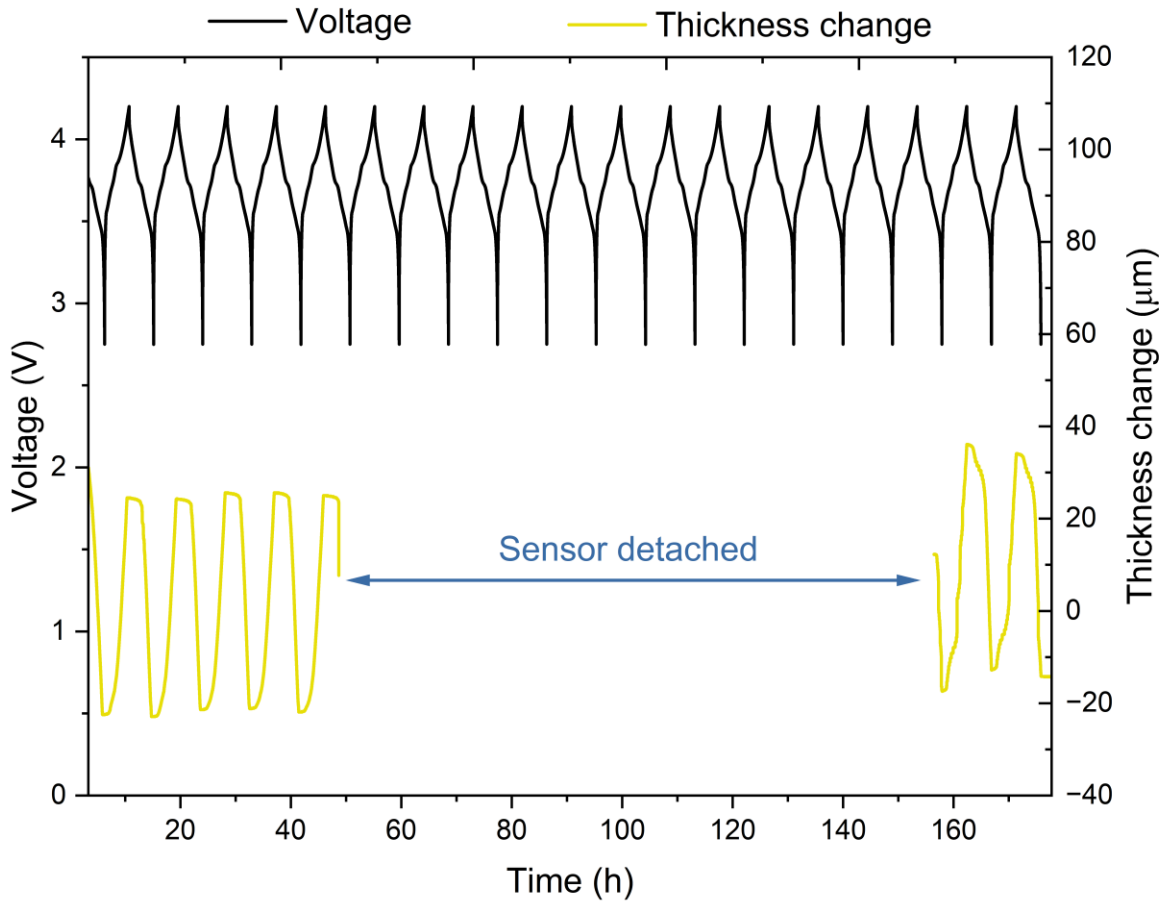
Important operation notes:

- Do not use the sensor in places where it may receive excessive shocks. Otherwise the inside of the sensor may be damaged or the unit may become unable to produce normal output signals.
- Locate the measuring unit at least 10 cm away from a strong magnetic source. (The sensor must not be used in magnetic fields exceeding 5 mT.)
- This unit is equipped with an anti-dust bellows on the spindle. Organic solvents, ozone, ultraviolet rays, and other adverse conditions in the ambient atmosphere can cause rapid deterioration of the anti-dust bellows. When using in these environments, replace anti-dust bellows periodically (every six months to one year).

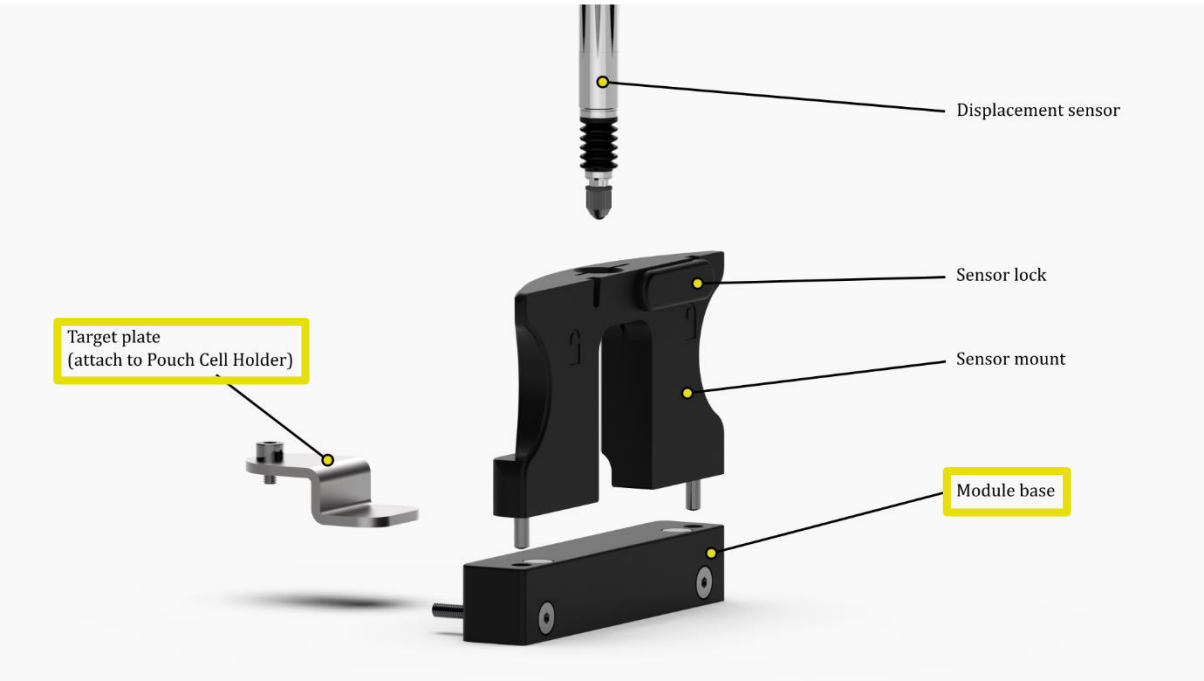
4.2 Using Thickness Sensor Module with multiple Pouch Cell Holders

Thickness Sensor Module, similarly to Force Sensor Module, can be used with multiple holders. This means, that with one sensor, thickness changes during cycling can be monitored on multiple test cells.

After setting up the system as described in 4.1, user can start the measurement and collect data. Then, during measurement, thickness sensor can be detached and used for another holder. After reattaching the sensor to the original holder, user can check how thickness of the cell changed in the meantime. Therefore, this approach allows intermittent thickness measurement on several holders, by alternating it between them during cycling. See example measurement plot below.



However, to operate it in this manner there are a couple of important points that must be highlighted. First, because it is very precise and delicate measurement, some of the parts of module must remain attached to holder to maintain accurate reference position. These are Target plate and Module base (see below). Secondly, the Displacement sensor cannot be removed from Sensor mount, i.e. the Sensor lock must stay in the 'locked' position.



This means, that to use Thickness Sensor Module with multiple holder user needs to purchase additional parts for each extra holder. Those are:

Same side tabs configuration:	Opposite tabs configuration:
1x Target plate	1x Target plate
1x Module base	1x Magnetic plate clamp

See detailed assembly and operation steps below.

1. For the assembly and operation of the first holder with Thickness Sensor Module follow steps described in 4.1
    - We recommend noting the absolute displacement position measured for reference. However, it is not crucial, since the logging software saves data for both absolute position and ‘zeroed’ reading.
2. To move sensor to the second holder, detach the sensor mount with displacement sensor from the first holder. Do not remove or change position of the sensor in the sensor mount.
3. Follow the assembly steps described in 4.1. for the second holder, however this time skip steps ‘4’ and ‘5’, since the sensor is already secured in the sensor mount.
4. Repeat above steps for more holders. Never remove or change position of the sensor in the sensor mount.
    - Relocating sensor in the sensor mount would cause losing the reference position.
5. Sensor mount with the sensor inside can be moved between the holders to measure current thickness of tested cells.

4.3 Software operation

> **Note:**
>
> This is simplified manual of the included data logging software, that covers most common use cases. For full software manual please see installation folder of Wattcrafts Omnisense.

4.3.1 Installation and setup

Install the Wattcrafts Omnisense software by downloading the latest installer from the product website.

1. Run the Setup Executable: Double-click wattcrafts_omnisense_setup.exe.
2. Follow Installer instructions
    - The installer automatically installs all necessary drivers and components, including Microsoft Visual C++ runtime libraries.
3. Launch Application: Once the installation is complete, you can launch Wattcrafts Omnisense from the Start Menu or the desktop icon (if created).
4. Upon the *first launch of the application itself*, it will attempt to create necessary folders in your Documents directory:
    - …\Documents\WattCrafts Omnisense\data: Default location for saved measurement CSV files.
    - …\Documents\WattCrafts Omnisense\logs: Stores application logs (app.log), useful for troubleshooting.

After installation connect the module and launch the Omnisense software.

4.3.2 Getting started

If there is either Thickness Sensor Module or Force Sensor Module or both connected when you launch the software, communication will be automatically established and the information about sensors will be displayed. If it does not happen automatically, click the Connect button for relevant sensor.

Application window:

Manual Connection:

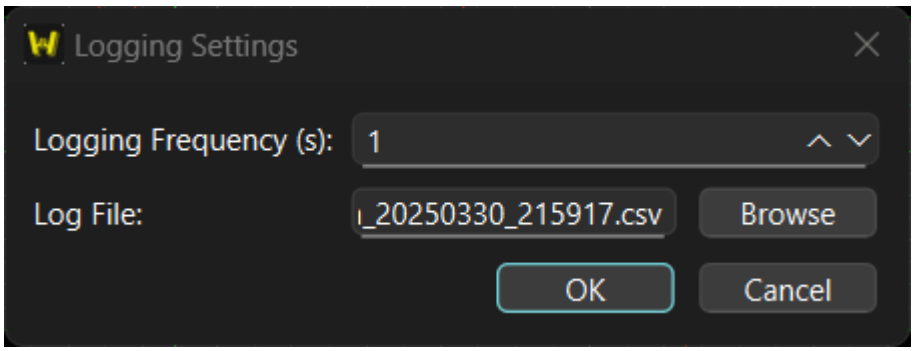
- If a sensor is not connected (or you disconnected it), click the corresponding "Connect [Sensor Type]" button.
- The application will attempt to establish a connection.
- The status label above the button will update with sensor details.
- The button text will change to "Disconnect [Sensor Type]" upon successful connection.

4.3.3 Logging data to file

Measurements data can be saved in a .csv format.

This mode actively records sensor data to a file at regular intervals.

1. **Connect Sensors:** Ensure the sensors you wish to log are connected.
2. **Click "Start Measurement":** This opens the "Logging Settings" dialog.



3. **Configure Logging:**
    - **Logging Frequency (s):** Set the interval (in seconds) at which data points should be saved. Minimum is 1 second.
    - **Log File:** Specify the path and filename for the CSV file.
        - Click "Browse" to use a standard file save dialog.
        - A default filename including the current date and time is suggested, saved in the …\Documents\WattCrafts Omnisense\data folder.
        - If you only provide a filename without a path, it will be saved in the default data folder.
4. **Start Logging:** Click "OK" in the Logging Settings dialog.
    - The main "Start Measurement" button changes to "Stop Measurement".
    - The top status bar shows "Status: Logging Data".
    - The individual "Live Graph" buttons become disabled (logging automatically activates data collection for *all connected* sensors).
5. **Logging Process:**
    - At the specified logging frequency, a timestamp, elapsed time since logging started, and both the *absolute* and *tare-adjusted* readings for displacement (mm) and force (N) are recorded in the CSV file.

- Graphs are updated periodically by reading the *logged data* from the CSV file to ensure the display matches the saved data.
- **CSV Columns:** Timestamp, Elapsed Time (s), Displacement Absolute (mm), Displacement (mm), Force Absolute (N), Force (N)

6. **Stop Logging:** Click the "Stop Measurement" button.
   - Logging stops.
   - The log file is closed.
   - The button reverts to "Start Measurement".
   - The "Live Graph" buttons are re-enabled.
   - The application returns to the Idle state.

5. Warranty

Wattcrafts Engineering Ltd. warrants that the product is free from defects in materials and workmanship under normal use for a period of 12 months from the date of purchase. During the warranty period, if the product is found to be defective, Wattcrafts Engineering Ltd. will, at its discretion, repair or replace the product at no charge to the customer.

This warranty does not cover:

- Damage resulting from misuse, abuse, accidents, or unauthorized modifications.
- Wear and tear from normal usage.
- Products that have been altered or repaired by unauthorized personnel.
- Damage caused by improper installation or failure to follow the instructions in the manual.

To make a warranty claim, please contact Wattcrafts Engineering Ltd. at info@wattcrafts.com with a description of the issue.

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