Overview

BiodaphO$_2$ Technology is an advanced environmental monitoring system designed for continuous measurement of key water quality parameters.
The platform integrates **industrial-grade sensors** with an **Arduino Opta Wi-Fi PLC**, enabling data acquisition and remote access for analysis and visualization.

The sensor suite includes:

- **Dissolved Oxygen Sensor Kit**
- **pH Sensor Kit**
- **Electrical Conductivity Sensor Kit (K = 0.1)**
- **Flow Sensor (flowmeter)**
- **Turbidity Sensor**

Each sensor transmits a **4–20 mA signal** to the Opta PLC, where readings are converted into calibrated values for **Dissolved Oxygen (mg/L)**, **pH**, **Electrical Conductivity (µS/cm)**, **Flow Rate (L/min)**, and **Turbidity (NTU)**.
Measurements are collected and transmitted via **Wi-Fi** to a **cloud server** for storage, long-term tracking, and visualization.

Data communication is handled through the **MQTT protocol**, ensuring efficient and reliable transmission.
Network connectivity is provided by an **outdoor 4G router**, which establishes the Wi-Fi network used by the Opta PLC.

In addition to remote monitoring through a **web-based dashboard**, the system automatically sends a **daily email report** summarizing the latest sensor readings organized in a .csv file.

Web-based dashboards are hosted in Dashboard Quart and Dashboard Antisa.
To add/remove an email destination of the .csv file please contact the provider.

System Architecture

Main installation (Quart, Spain)

- Two pool modules. Each pool includes: one pH sensor (Atlas Scientific, industrial), one conductivity sensor (Atlas Scientific, industrial), and one dissolved oxygen sensor (Atlas Scientific, industrial).
- One main control box with: Arduino Opta Wi-Fi PLC; analog extension module; three flow meters (general inlet plus two for the pools); one turbidity sensor; outdoor 4G router for data transmission.

Secondary installation (Antisa, Greece)

- One main control box with: Arduino Opta Wi-Fi PLC; one pH sensor (Atlas Scientific, industrial); one conductivity sensor (Atlas Scientific, industrial).

All sensor data is collected by the main control unit, compiled into a CSV file, and sent by email every day.

❓ Frequently Asked Questions (FAQs)

What should I do if I stop receiving the daily emails?

If no `.csv` files are being received, restart the **Main Module**:

- **Quart installation:** switch off the large metal control box (the main module).
- **Antisa installation:** switch off the single module provided for that site.

In both cases, toggle the **I1 switch** (bottom-right in “Connections Diagram.pdf”) off for 5 seconds, then turn it back on.

The system will reboot and resume normal operation.

If you have a computer with the Arduino IDE installed (see documentation for setup), you can connect via USB to monitor sensor updates every 5 seconds.

What if a sensor shows abnormal or negative readings, but emails are still being received?

If the data email arrives but one sensor is returning impossible values (e.g., negative EC or unstable pH readings), you only need to **restart the affected pool module**:

- Identify which pool is sending the incorrect values.

- On that pool’s box, toggle the **I1 switch** (bottom-right) off for 5 seconds, then turn it back on.

The module will reset and resume normal readings.

No calibration is needed after this restart.

How can I calibrate the sensors?

Calibration procedures for DO, EC, and pH sensors are explained in the document:

`/documentation/calibrating_sensors.pdf`

How often should sensors be calibrated?

Calibration frequency depends on the sensor type and environmental conditions.

Refer to the manufacturer and project guidelines available in:

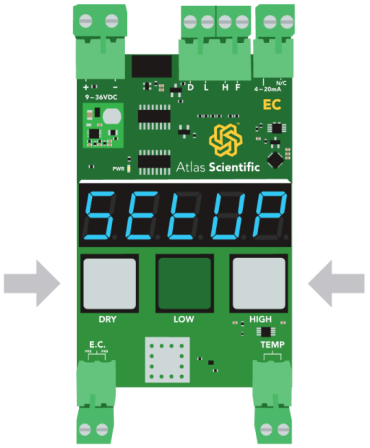
📁 `/sensors_and_controllers/`

Sensor Calibration

Conductivity Transmitter Sensor Calibration

1. **Selecting a probe type:** The provided probe is a K 0.1 so we need to select the option “0.1” in the Transmitter. *Attention: in the image below you see 0.1L or 0.01 options, but in the display you see “0.1L” or “0.1”, pick “0.1”.*

   To change the probe type, press and hold the two gray buttons marked as HIGH and DRY simultaneously for 1.5 seconds



1.5 seconds

This will open the setup menu.
In the setup menu there are only 3 options.

PrObE
4-20 H
4-20 L

The first option is “PrObE”. Press the **green LOW (up)** or **gray HIGH (down)** buttons to select you probe type. Press the **gray DRY (save)** button when the correct probe type has been selected. The probe type selection is now complete.

1.00
0.1L
0.01

2. **Calibration:** The Industrial Conductivity Transmitter uses 3-point calibration: “dry”, “low”,and “high”. The first calibration point is “dry”.

   The dry calibration only needs to be done when a new probe is connected for the first time to the transmitter.

   The other two calibration points have been preset to specific industry standard calibration values. The calibration values are dependent on what probe type the

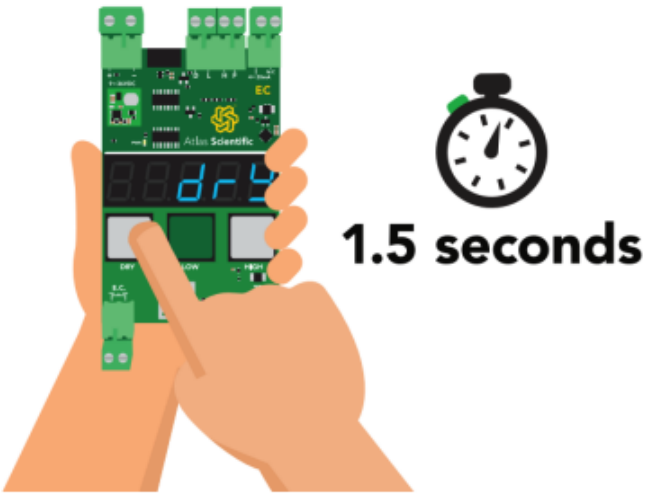
transmitter is connected to. The calibration data is stored in the EEPROM and will be retained even if the Transmitter is powered off.

Probe type	Low point calibration	High point calibration
K 0.1L	84µs	1,413µs
K 0.1	1,413µs	12,880µs
K 1.0	12,880µs	80,000µs

3. **Dry calibration:** *This step is only done when a new probe is first connected to the device.*

Dry probe calibration is similar to the tare function on a scale. After dry calibration the displayed conductivity should be 0.

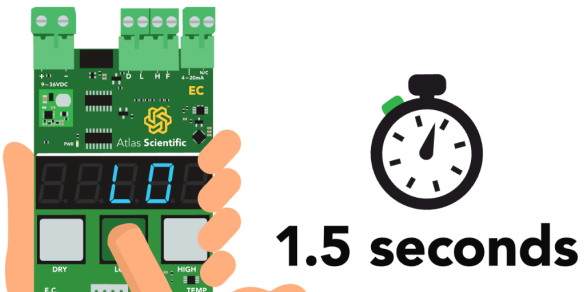
If the probe is not dry, dry it off. Press and hold the DRY calibration button for 1.5 seconds. The screen will display “dry” then “dONE”. Dry probe calibration has been completed.



4. **Low point calibration:** The probe should be put in the correct low point calibration solution.

Wait until the conductivity readings stabilize. Press and hold the LOW calibration button for 1.5 seconds. The screen will display “Lo” then “dONE”. The low point calibration has been completed.

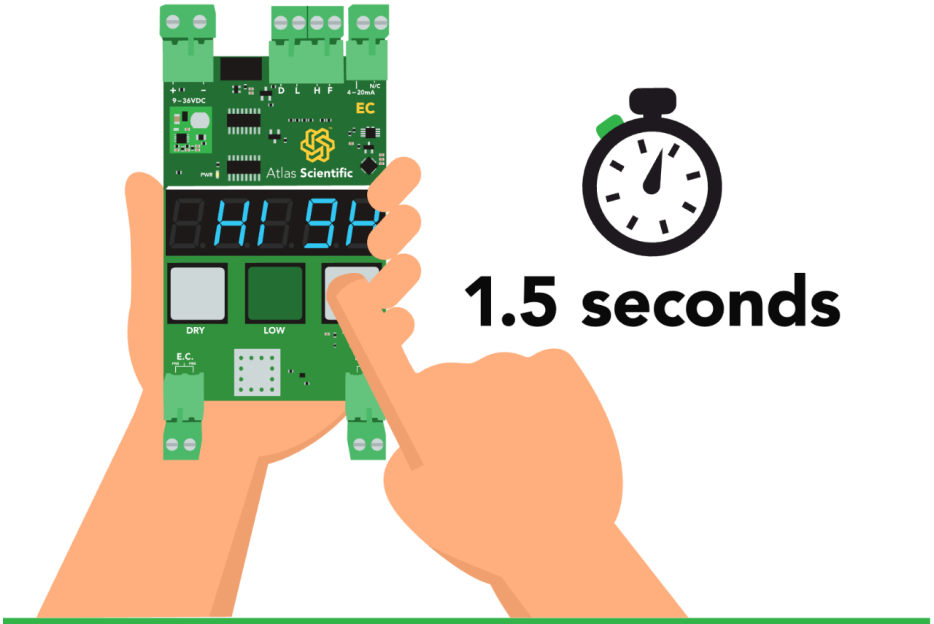
Probe type	Low point calibration
K 0.1L	84µs
K 0.1	1,413µs
K 1.0	12,880µs



5. **High point calibration:** The probe should be put in the correct high point calibration solution.

   Wait until the conductivity readings stabilize. Press and hold the HIGH calibration button for 1.5 seconds. The screen will display “HigH” then “dONE”. The High point calibration has been completed.

Probe type	High point calibration
K 0.1L	1,413µs
K 0.1	12,880µs
K 1.0	80,000µs



The conductivity readings will not change after low point calibration. The readings will change only when both high and low point calibration has been completed.

pH Transmitter Sensor Calibration

Calibration: The Atlas Scientific Industrial pH Transmitter has a flexible calibration protocol, allowing for single point, two points, or three-point calibration. The calibration data is stored in the EEPROM and will be retained even if the Transmitter is powered off. The calibration values are 4.00, 7.00, and 10.00

Note

The first calibration point must be pH 7.00
Calibrating to pH 7.00 will reset the stored calibration. If two, or three point calibrati has been done in the past, it must now be redone.

There is no correct order when calibrating to **4.00** and/or **10.00**. Recalibrating these two points will not have any effect on the other stored calibration points. Calibrating the Industrial pH Transmitter to **4.00** and/or **10.00** can be done at any time.

No calibration

Single point calibration

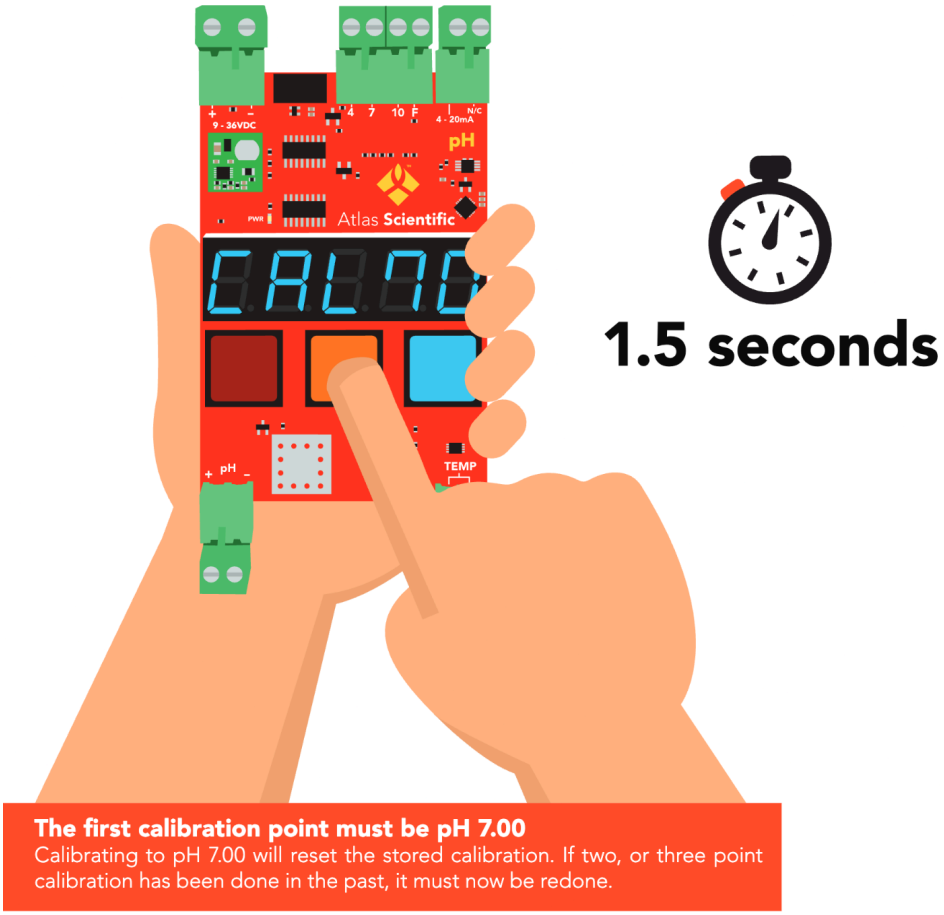
Two point calibration

Two point calibration will provide high accuracy between **7.00** and the second point calibrated against, such as a **4.00**.

Three point calibration

Three point calibration will provide high accuracy over the full pH range. Three point calibration at **4.00**, **7.00** and **10.00** should be considered the standard.

On board Calibration: To begin the on-board calibration process, press and hold the middle orange button for 1.5 seconds to calibrate to a pH of 7.00

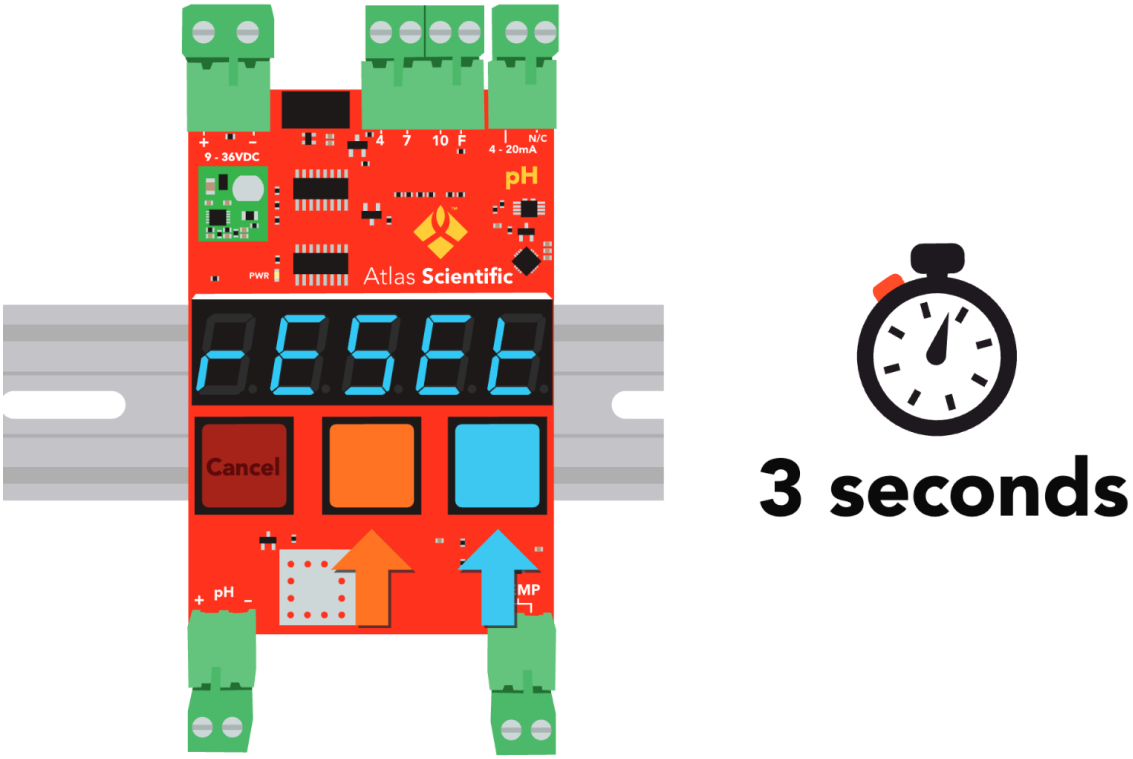


The display will flash: CAL7.0, after a few seconds the display will then flash: donE
If two point or three-point calibration is required, repeat this process to calibrate for pH 4.00 (left red button) and pH 10.00 (right blue button).

Factory Reset: If necessary all transmitters can be rebooted to original settings by performing a Factory Reset:

The Industrial pH Transmitter can be reset to its default settings. To issue a factory reset, press and hold the orange and blue buttons for three seconds.

The display will flash: “rESET”



Press and hold the **orange** and **blue** buttons again to confirm the factory reset.
To cancel a factory reset, press the **red** button.