

# AquapHOx<sup>®</sup> Logger Underwater O<sub>2</sub>, pH, T Meter

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MANUAL



# AquapHOx® Logger

## Underwater O<sub>2</sub>, pH, T Meter

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# 1 INTRODUCTION

The AquapHOx® Logger family (item no. APHOX-LX, APHOX-L-PH, APHOX-L-O2) are long-term loggers for underwater operation down to 4000 m (APHOX-LX) or 100 m (APHOX-L-PH and APHOX-L-O2) depth. The AquapHOx® Logger platform offers one optical port for connection of a wide range of optical O<sub>2</sub>- or pH-sensors from PyroScience. A fixed NTC temperature sensor provides automatic temperature compensation of the optical sensors. The integrated rechargeable LiPo battery offers stand-alone logging for up to 1 year. A huge internal data memory can store up to 40 million data points. The included USB cable is used for operating the device with the user-friendly software Pyro Workbench.

## 2 OVERVIEW

The front of the AquapHOx® Logger provides the port for connecting optical sensors using the PyroScience SUB-connector, the fixed NTC temperature sensor for automatic temperature compensation, and a mounting thread for calibration containers or protective cage during deployment/transport. The backside of the device provides the connector with the USB interface.



The housing is dependent on the chosen device. APHOX-LX comes with a titanium housing for deployments down to 4000m. APHOX-L-PH and APHOX-L-O<sub>2</sub> come with a POM housing capable for deployments down to 100m.

### 2.1 Optical Port

The AquapHOx® Loggers are compatible with PyroScience sensors for underwater applications designated by the appendix '-SUB' in the item number. Any of these sensor heads can be connected to the SUB-connector ("optical port") of the AquapHOx® Logger. The shallow-water versions APHOX-L-O<sub>2</sub> and APHOX-L-PH only support sensor heads for either oxygen or pH, respectively. The deep-sea version APHOX-LX supports oxygen as well as pH sensor heads for e.g. successive measurements.

### 2.2 Built-In Temperature Sensor

Optical oxygen and pH sensors show generally a temperature dependency, which can be automatically compensated by the device. For this purpose, the AquapHOx® Logger offers a high-precision, fast responding NTC temperature sensor. This sensor is fixed to the housing, it cannot be removed.

## 2.3 Air Pressure Compensation

For APHOX devices, the Pyro Workbench offers two ways to compensate for deviating ambient air pressure at the water surface. The ambient air pressure can either be entered in "hPa" as fixed pressure (measured at the water surface), or in approx. meters above sea level.

## 2.4 Included Accessories

1x USB configuration cable: allows easy calibration and setup with the powerful Windows software packages Pyro Workbench or Pyro DeveloperTool, as well as charging of the battery. Not intended for deployment during sampling.

1x Dummy Plug: used for protecting the electrical connector from water during the deployment.

1x Protection Cage: provides protection of the sensor ports during deployment or transport.

2x Calibration Containers: used for calibration standards during sensor calibration.

Calibration Capsules: used for preparation of calibration standards.

## 2.5 Optional Accessories

Sensor protection cage with anti-(bio)fouling net (item: APHOX®-CAGE-AF).



Anti-(bio)fouling net for underwater (-SUB) pH and oxygen sensor caps (item APHOX®-CAP-AF).



For optimal protection, the anti-(bio)fouling net (copper alloy) for the sensor cap protection cage (item: APHOX®-CAP-AF) should be combined with the sensor protection cage for AquapHOx® meters (item: APHOX®-CAGE-AF). Both protection cages can be purchased separately at any time and replaced once exhausted.



Flow-through-cell (item: APHOX®-FTC).

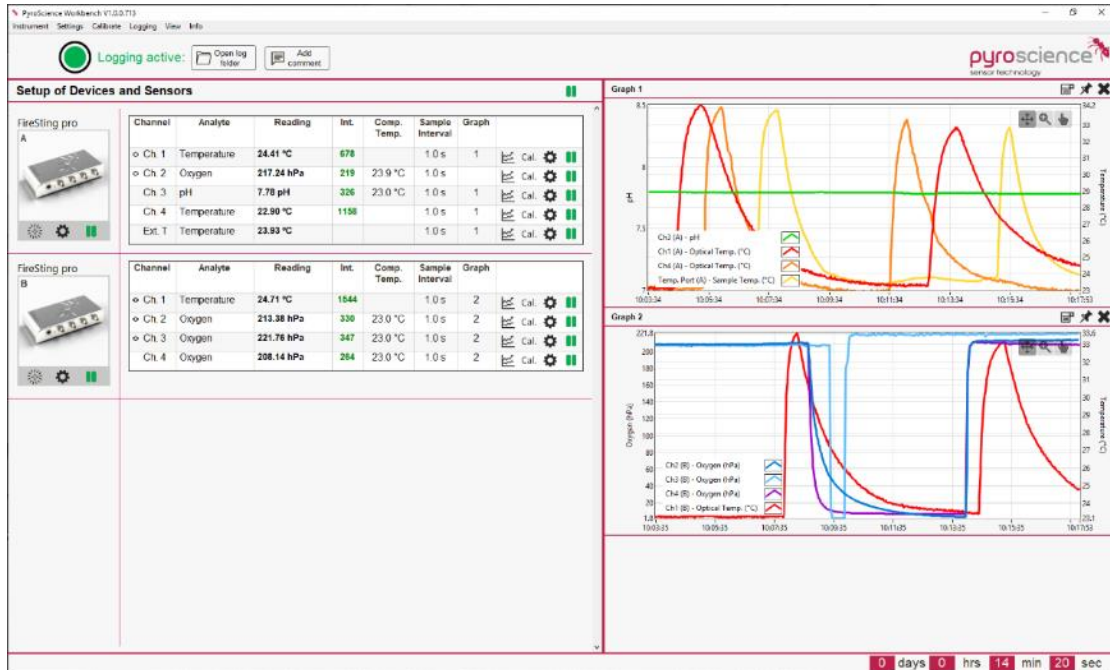


The flow-through cell allows to connect the APHOX® devices to a flow path. It can be used fully submerged, as well as in the laboratory, and can be combined with all PyroScience cap sensors with SUB-connector. Typical use cases are pumped CTD systems, FerryBox Systems, and industrial applications. Please refer to the APHOX®-FTC leaflet for product mounting.



### 3 SOFTWARE INSTALLATION

The AquapHOx® Logger is operated with the user-friendly software Pyro Workbench. This software offers comfortable settings and calibration wizards, as well as advanced logging features. Several devices can be operated in parallel within a single window.



System requirements: PC with Windows 7/8/10/11 and min. 1000 MB free disk space.

Do not connect the USB cable to your PC before the software has been installed! The software will automatically install the appropriate USB-drivers.

Installation steps:

- Download the Pyro Workbench from <https://www.pyroscience.com/en/downloads/underwater-devices>
- Unzip and start the installer and follow the instructions.
- Connect the AquapHOx® Logger to your PC with the included USB cable.
- Start the Pyro Workbench software.

For more detailed information on the software, please refer to the Pyro Workbench manual available at <https://www.pyroscience.com/en/downloads/underwater-devices>.

## 4 CONFIGURATION

This chapter provides short instructions how to install, configure, and calibrate sensor heads to the AquapHOx® Logger.

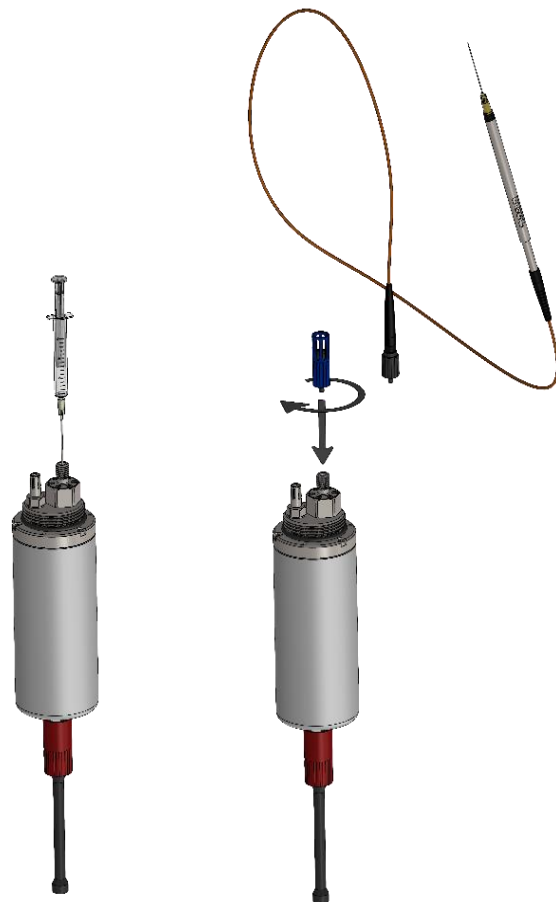
For in-depth information especially on sensor settings and sensor calibration, please refer to the respective Analyte Sensor Manual for optical oxygen or pH sensors available at <https://www.pyroscience.com/en/downloads/underwater-devices>.

### 4.1 Connecting the Sensor Head

An index matching liquid inside the connector enhances the sensor signals. Before connecting a sensor, insert the provided Pasteur pipette filled with deionized water (NOT seawater) to the bottom of the connector and fill it completely with the deionized water (NOT seawater).

Alternatively, and mandatory for the optical fiber with lens (item no. SPFIB-LNS-SUB/SPFIB-LNS-CL2-SUB) for read-out of sensor spots, insert the provided Pasteur pipette filled with silicone oil to the bottom of the connector and fill it with silicone oil.

The sensor is inserted and secured with the cap nut. Do not use a wrench. It is sufficient to tighten the nut by hand.



## 4.2 Sensor Settings

Open the settings Window in Pyro Workbench. Enter the Sensor Code of the connected sensor and adjust all further required settings as requested by the respective software.

## 4.3 Calibration Setup

Similar to the settings wizard, the user is guided through a calibration wizard for performing the required optical sensor calibration.

When using sensor caps, calibration can be performed by screwing the included calibration containers onto the AquapHOx® device.

When using fiber-based sensors, please ensure that the temperature sensor of the AquapHOx® has the same temperature as your calibration solution.

## 4.4 Calibration of Oxygen Sensors

The sensor needs to be calibrated in air-saturated water or in air with 100% relative humidity (upper calibration) and optionally in de-oxygenated water (0% calibration).

### 1-point calibration

- For calibration in air saturated water, it is very important that the water is indeed 100% saturated with air. Fill an appropriate amount of demineralized water into a flask. Stream air through the water with an air stone connected to an air pump (available as commercial equipment for fish aquaria) for about 10 minutes.
- When using the calibration container, it is possible to put wet paper tissues or a sponge onto the bottom of the calibration container and screw it on the AquapHOx® device to perform a calibration at air with 100% relative humidity.
- Enter all required parameters in the software, and perform a sensor calibration.

### 2-point calibration

- For 0% calibration, use the 0% calibration capsules from PyroScience, giving 50mL 0% calibration standard (item no.: OXCAL).
- For calibration using the calibration container, please dissolve 2 capsules in 100ml deion. water (NOT seawater). Screw the calibration container onto the device and perform the 0% calibration.



## 4.5 Calibration of pH Sensors

- A one-point calibration is obligatory to start measurements.
- A two-point calibration is highly recommended before every measurement.
- An additional pH offset-adjustment is recommended only for advanced applications, e.g. measurements in complex media.

If the sensor was previously stored under dry conditions or used for the first time, wait for at least 60 min to achieve wetting of the sensor membrane. This is the minimum time. For higher accuracy, it is necessary to condition the sensor for several hours (overnight) in e.g., seawater.

### 1-point calibration

- Screw the calibration container onto the device (in case of using a PHCAP) and let the sensor equilibrate (at least 15 min) in the stirred pH 2.0 buffer solution (freshly prepared using item no. PHCAL2). For more information see the pH sensor manual.
- Calibrate the pH sensor.

**Important:** The pH sensor must stay wet all the time between calibration and measurement. For this purpose, you might keep the calibration container attached to the device.

### 2-point calibration

- Perform the 1-point calibration as described above.
- Immerse the pH sensor and the temperature sensor into the stirred pH 11 buffer solution (freshly prepared using item no. PHCAL11). For more information see the pH sensor manual.
- Calibrate the pH sensor.

### pH offset adjustment

The pH offset adjustment does NOT replace the required calibration steps as described above. It offers an additional pH-offset adjustment using a buffer solution with exactly known pH value. This can be used if a reference measurement (e.g. spectrophotometric measurement) is available. The pH of this sample needs to be at the PK value of your sensor (pH 7.5 – 8.5 in case of a PK8 sensor). Please refer to the pH sensor manual for more information.

## 4.6 Calibration of Optical Temperature Sensors

The shallow-water AquapHOx® devices, item no. APHOX-L-O<sub>2</sub> and APHOX-L-PH, are capable of using PyroScience optical temperature fiber sensors. Calibration of these sensors can be performed by using the internal temperature sensor.

- Click on Calibrate and follow the calibration instructions.

- Select the desired calibration against the integrated NTC Temperature Sensor or against a Fixed Reference Temperature.
- Calibrate the optical temperature sensor.

**Important:** When using the integrated NTC temperature sensor for the reference temperature, ensure that the connected optical temperature sensors is exposed to the same temperature as the NTC temperature sensor.

## 5 MEASUREMENTS

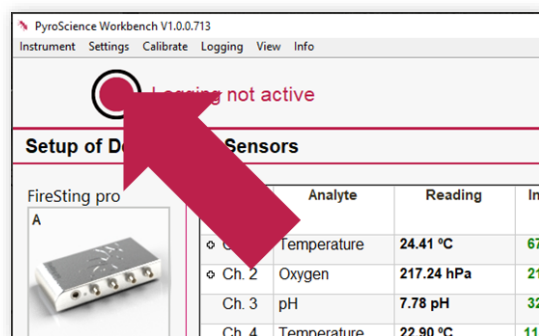
After the device has been configured as described in the previous chapter, measurements and data logging can be started using the software Pyro Workbench.

### 5.1 Online Measurements

The main window of Pyro Workbench will automatically start with periodic measurements (indicated by "II") after a successful sensor calibration. These measurements are not yet saved, they are only visualized in the software window. The actual readings are shown in tables and graphs. Configure the graphs by clicking on the graph symbol in the respective row of the table. Please refer to the Workbench Manual for further instructions. To ensure communication free of interference a connection to a PC should only be established in electromagnetically controlled environments.

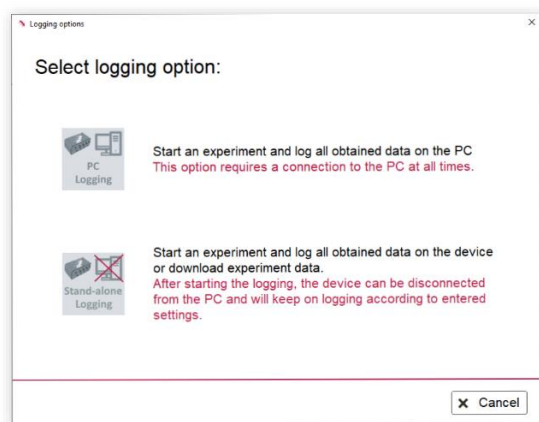
### 5.2 Data Logging

For data logging, click the red record button in the upper left corner of the Pyro Workbench.



There are two different options for data logging: **PC Logging** and **Stand-alone Logging**.

Note, both logging modes can be activated in parallel. However, for most usage scenarios this does not make sense.



**PC Logging** requires a permanent connection via the USB cable to the PC. The data are not stored on the device, but on the PC.

**Stand-alone Logging** does not require a connection the PC. The data are stored on the device. After completion of the experiment, the data are downloaded from the device to a PC.

**Important for Stand-alone Logging:** Check the battery status. The battery is sufficient for >1-year deployment with 10 min sampling interval and is fully recharged within ca. 2 hours while connected to a PC.

Enter the required information on the respective logging panel and start the data logging.

## 5.3 Charging the Battery

The internal LiPo battery is charged by connecting the device to any computer USB 2.0 port or to any standard USB charger. If the used USB port provides up to 500 mA charging current, the charging is completed within ca. 2h, if the battery was fully discharged. Some USB ports provide only max. 100 mA, in this case the charging duration will increase to ca. 10h. The software Pyro Workbench gives you information on the charging status.

## 5.4 Deployment

If you are using sensors caps (and not fiber-optic sensor heads): Before the actual deployment, it is recommended to keep the sensor caps immersed in the calibration container filled with the respective calibration standard. This is especially important for pH sensors in order to keep them wet.

For deployment, disconnect the device from the PC and protect the electrical connector with the dummy plug. Remove the calibration container shortly before the deployment, and replace it with the protection cage. Deploy the AquapHOx® Logger.



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In shallow water environments, it is strongly recommended to slip over the APHOX®-CAP-AF anti-(bio)fouling net onto the sensor cap and to use the APHOX®-CAGE-AF with anti-biofouling net on the APHOX® device (instead the included protection cage without net).

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## 5.5 Data Retrieval

After retrieving the logger, remove the dummy plug and connect the device to the PC with the included USB cable.

- Start the Pyro Workbench software.
- Click on **Stop Logging**
- Download the recorded data to the PC by selecting the respective logfile from the list of **Logfiles in device memory** in the **Stand-alone logging** window and clicking on "Download". These ".txt" files can be easily imported into common spreadsheet programs.

Data retrieval should only be attempted in electromagnetically controlled environments to ensure communication free of interference.

Please note that PC and device logging can be simultaneously active. The obtained data via PC logging will not show up in the device logging file and vice versa.



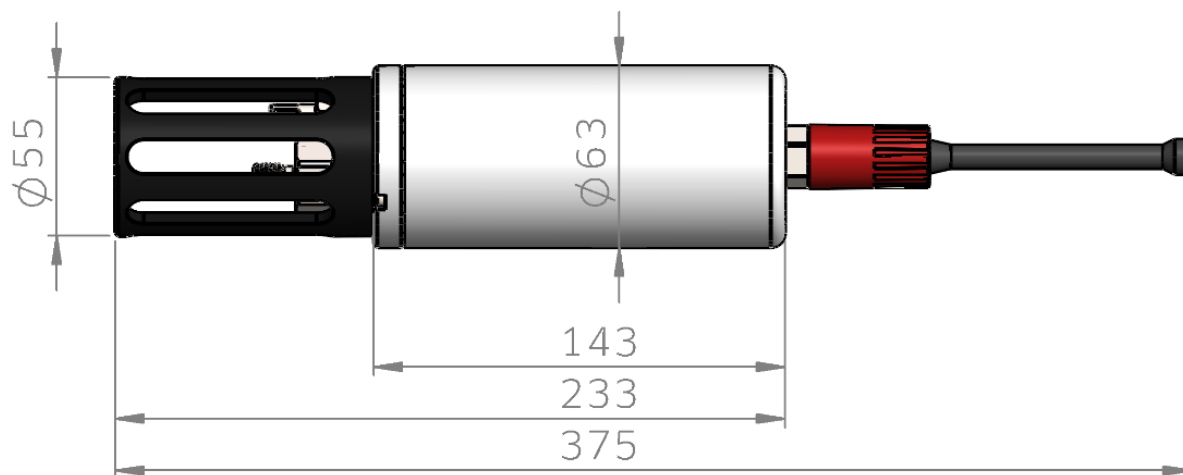
## 5.6 Compensation of pH Sensor Drift

For long-term measurements of pH sensors, it is possible to perform a manual drift compensation using the Pyro Data Inspector.

- After retrieving the logger, rinse the pH sensor with distilled water and put the sensor into a freshly prepared pH 2 (PHCAL2) calibration solution. Let the logger record several data.
- Remove the connector dummy and connect the AquapHOx® device to the PC with the included USB cable. Start the Pyro Workbench software.
- Click on **Stop Logging**
- Download the recorded data to the PC by selecting the respective logfile from the list of **Logfiles in device memory** in the **Stand-alone logging** window and clicking on "Download and open in Data Inspector". After the download the Measurement will be opened in the Data inspector.
- For more detailed information on the pH drift compensation and the Data Inspector, please refer to the Pyro Workbench manual.

## 6 APPENDIX

### 6.1 Dimensions



### 6.2 Device Specification

For sensor specifications and response times, please refer to the webpages of the different sensor types.

Specifications		
Item No.	APHOX-LX	APHOX-L-PH / APHOX-L-O <sub>2</sub>
Dimensions	63 x 300 mm	63 x 300 mm
Weight in air	1.35 kg	0.450 kg
Housing Material	Titanium	Polyoxymethylene (POM)
Max. hydrostatic pressure	400 bar (4000m)	10 bar (100m)
Supported analytes	optical pH and O <sub>2</sub>	APHOX-L-PH: pH and optical temperature  APHOX-L-O <sub>2</sub> : O <sub>2</sub> and optical temperature
Optical sensor connector	PyroScience underwater connector (-SUB)	

Optical sensor port	1
Compatible optical sensors	Portfolio of optical sensors with underwater connector (-SUB) from PyroScience
External temperature sensor	NTC thermistor for temperature compensation
Resolution	0.005°C
Accuracy	0.05°C
Typical response time	0.5 s
Software	Software Pyro Workbench or Pyro DeveloperTool
Computer interface	USB 2.0
Electrical Connector	Subconn MCBH6M
Charging	via included USB cable
Battery	Rechargeable LiPo battery, 1250 mAh
Data storage	4 GB (ca. 40 million data points)
Fastest sample rate	1 Sample per sec.
Typical stand-alone logging time (fully charged battery)	ca. 1 week for 1s logging interval ca. 2 months for 10s logging interval ca. 6 months for 1 min logging interval ca. 1 year for >10 min logging interval
Operating / storage temperature	-10 – 60 °C Storage -5 – 40 °C Operating
Oxygen sensors	Refer to the separately available specifications for the connected oxygen sensor
pH sensors	Refer to the separately available specifications for the connected pH sensor
Optical temperature sensors	Refer to the separately available specifications for the connected optical temperature sensor

\*Please note, that the optical sensors have a different temperature range

## 6.3 Warnings & Safety Guidelines

In case of problems or damage, disconnect the device and mark it to prevent any further use. Consult PyroScience for advice! There are no serviceable parts inside the device. Please note that opening the housing will void the warranty.

Follow appropriate laws and guidelines for safety in the laboratory, like EEC directives for protective labor legislation, national protective labor legislation, safety regulations for accident prevention and safety data-sheets from manufacturers of chemicals used during the measurements and of PyroScience buffer capsules.

Handle the sensors with care especially after removal of the protective cap! Prevent mechanical stress to the fragile sensing tip! Avoid strong bending of the fiber cable! Prevent injuries with needle-type sensors!

Handle the protection cages with care to avoid injuries! As the anti-(bio)fouling net contains **nickel**, it is strongly recommended to wear **gloves** during handling, especially in case of a known contact allergy.

The sensors are not intended for medical or military purposes or any other safety-critical applications. They must not be used for applications in humans; not for in vivo examination on humans, not for human-diagnostic or any therapeutic purposes. The sensors must not be brought in direct contact with foods intended for consumption by humans.

Handle the device with extreme care if there is any suspicion that it was flooded during deployment. Internal pressure might have built up as a consequence. Point the sensor side of the device away from people and material assets at all times, and carefully loosen the Subcon connector to relieve potential internal pressure before sending the instrument to PyroScience for service.

Keep the sensors and the device out of reach of children!

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