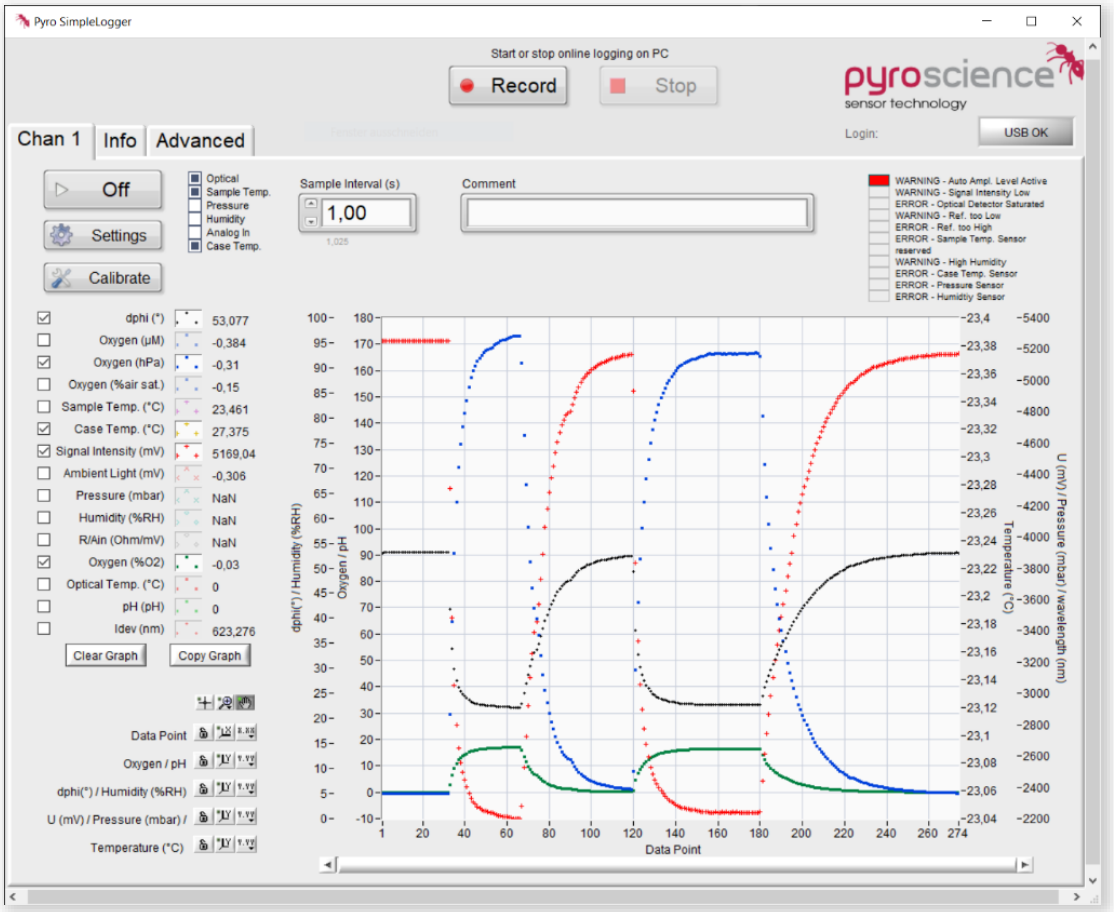
pyroscience
sensor technology

Pyro Developer Tool
PyroScience Logger Software

QUICKSTART MANUAL



Pyro Developer Tool
PyroScience Logger Software

Document Version 2.06

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1 INTRODUCTION

The **Pyro Developer Tool software** is an advanced logger software especially recommended for evaluation purposes of OEM modules. It offers simple settings and calibration procedures, as well as basic logging features. Furthermore, additional advanced settings offer full control on all features of the module.

1.1 Technical Requirements

	Minimal requirements	**Recommended requirements**
Operating system	Windows 7 / 8 / 10	Windows 10
Processor	Intel i3 Gen 3 (or equivalent) or later	Intel i5 Gen 6 (or equivalent) or later
Graphic	1366 x 768 pixel (Windows scaling: 100%)	1920 x 1080 pixel (Full HD)
Disk space	1 GB	3 GB
RAM	4 GB	8 GB

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1.1 Installation

> **Important:** Do not connect the **PyroScience** device to your PC before the **Pyro Developer Tool** has been installed. The software will install automatically the appropriate USB-driver.

Installation steps:

- Please find the correct software in the downloads tab of your purchased device on www.pyroscience.com
- Unzip and start the installer and follow the instructions
- Connect the supported device with the USB cable to the computer.
- After successful installation, a new program short-cut "Pyro Developer Tool" is added to the start menu and can be found on the desktop.

1.2 Supported Devices

This software works with any **PyroScience** device with firmware version >= 4.00. If the device is equipped with a USB interface, it can be directly connected to a Windows PC and operated with this software. If the module comes with an UART interface, then a separately available USB adapter cable is required for using this software.

Multi-analyte meter FireSting-PRO with

- 4 optical channels (item no.: **FSPRO-4**)
- 2 optical channels (item no.: **FSPRO-2**)
- 1 optical channel (item no.: **FSPRO-1**)

Oxygen meter FireSting-O_2 with

- 4 optical channels (item no.: **FSO2-C4**)
- 2 optical channels (item no.: **FSO2-C2**)
- 1 optical channel (item no.: **FSO2-C1**)

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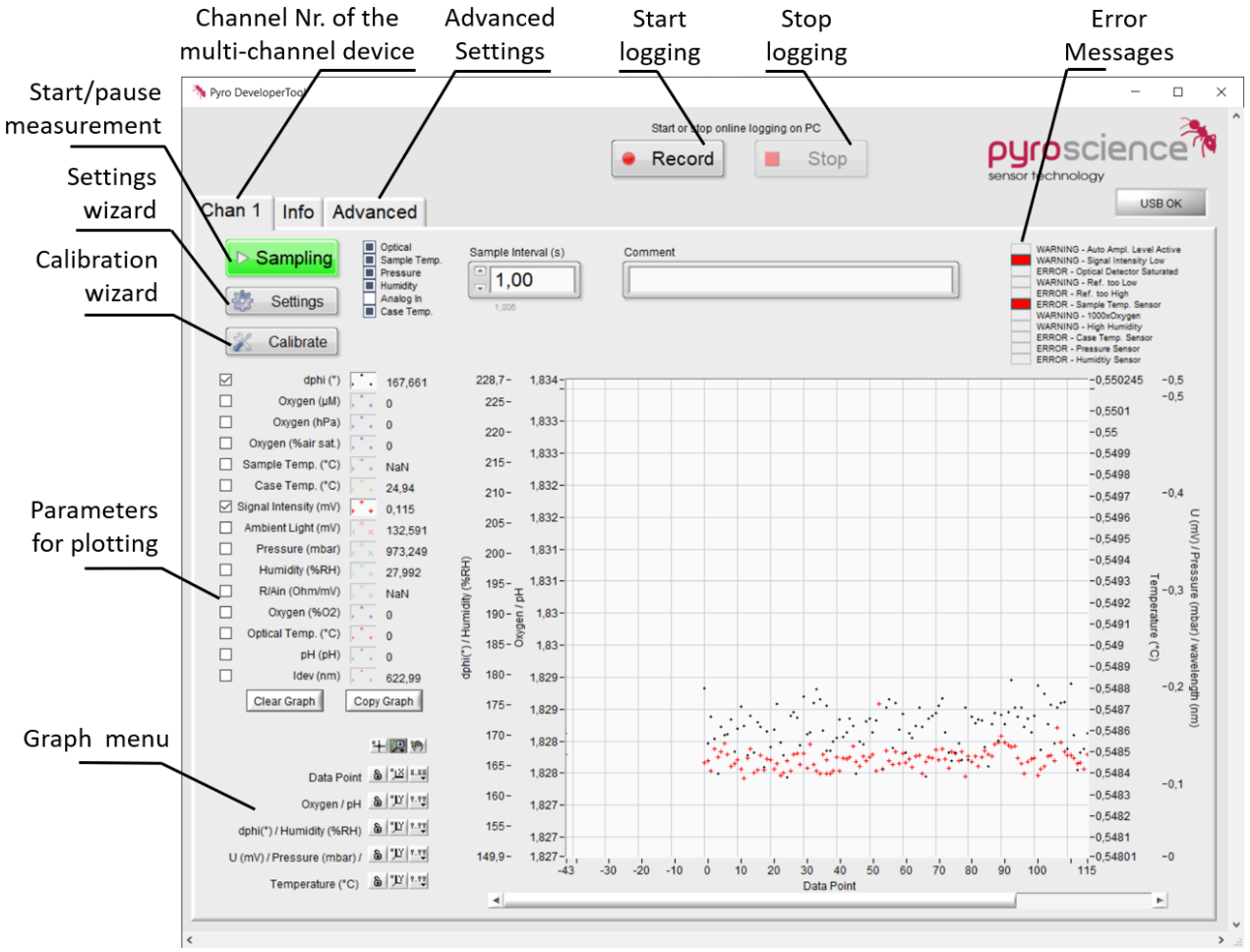
OEM meters

- Oxygen OEM module (item no.: **PICO-O2, PICO-O2-SUB, FD-OEM-O2**)
- pH OEM module (item no.: **PICO-PH, PICO-PH-SUB, FD-OEM-PH**)
- Temperature OEM module (item no.: **PICO-T**)

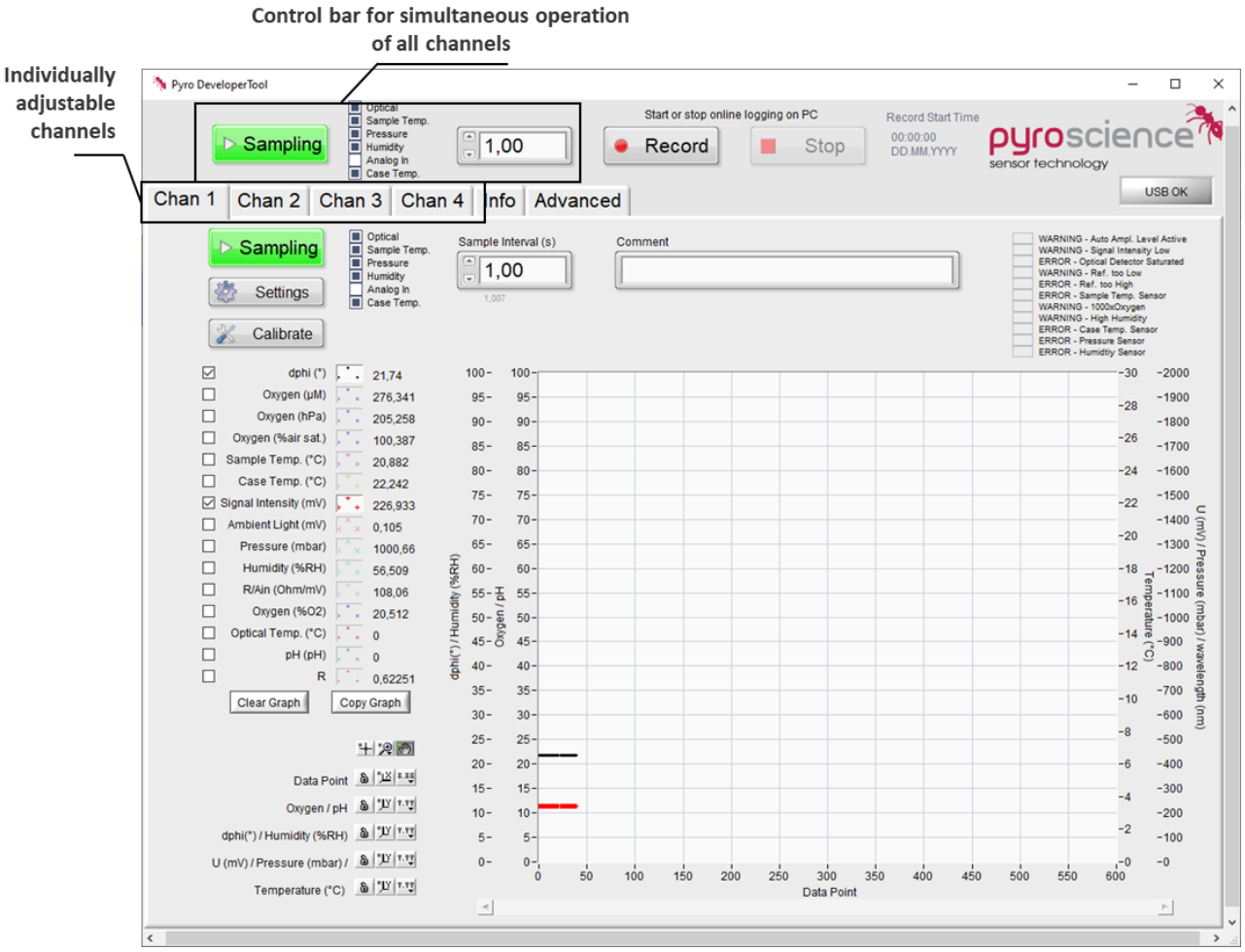
Underwater AquapHOx meters

- Logger (item no.: **APHOX-LX, APHOX-L-O2, APHOX-L-PH**)
- Transmitter (item no.: **APHOX-TX, APHOX-T-O2, APHOX-T-PH**)

2 OVERVIEW MAIN WINDOW

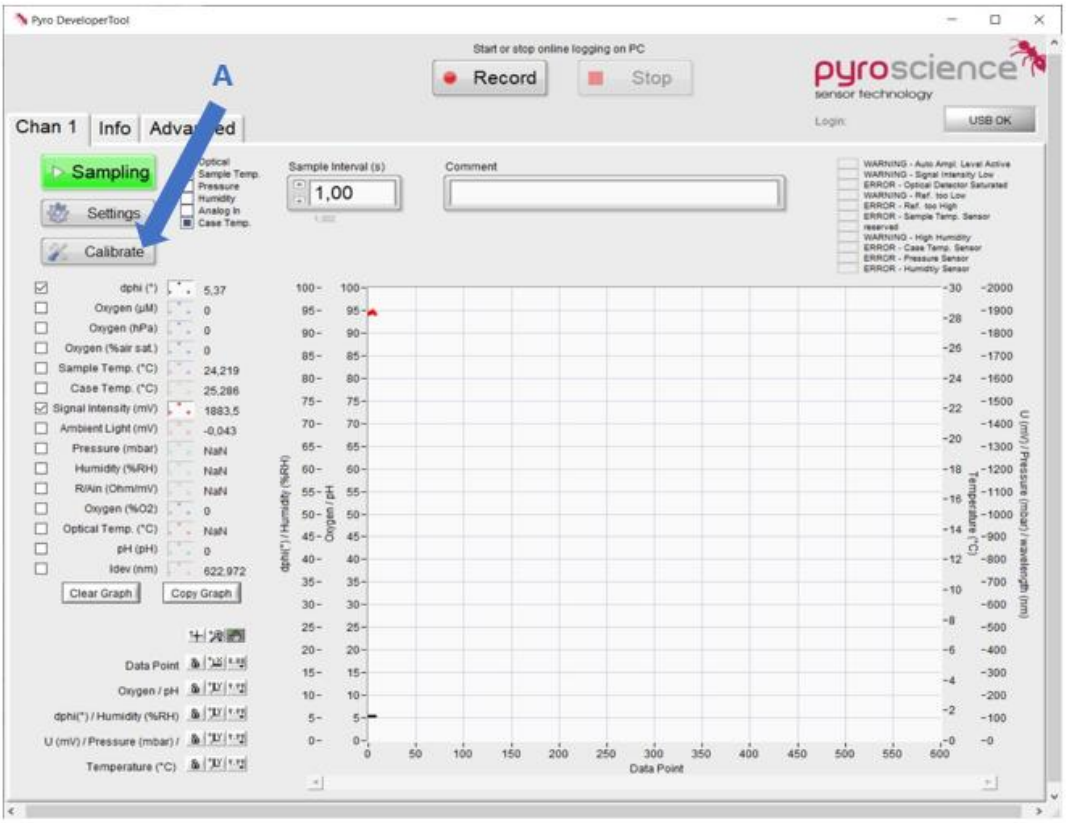


The main window can look differently depending on the type of device you are using. When using a multi-channel device such as **FSPRO-4**, each channel is individually adjustable and will be shown in the tabs. All channels are controllable simultaneously with an additional control bar. When using devices with stand-alone logging function such as **AquapHOx Loggers**, a new tab for the logging function will be shown.


Control bar for simultaneous operation of all channels
Individually adjustable channels
Pyro DeveloperTool
Sampling
Optical
Sample Temp.
Pressure
Humidity
Analog In
Case Temp.
1,00
Start or stop online logging on PC
Record
Stop
Record Start Time
00:00:00
DD.MM.YYYY
pyroscience
sensor technology
USB OK
Chan 1
Chan 2
Chan 3
Chan 4
Info
Advanced
Sampling
Settings
Calibrate
Sample Interval (s)
1,00
Comment
WARNING - Auto Ampl. Level Active
WARNING - Signal Intensity Low
ERROR - Optical Detector Saturated
WARNING - Ref. too Low
ERROR - Ref. too High
ERROR - Sample Temp. Sensor
WARNING - 1000xOxygen
WARNING - High Humidity
ERROR - Case Temp. Sensor
ERROR - Pressure Sensor
ERROR - Humidity Sensor
dphi (°) 21,74
Oxygen (µM) 276,341
Oxygen (hPa) 205,258
Oxygen (%air sat.) 100,387
Sample Temp. (°C) 20,882
Case Temp. (°C) 22,242
Signal Intensity (mV) 226,933
Ambient Light (mV) 0,105
Pressure (mbar) 1000,66
Humidity (%RH) 56,509
R/Ain (Ohm/mV) 108,06
Oxygen (%O2) 20,512
Optical Temp. (°C) 0
pH (pH) 0
R 0,62251
Clear Graph
Copy Graph
Data Point
Oxygen / pH
dphi(°) / Humidity (%RH)
U (mV) / Pressure (mbar) /
Temperature (°C)
dphi(°) / Humidity (%RH)
Oxygen / pH
Temperature (°C)
U (mV) / Pressure (mbar) / wavelength (nm)
Data Point

3 SENSOR SETTINGS

- Connect your device to the PC and start the **Pyro Developer Software**
- Click on Settings (A)



- Enter the Sensor Code of your purchased sensor

The software will recognize the analyte (O_2, pH, temperature) automatically based on the sensor code.

- Please choose your temperature sensor for automatic temperature compensation of your measurement

Please note that you can use several options for temperature compensation of optical analyte sensors (pH, O_2):

Sample Temp. Sensor: An additional Pt100 temperature sensor is connected to your device.

In case of **AquapHOx**, the integrated temperature sensor will be used.

In case of **PICO** devices, a Pt100 temperature sensor need to be soldered to the device (**TSUB21-NC**).

Case Temp. Sensor: The read-out device has a temperature sensor inside. You can use this temperature sensor if the entire device will have the same temperature as your sample.

Fixed Temp: The temperature of your sample will not change during measurement and will be kept constant using a thermostatic bath.

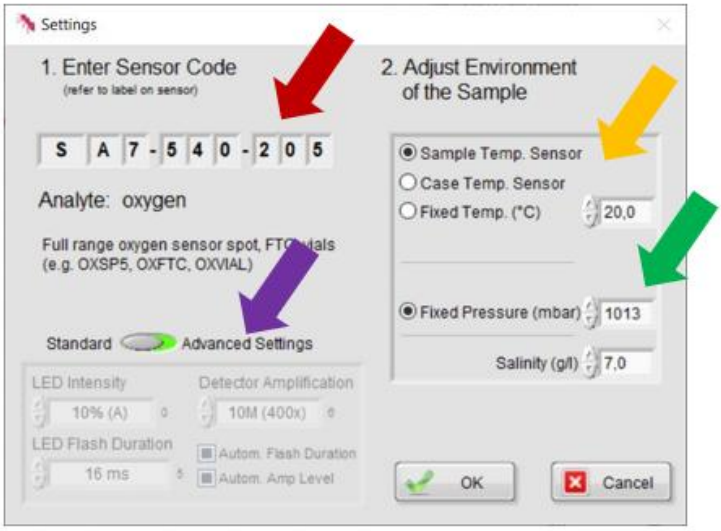
- Please type in the pressure (mbar) and the salinity (g/l) of your sample

For salt solutions based on NaCl the salinity value can be calculated by a simplified approach:

Salinity [g/l] = Conductivity [mS/cm] / 2

Salinity [g/l] = Ionic Strength [mM] / 20

When changing to advanced device settings, it is possible to change LED intensity, the detector amplification and then LED flash duration. These values will influence the sensor signal (and the rate of photobleaching). Do not change these values if your sensor signal is sufficient (recommended values: >100mV at ambient air)



4 SENSOR CALIBRATION

4.1 Calibration of oxygen sensors

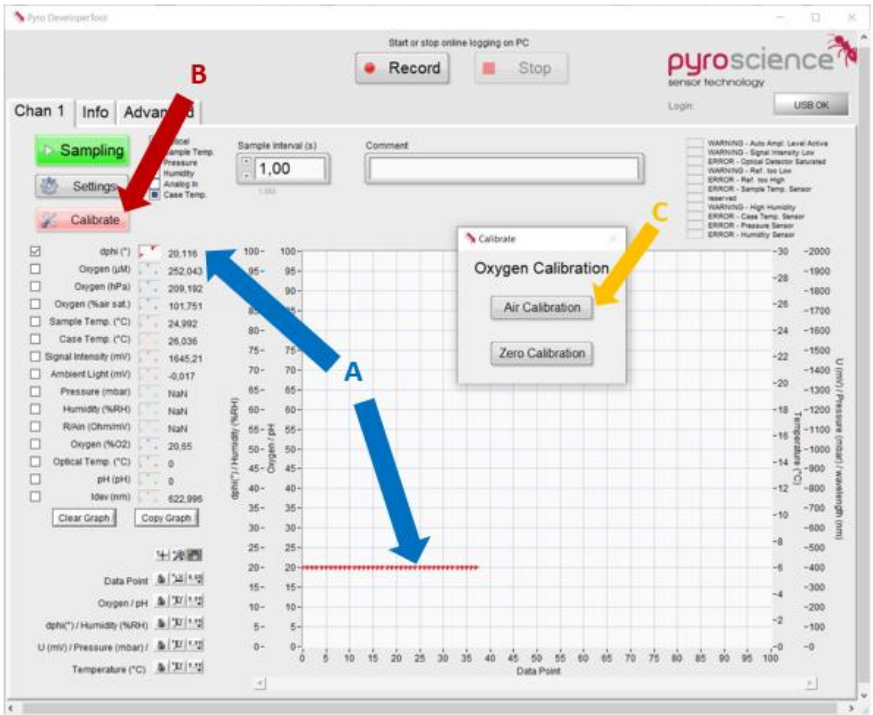
There are two calibration points for oxygen sensor calibration:

- Upper calibration: calibration at ambient air or 100% oxygen
- 0% calibration: calibration at 0% oxygen; recommended for measurements at low O2

A calibration of one of those points is required (1-point calibration). An optional 2-point calibration with both calibration points is optional but preferable for high accuracy measurements in the full sensor range.

Upper Calibration

- Connect your oxygen sensor to your device and let the sensor equilibrate at your calibration conditions (refer to the **oxygen sensor manual** for more detailed description calibration)
- To ensure stable signal, please follow 'dPhi (°)' (A) on the graphical interface. dPhi represents the measured raw value
- Once you reached a stable signal of dPhi and the temperature, click on Calibrate (B) and then on Air Calibration (C).



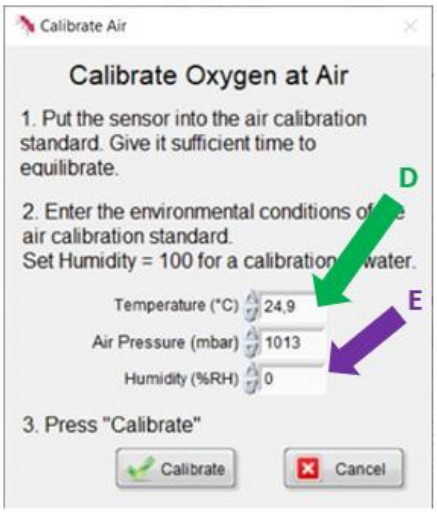
Note: When the calibration window is opened, the last measured dPhi and temperature value is used. No further measurement is conducted. Open the window only once the value is stable.

A calibration window will open. In the Calibration window, the last measured temperature value will be shown (D).

- Type in the current air pressure and the Humidity (E)

Both values can also be seen on the measured values in the main window. If the sensor is submerged in water or if the air is saturated with water, enter 100% Humidity.

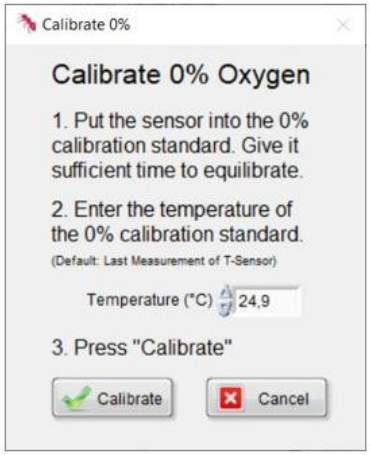
- Click on Calibrate to perform the upper calibration



0% Calibration

- Put the oxygen and temperature sensor into your oxygen-free calibration solution (item no. **OXCAL**) and wait again until a stable sensor signal (dPhi) and temperature is reached
- After a stable signal is reached, click on Calibrate (B) and then on Zero Calibration (C).
- In the calibration window, control the measured temperature and then click on Calibrate

The sensor is now 2-point calibrated and ready to use.



4.2 Calibration of pH sensors

Depending on the applied equipment and requirements, the following calibration modes are possible:

- **Calibration free measurements** are possible with pre-calibrated pH sensors (SN>231450494) in combination with pre-calibration ready **FireSting-PRO** devices (SN>23360000 and labeled devices) and with the bare optical fiber **SPFIB-BARE** (**NOT SPFIB-LNS**). To achieve higher accuracy and precision a manual calibration is advised.
- **A one-point calibration** at pH 2 is required for the continued use of the pH sensors, for readout devices which do not support pre-calibrated sensors and for measurements in combination with **SPFIB-LNS**.
- **A two-point calibration** at pH 11 before every measurement is highly recommended when high accuracy and precision are required.
- **pH offset adjustment** is recommended for measurements in complex media (only advanced applications)

Important: Please do NOT use commercially available buffer solutions used for pH electrodes. These buffers (colored and uncolored) contain anti-microbial agents that will irreversibly change the optical pH sensor performance. It is important to use only PyroScience buffer capsules (Item PHCAL2 and PHCAL11) or self-made buffers with known pH and ionic strength for calibration (more details on request).

Low pH calibration (First calibration point)

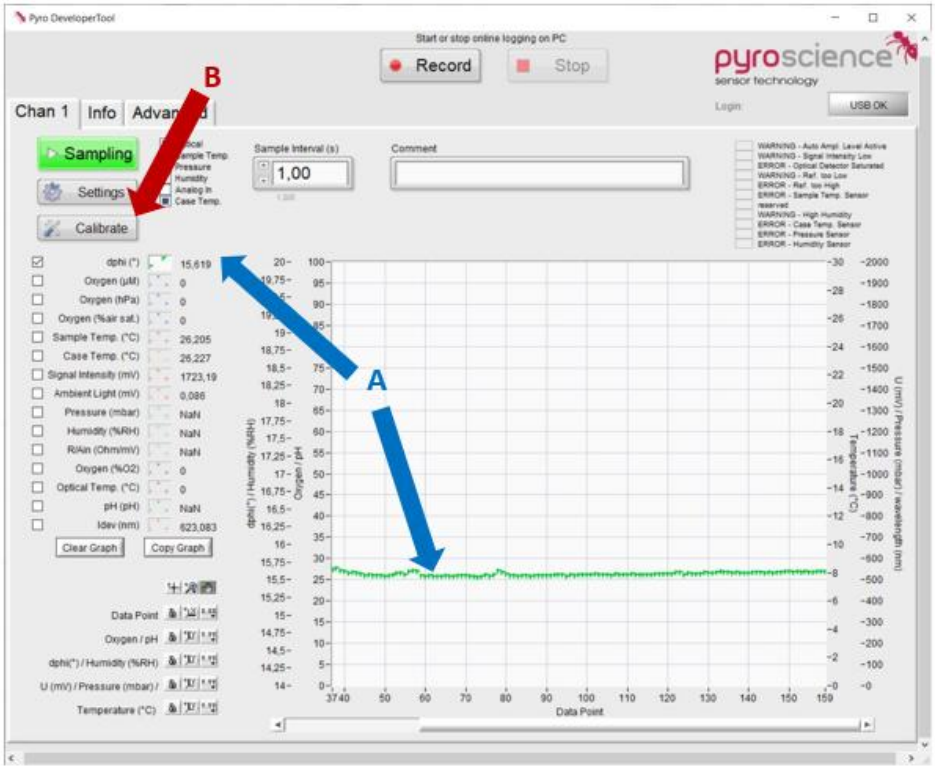
Read the **pH sensor manual** for more information on the calibration procedure.

- Connect your pH sensor to your device and let the sensor equilibrate in dest. H_2O for at least **60 min** to facilitate **wetting of the sensor.**
- Prepare a pH 2 buffer (item no. **PHCAL2**). Immerse the sensor into the **stirred** pH 2 buffer and let the sensor equilibrate for at least 15 min.
- To ensure stable signal, please follow 'dPhi (°)' (A) on the graphical interface. dPhi represents the measured raw value

Important: Please check the value of "Signal intensity". If the value is < 120mV please increase the LED intensity.

- Once you reached a stable signal, click on Calibrate (B).

Note: when the calibration window is opened, the last measured dPhi and Temperature value is used. No further measurement is conducted. Open the window only once the value is stable.

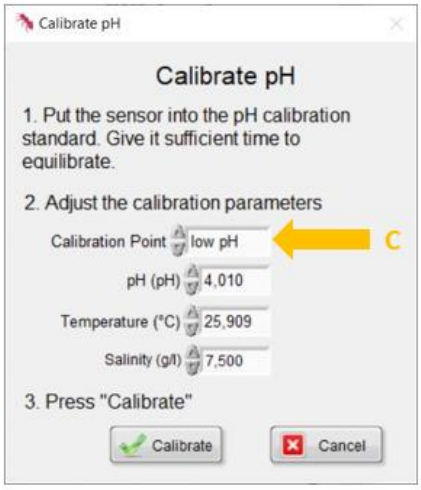


- In the Calibration window, choose low pH (C), enter the pH value and salinity of your pH buffer and ensure that the correct temperature is displayed

When using **PHCAL2**, please type in the pH value at the current temperature. The salinity of the buffer is 2 g/l.

Temperature	pH
10°C	2.40
15°C	2.36
20°C	2.3
25°C	2.26
30°C	2.23

- Click on Calibrate to perform the low pH calibration



High pH calibration (Second calibration point)

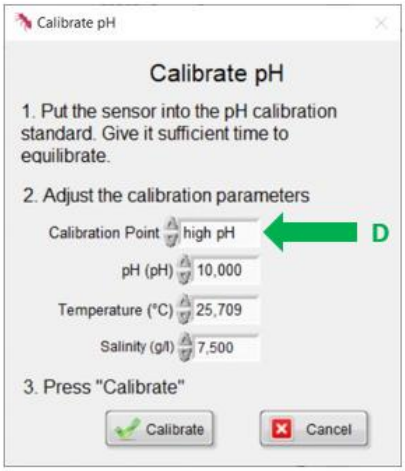
- For the 2nd calibration point prepare a buffer with pH 11 (**PHCAL11**)
- Rinse the pH sensor with distilled water and immerse the sensor into the pH 11 buffer
- Let the sensor equilibrate for at least 15 min
- After a stable signal is reached, click on Calibrate (B)
- In the Calibration window, choose high pH (D), enter the pH value and salinity of your pH buffer and ensure that the correct temperature is displayed

When using **PHCAL11**, please type in the pH value at the current temperature. The salinity is 6 g/l.

Temperature	pH
10°C	10.81
15°C	11.05
20°C	11.14
25°C	11.23
30°C	11.28

- Click on Calibrate to perform the high pH calibration

The sensor is now 2-point calibrated and ready to use.

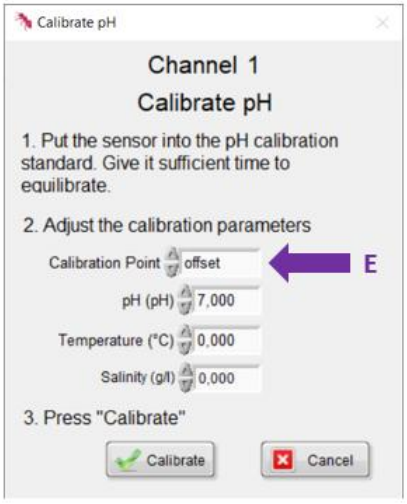


pH offset adjustment (optional, only for advanced applications)

This will perform a pH-offset adjustment to a buffer with exactly known pH value. This can be used for measurements in highly complex media (e.g. cell culture media) or to perform an offset to a known reference value (e.g. spectrophotometric pH measurement). Please refer to the **pH sensor manual** for more information.

The buffer/ sample for this pH offset calibration must be within the dynamic range of the sensor. This means, the solution must have e.g. a pH between 6.5 and 7.5 for PK7 sensors (or pH 7.5 and 8.5 for PK8 sensors).

- Put the sensor into a buffer with known pH value and salinity. After a stable signal is reached, click on calibrate in the main window (A). Choose offset (E) and enter the pH value of the reference

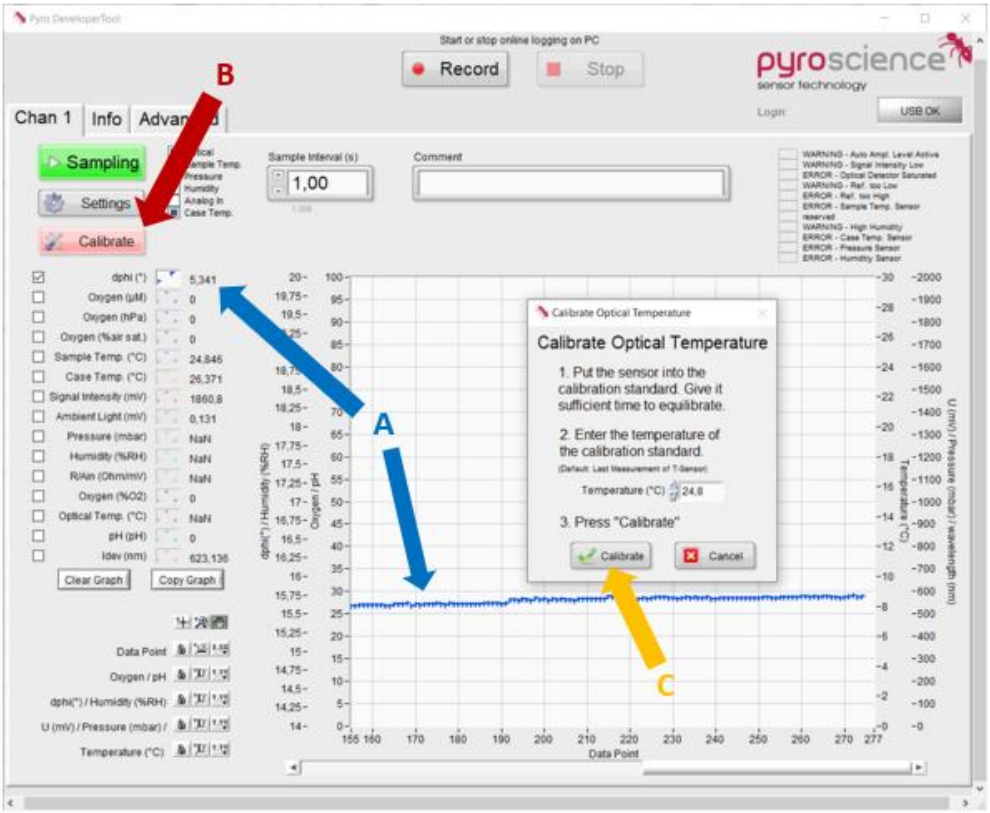


4.3 Calibration of optical temperature sensors

Optical temperature sensors are calibrated against an external temperature sensor.

- Connect your optical temperature sensor to your device
- To ensure a stable sensor signal, follow 'dPhi (°)' (A) on the graphical interface. dPhi represents the measured raw value.
- Once you reached a stable signal, click on Calibrate (B)
- In the calibration window, type in the reference temperature and click on Calibrate (C).

The sensor is now calibrated and ready to use.



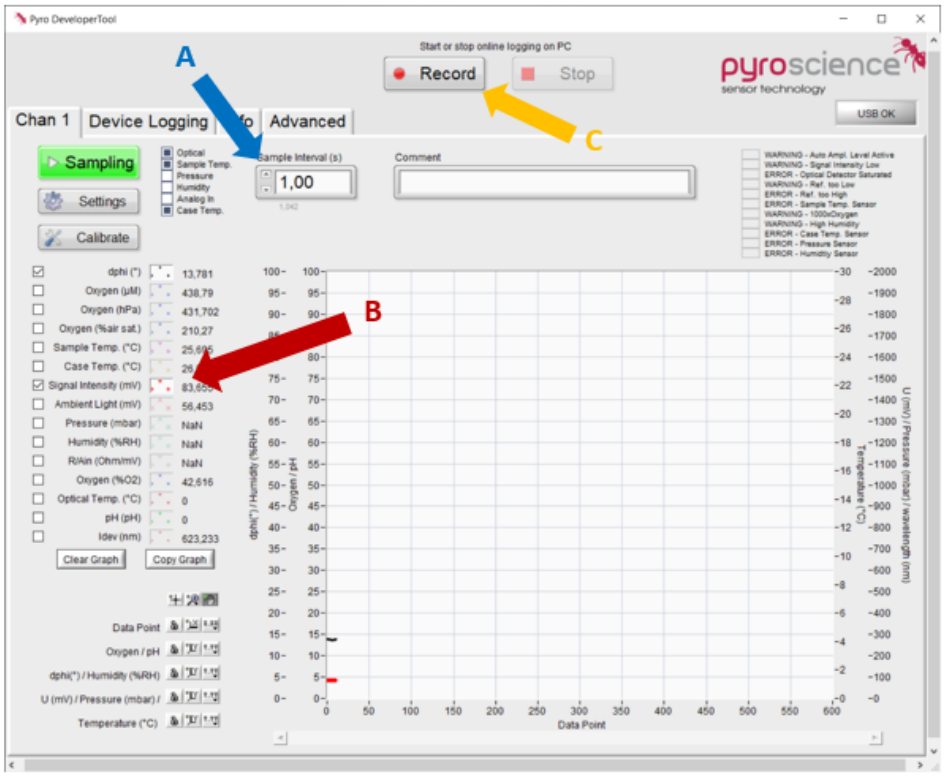
5 MEASUREMENT AND LOGGING

After a successful sensor calibration, **Measurements** and **Logging** can be started.

5.1 Measurements

- In the main window, adjust your sample interval (A)
- Choose your parameter which should be shown in the graph (B)
- Click on Record (C) to save the data in a tab separated textfile with the file extension '.txt'. All parameters and raw values will be recorded.

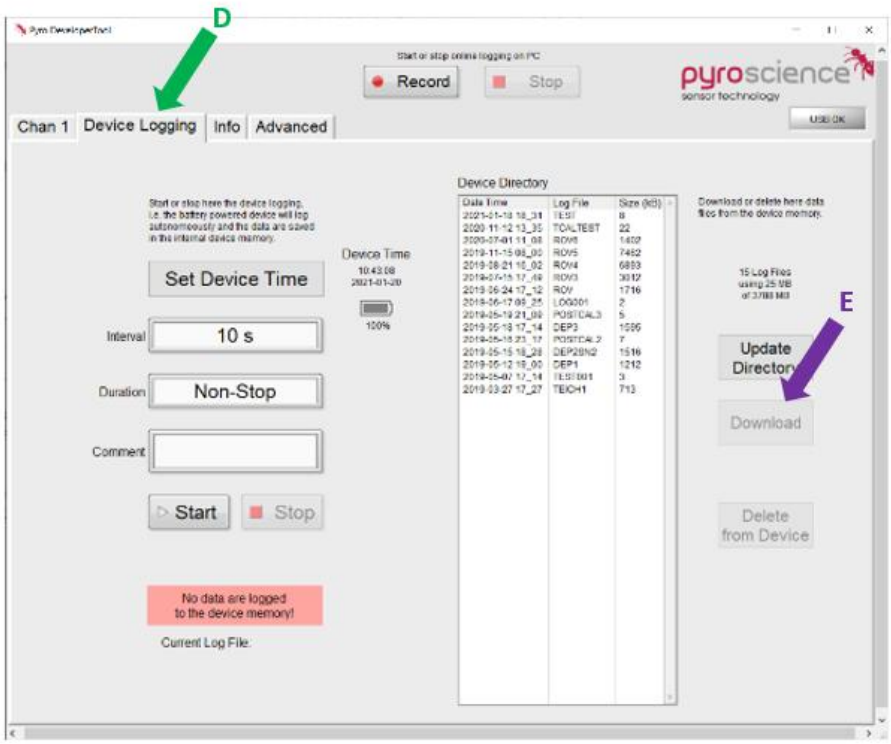
Note: The data file saves the data with a factor of 1000 in order to prevent a comma separator. Divide the data with 1000 to receive commonly used units (pH 7100 = pH 7.100).



5.2 Device Logging/ Stand-Alone Logging

Some devices (e.g. **AquapHOx Logger**) offer the option to log data without the connection to a PC.

- To start logging, go to Device Logging (D) and adjust your settings
- Choose a Filename
- Start the logging by clicking on Start logging. The device can now be disconnected from the PC and will continue data logging.
- After the experiment, connect the logging device to a PC, again
- The obtained data can be downloaded after the experiment on the right side of the window by selecting the correct logfile and clicking on Download (E). These '.txt' files can be easily imported in common spreadsheet programs.



6 CUSTOM INTEGRATION OF THE READ-OUT DEVICE

For integration of the read-out device into a custom setup, it is possible to close the software after calibration and disconnecting the device from the PC. After closing the software and flashing the module, the configuration is automatically saved within the internal flash memory of the module. This means that the adjusted settings and the last sensor calibration are persistent even after a power cycle of the module. Now the module can be integrated into a customer specific setup via its UART interface (or via the USB interface cable with its virtual COM port). Please refer to the respective device manual for more information on the communication protocol.

7 ANALOG OUTPUT AND BROADCAST MODE

Some devices (e.g. **FireSting pro, AquapHOx Transmitter**) offer an integrated **Analog Output**. It can be used for transferring measurement results (e.g. oxygen, pH, temperature, pressure, humidity, signal intensity) as voltage/ current (depending on the device) signals to other electronic equipment (e.g. loggers, chart recorders, data acquisition systems).

Further, some devices can be operated in a so-called **Broadcast Mode**, in which the device performs measurements autonomously without any PC connected. The auto-mode does not possess any integrated logging functionality, but the measured values must be read out via the analog output e.g. by an external data logger. The basic idea behind the auto-mode is that all operations related to sensor settings and sensor calibrations are still performed during the general operation with a PC. When this is done, the broadcast modus can be configured and the device will trigger a Measurement autonomously as long as a power supply is given via the USB or extension port.

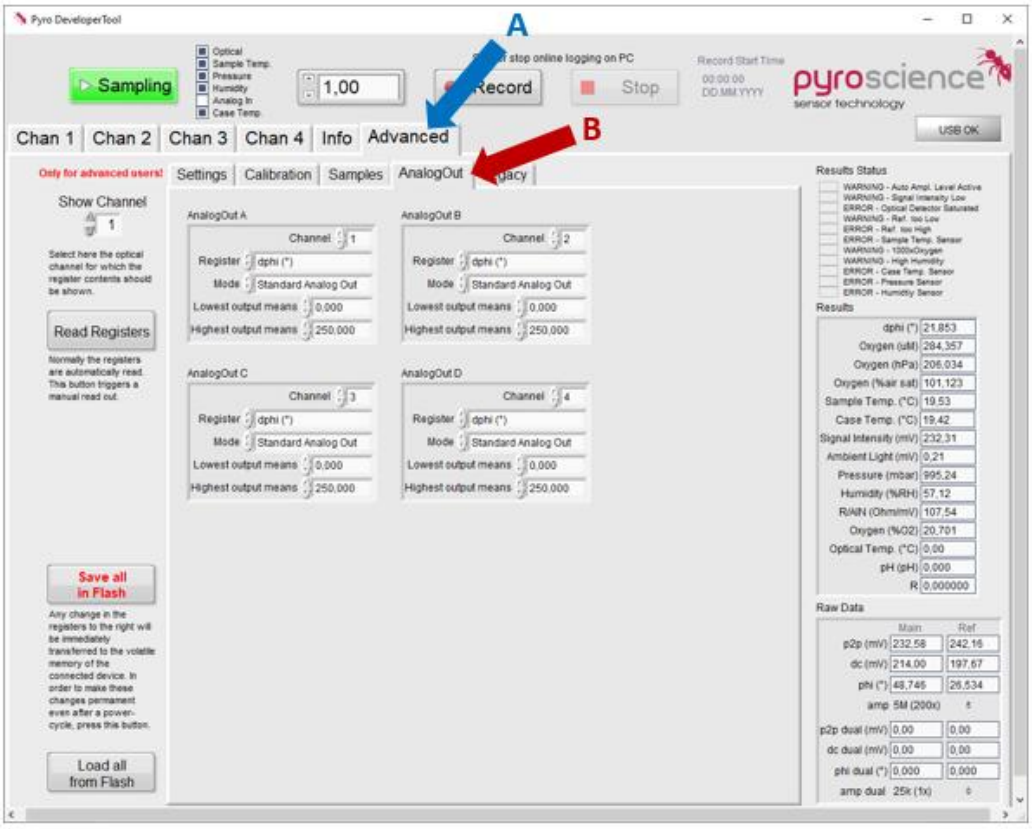
And finally, the extension port offers also a complete digital interface (UART) for advanced integration possibilities into custom electronics equipment. This UART interface might be also utilized during auto-mode operation for a digital read-out of the measured values.

7.1 FireSting-PRO

To enter the Analog Output settings, please go to Advanced (A)– AnalogOut (B).

The 4 analog outputs are deliberately designated with A, B, C, and D for distinguishing them clearly from the numbering 1, 2, 3, and 4 of the optical channels. The background is that the analog outputs are not fixed to specific channels ensuring highest flexibility.

The output of the analog output is device dependent. In the example below, AnalogOutA offers a voltage output between 0 and 2500 mV. Click on Save all in Flash to save the settings.



Note: The corresponding values of the minimum and maximum outputs are always in the unit of the selected value. Meaning in the example above, 0 mV corresponds to 0° dphi and 2500 mV corresponds to 250° dphi.

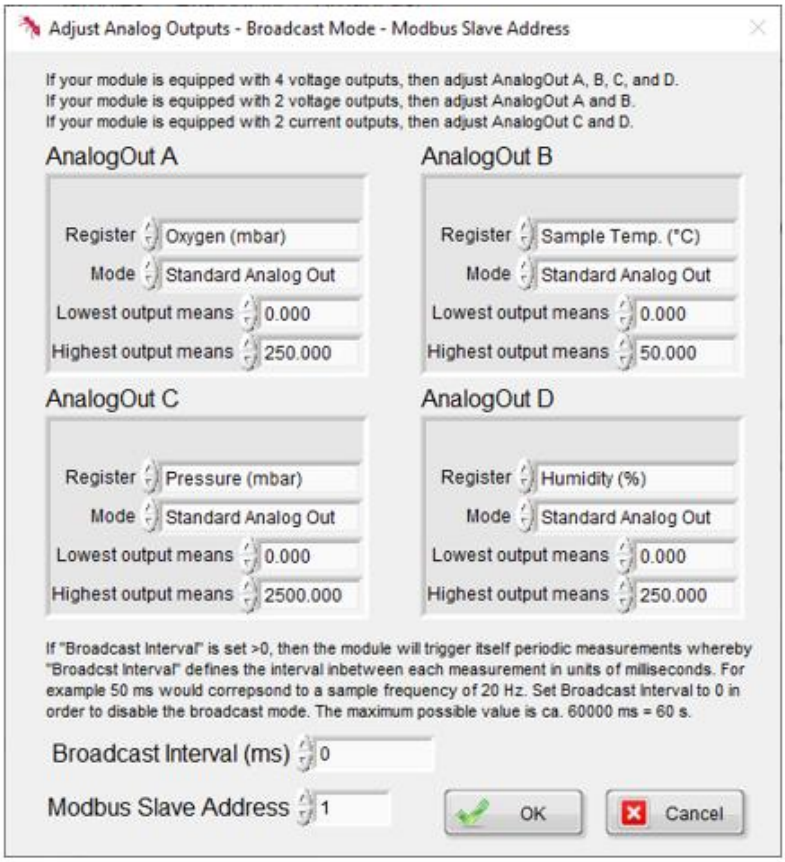
7.2 AquapHOx Transmitter

To enter the Analog Output settings, please close the Pyro Developer Tool software. The settings window will open automatically.

This device is equipped with 2 voltage/current analog outputs. When using the 0-5V output, please adjust AnalogOut A and B. When using the 4-20mA output, please adjust AnalogOut C and C.

The output of the analog output is device dependent. In the example below, AnalogOutA offers a voltage output between 0 and 2500 mV.

During broadcast modus operation, the measurement results can be read out e.g. by an analog data logger from the analog output. The Broadcast modus is disabled by default: **Broadcast interval [ms]** is set to 0. By changing this, the broadcast modus is automatically activated.


Adjust Analog Outputs - Broadcast Mode - Modbus Slave Address
If your module is equipped with 4 voltage outputs, then adjust AnalogOut A, B, C, and D.
If your module is equipped with 2 voltage outputs, then adjust AnalogOut A and B.
If your module is equipped with 2 current outputs, then adjust AnalogOut C and D.
AnalogOut A
Register Oxygen (mbar)
Mode Standard Analog Out
Lowest output means 0.000
Highest output means 250.000
AnalogOut B
Register Sample Temp. (°C)
Mode Standard Analog Out
Lowest output means 0.000
Highest output means 50.000
AnalogOut C
Register Pressure (mbar)
Mode Standard Analog Out
Lowest output means 0.000
Highest output means 2500.000
AnalogOut D
Register Humidity (%)
Mode Standard Analog Out
Lowest output means 0.000
Highest output means 250.000
If "Broadcast Interval" is set >0, then the module will trigger itself periodic measurements whereby "Broadcst Interval" defines the interval inbetween each measurement in units of milliseconds. For example 50 ms would correpsond to a sample frequency of 20 Hz. Set Broadcast Interval to 0 in order to disable the broadcast mode. The maximum possible value is ca. 60000 ms = 60 s.
Broadcast Interval (ms) 0
Modbus Slave Address 1
OK
Cancel

8 ADVANCED SETTINGS

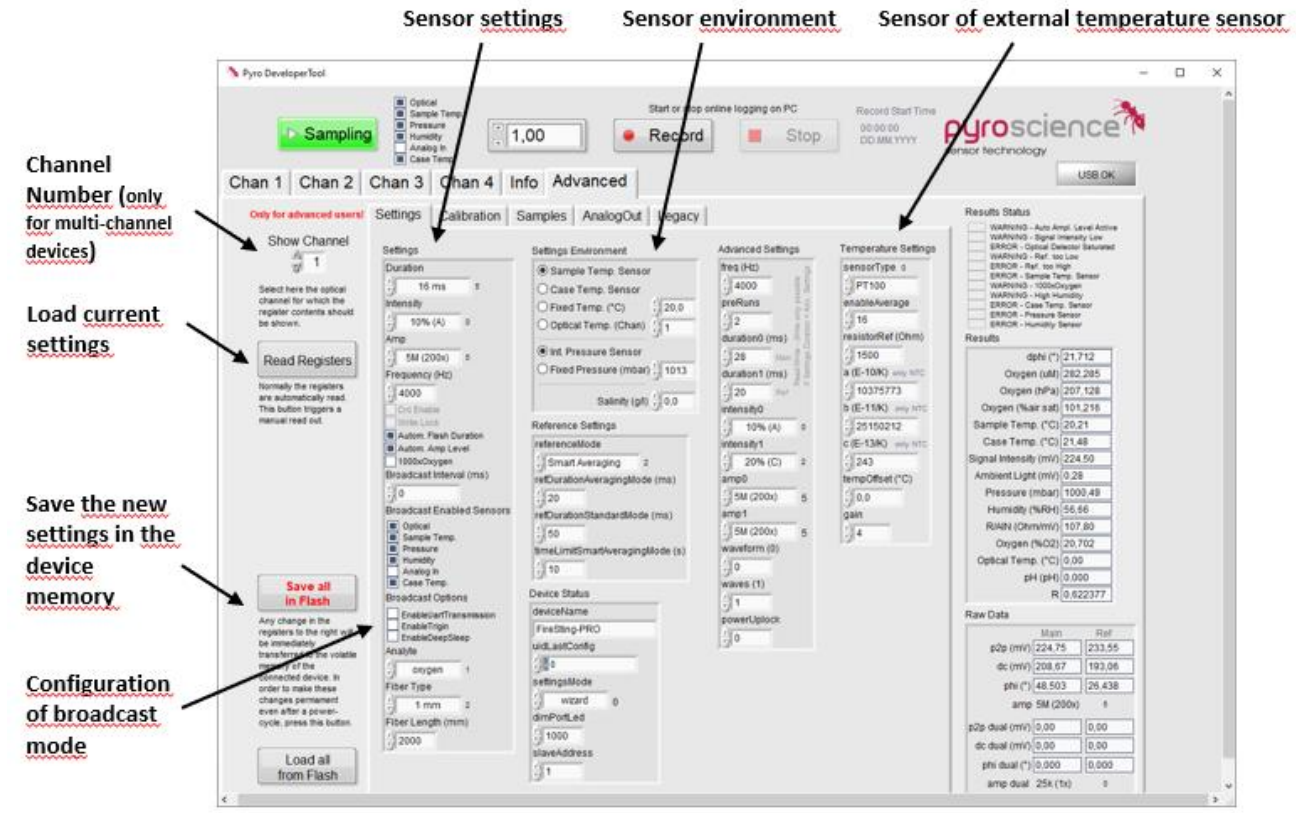
The advanced settings contain the setting registers, calibration registers and the settings for analog output and broadcast mode. To enter these settings, please go to Advanced in the main window and select the respective settings register.

8.1 Changing the settings

In the settings registers are the settings which were defined by the sensor code. Like in the settings window it is possible to change LED intensity, the detector amplification and the LED flash duration. In the register for the settings environment, the temperature sensor for the automatic temperature compensation can be selected. Further registers include more advanced settings and settings of the external temperature sensor, for example a Pt100 temperature sensor. Changes in the settings registers will influence the sensor signal. Do not change these values if your sensor signal is sufficient. If you change the setting registers, recalibrate before use of the sensor for measurements.

After adjusting your settings, it is important to save these new settings on the internal flash memory of the device. Click **Save all in Flash** to make these changes permanent, even after a power-cycle.

In newer software versions, the broadcast mode can be configured together with the sensor settings.



8.2 Changing the Factory Calibration

Oxygen

In the calibration register are the factory calibration factors listed. These factors (**F, fixed f, m, fixed Ksv, kt, tt, mt** and **Tofs)** are specific constants to the *REDFLASH* indicators and are automatically adjusted for the selected sensor type in the Sensor Code. It is strongly advised to change these parameters only after communication with PyroScience.

pH

As for oxygen, the factory calibration factors for pH are listed in the calibration register and are automatically adjusted for the selected sensor type in the Sensor Code (e.g. **SA, SB, XA, XB**).

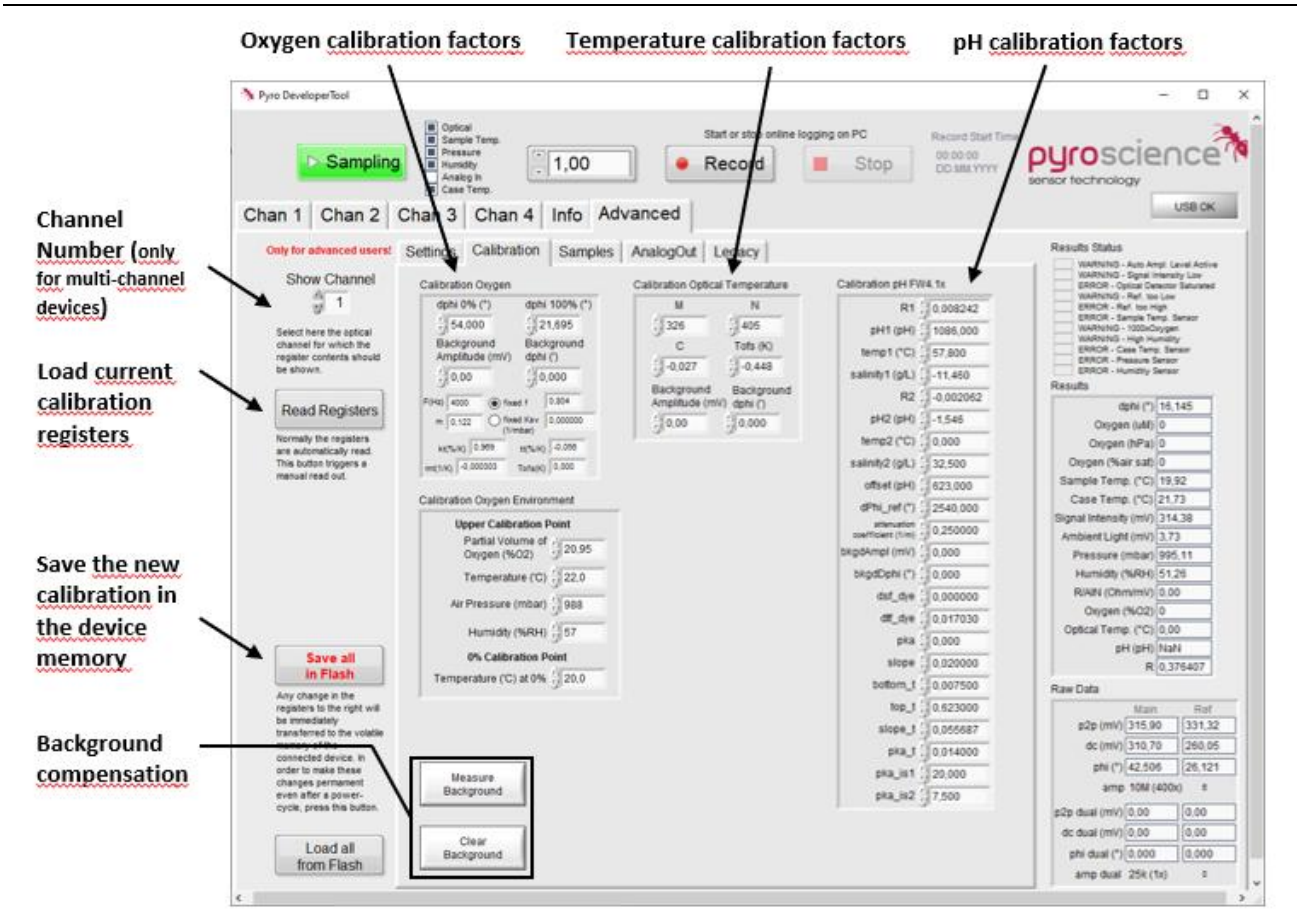
Temperature

The factory calibration factors for optical temperature are listed in the calibration registers. These factors are specific constants and are automatically adjusted for the selected sensor type in the Sensor code.

Changing the factory calibration

- Ensure that the correct measurement channel is shown (important for multi-channel device **FireSting-PRO**) before changing calibration factors
- Click on Read Registers to see the current calibration factors
- Adjust the settings
- Click Save all in Flash to make these changes permanent, even after a power-cycle

Important: Only the calibration register corresponding to the selected analyte can be adjusted.

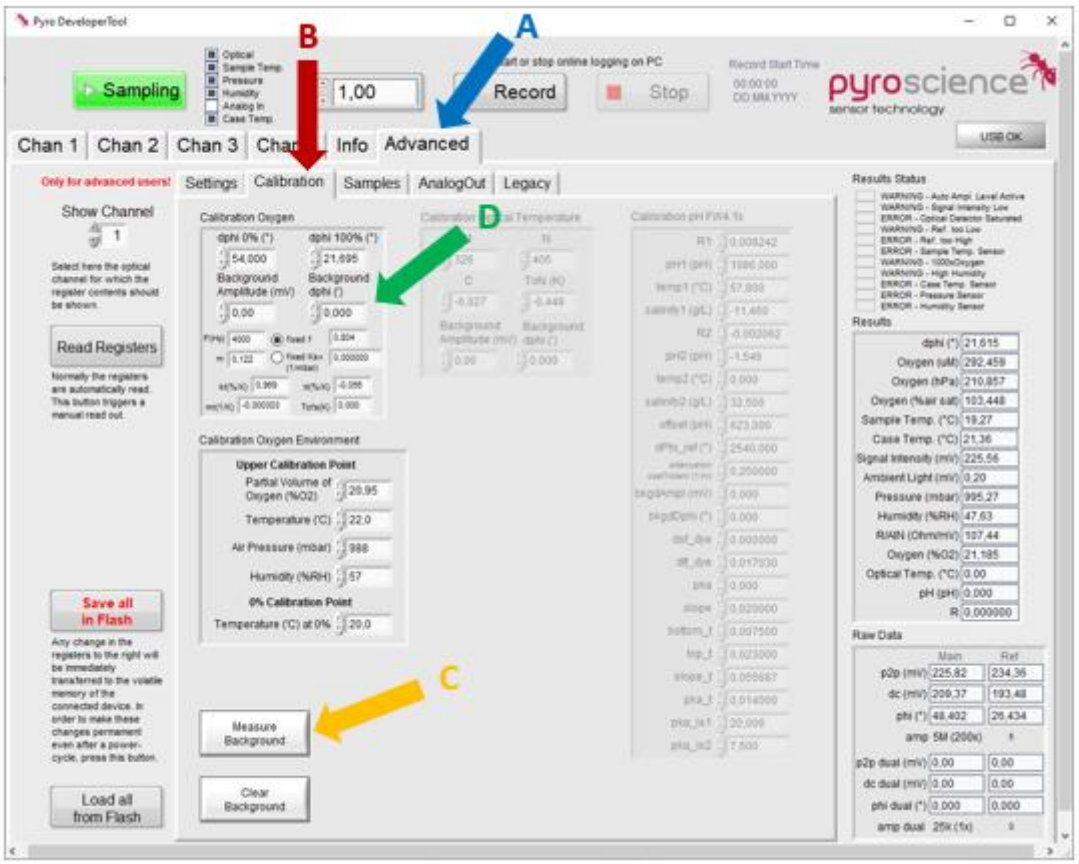


8.3 Background compensation

Click on the register Advanced (A) and then on Calibration (B).

If you are using a 1m, 2m or 4m optical fiber, please type in these values into the respective window (C).

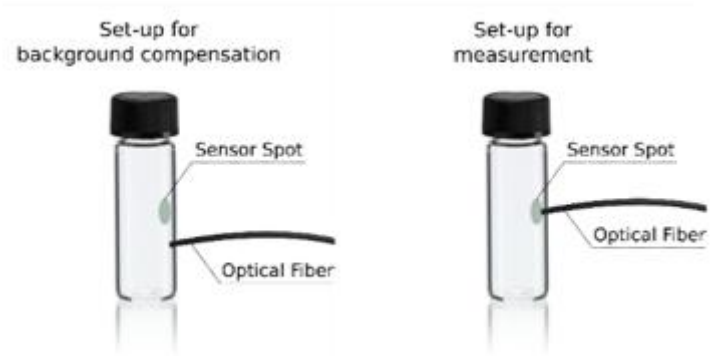
Fiber length	Background Amplitude (mV)	Background dPhi (°)
AquapHOx PHCAP	0.044	0
2cm-5cm (PICO)	0.082	0
1m (PICO)	0.584	0
1m fiber for APHOx or FireSting	0.584	0
2m fiber for APHOx or FireSting	0.900	0
4m fiber for APHOx or FireSting	1.299	0



Manual background compensation

In case you are measuring a sensor spot with a bare fiber (SPFIB), you can also perform a manual background compensation. Please make sure, that your fiber/rod is connected to the device but is NOT connected to the sensor.

- Click on Measure Background (D) to perform the manual luminescence background



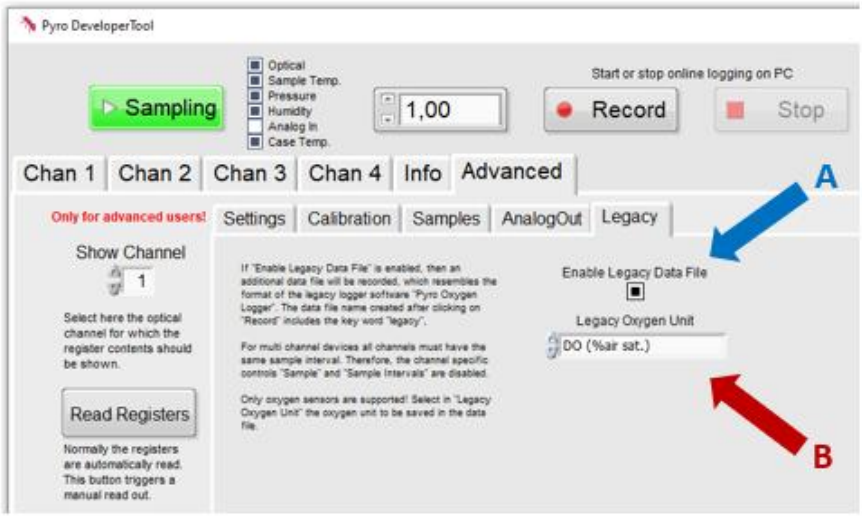
8.4 Samples

Graphical representation of sinusoidally modulated excitation light and emission light. The phase shift between excitation and emission light is visible in the graphic representation.

8.5 Additional legacy data file

An additional data file will be recorded, if Enable Legacy Data File (A) is enabled. The additional data file is a .tex file which resembles the format of the legacy logger software Pyro Oxygen Logger. For identification of the additional file after recording, the data file name includes the key word legacy.

Generation of an additional legacy data file is only supported for **oxygen sensors**. Select in Legacy Oxygen Unit (B) the oxygen unit to be saved in the additional legacy data file.



Note: For multi-channel devices, all channels must have the same sample interval.

9 WARNINGS AND ERRORS

The warnings are shown on the right upper corner of the main measurement window of Pyro Developer Tool.

Warning or Error	Description	What to do ?
Auto Ampl. Level Active	Detector of the device is saturated due to too much signal intensity. The amplification is reduced automatically to avoid oversaturation of the detector.	Reduction of ambient light (e.g. lamp, sunlight) recommended. Or decrease the LED intensity and/or the detector amplification (refer to Settings). IMPORTANT: this requires a new sensor calibration.
Signal Intensity Low	Sensor intensity low. Elevated noise in sensor readings.	For contactless sensors: check the connection between fiber and sensor. Alternatively, change the the LED intensity under advanced

		settings. IMPORTANT: this requires a new sensor calibration.
Optical Detector Saturated	Detector of the device is saturated due to too much ambient light.	Reduction of ambient light (e.g. lamp, sunlight) recommended. Or decrease the LED intensity and/or the detector amplification (refer to Settings). IMPORTANT: this requires a new sensor calibration!
Ref. too Low	Reference signal intensity low (<20mV). Increased noise in optical sensor reading.	Contact info@pyroscience.com for support
Ref. too High	Reference signal too high (>2400mV). This can have a strong negative effect on the accuracy of the sensor reading.	Contact info@pyroscience.com for support
Sample Temp. Sensor	Failure of sample temperature sensor (Pt100).	Connect a Pt100 temperature sensor to the Pt100 connector. If a sensor is already connected, the sensor might be broken and needs to be replaced.
Case Temp. Sensor	Failure of case temperature sensor.	Contact info@pyroscience.com for support
Pressure Sensor	Failure of pressure sensor.	Contact info@pyroscience.com for support
Humidity Sensor	Failure of humidity sensor.	Contact info@pyroscience.com for support

10 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!

The sensors are not intended for medical, aerospace, 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.

The device and the sensors must be used in the laboratory by qualified personnel only, following the user instructions and the safety guidelines of the manual.

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

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