# FirePlate-O2
## 96 Channel Oxygen Reader

**USER MANUAL FOR FIREPLATE-O2 AND OXYGEN SENSOR MICROPLATES**

O2 T

© PyroScience GmbH

# FirePlate-O2
## 96 Channel Oxygen Reader

**Document Version 1.03**

**The FirePlate-O2 & the Oxygen Sensor Microplates are released by:**

**PyroScience GmbH**
Kackertstrasse 11
52072 Aachen
Germany

Phone +49 (0)241 5183 2210
Fax +49 (0)241 5183 2299
Email info@pyroscience.com
Web www.pyroscience.com

Registered: Aachen HRB 17329, Germany

© PyroScience GmbH 

# TABLE OF CONTENT



© PyroScience GmbH 

# 1 OVERVIEW

The compact PC-operated optical multi-channel oxygen reader **FirePlate-O2** with 96 channels enables:

- simultaneous measurements of dissolved oxygen (DO) and $O_2$ in up to 96 channels
- contactless measurements in sterile 96-well microplates **OXMWP-96R** or **OXMWP-96F** with integrated oxygen sensors
- real-time oxygen turnover rates measurements in up to 96 wells with dispersible oxygen nanoprobes **OXNANO**
- a free configuration of 96 channels for $O_2$ and temperature sensors
- temperature-compensated oxygen measurements in third-party incubators or on a shaker
- easy calibration and customization with a customer friendly measurement software

This 96-channel oxygen reader for oxygen sensor microplates is ideal for efficient screening, scale-up/-down, process engineering, small-scale cell cultivation and respiration rate measurements, determination of enzyme activities and environmental analyses.

The plate reader has integrated temperature and atmospheric pressure sensors for precise and easy oxygen sensor calibration, but also for automatic temperature and pressure compensation of the oxygen measurements.

The new version of the innovative and user-friendly **Pyro Workbench** allows operation of up to three **FirePlate-O2** meters in parallel as a scalable multi-channel system.

© PyroScience GmbH

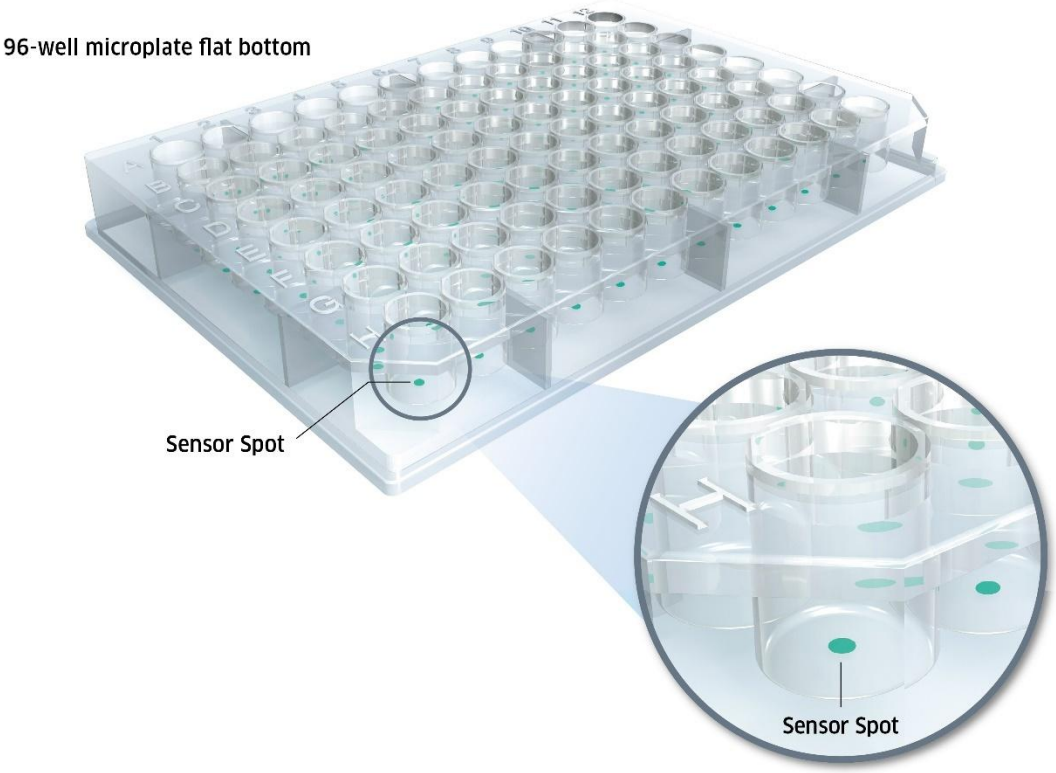
# 2 INTRODUCTION

The **FirePlate-O2** comes with 96 channels for contactless optical measurements of oxygen and temperature sensors in 96, 24 or 12 well plates. The integrated temperature sensor enables automatic temperature compensation of the oxygen measurements. The air inlet is protected with a membrane and equilibrates the internal pressure sensor, which is positioned in a gas tight measuring chamber with the surrounding. Avoid covering this inlet to ensure pressure equilibration.


The **FirePlate-O2** is connected to a USB port of a Windows PC with the included cable (M8 connector to USB, 3 m in length).

The compatible 96 well oxygen sensor microplates **OXMWP** are equipped with integrated oxygen minispots in each well. They are pre-sterilized and available with flat or round bottoms. The **OXMWP** are placed directly on the **FirePlate-O2** device and read-out contactless through the bottom of the wells. This enables the determination of enzyme activities, environmental analysis, small-scale cell cultivation and process engineering.

© PyroScience GmbH


96-well microplate flat bottom
Sensor Spot
Sensor Spot

# 3 QUICK START

**Step 1**: Download the correct software and manual from the download tab of your purchased device on www.pyroscience.com.

**Step 2:** Install the **Pyro Workbench** Software on a Windows PC/laptop (Windows 7, 8, 10 & 11) according the **Pyro Workbench** Manual.

**Step 3:** Connect the **FirePlate-O2** meter with the included cable (M8 connector to USB) to a USB-port of the Windows PC/laptop (Windows 7, 8, 10 or 11). For this, plug in the round connector into the M8 connector of the **FirePlate-O2** and secure it using the locking screw.

**Step 4:** If applicable, mount the **FirePlate-O2** to a shaker using the available adapter **FP96-ADPT1** according to chapter 4.1.

**Step 5:** Start the logger software by clicking on the short-cut "**Pyro Workbench**" on your desktop.

**Step 6:** Place the sensor plate **OXMWP** or appropriate contactless **PyroScience** sensors on the plate reader (see 4.2). Ensure temperature equilibration of the **FirePlate-O2** and the sensor plate.

**Step 7:** Open the **Settings Wizard** by clicking on the **FirePlate-O2** picture**.** Adjust the settings of each sensor or sensor group with the **Pyro Workbench** software according to 5.1.

**Step 8:** Open the **Calibration Wizard** and follow the calibration instructions for each sensor/sensor group (see chapter 0).

**Step 9:** Configure the **Graphs** according to your preferences (see chapter 0).

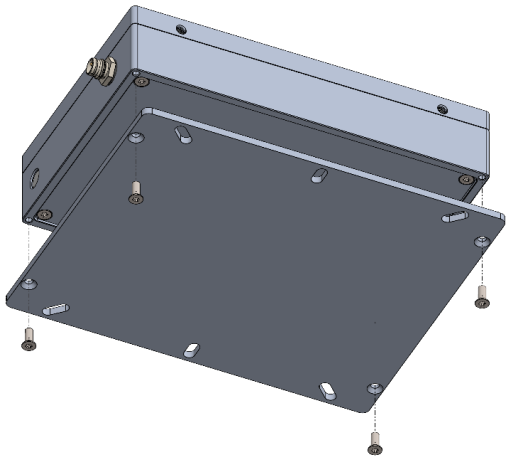
**Step 10:** Activate **Data Logging** (chapter 5.3.2).

# 4 SETUP OF FIREPLATE READERS AND SENSOR MICROPLATES

## 4.1 Mounting the FirePlate-O2 to a Shaker using the Adapter Plate

To mount the **FirePlate-O2** to a Kuhner shaker or Infors shaker, the adapter plate **FP96-ADPT1** is required.

The adapter plate is attached to the **FirePlate-O2** using the four countersunk screws which are supplied with the meter.



The enclosed screws are pre-treated with an adjustable thread locker that can be reused up to five times.

> **Important**: The screws should only be tightened hand-tight. Repeated assembly and disassembly are not recommended.

The adapter plate with the mounted **FirePlate-O2** can then be screwed to the tray of the shaker using the six additional holes with screws countersunk in the adapter plate. The required screws for this depend on the type of shaker and are not provided with the adapter plate.

© PyroScience GmbH

## 4.2 Fixing of the Sensor Plates on the FirePlate-O2

To fix a microplate **OXMWP** on the **FirePlate-O2** for calibration and measurement, place the short side of the sensor plate on the glass plate in the position of column 2. Slide the plate horizontally towards the final position and push it into the existing spring until the plate can be fully lowered into the frame of the **FirePlate-O2**. If necessary, slightly press the plate on all four sides until it is in close contact with the glass plate (mandatory for correct read-out). Assure that the oxygen sensor mini spots (green dots at the bottom of the wells) are centered above the optical channels of the **FirePlate-O2**.

To release the sensor plate after the measurements, push it into the spring and carefully lift it at the other end. Then pull the sensor plate out of the frame of **FirePlate-O2**.

**Note:** It is possible that sliding of the microplate on the glass plate of the **FirePlate-O2** makes a squeaking noise.

> **Important:** The position of the oxygen minispots may slightly vary from one well to another. These variations do not impact the sensor readings due to the optical geometry of the **FirePlate-O2** read-out device.

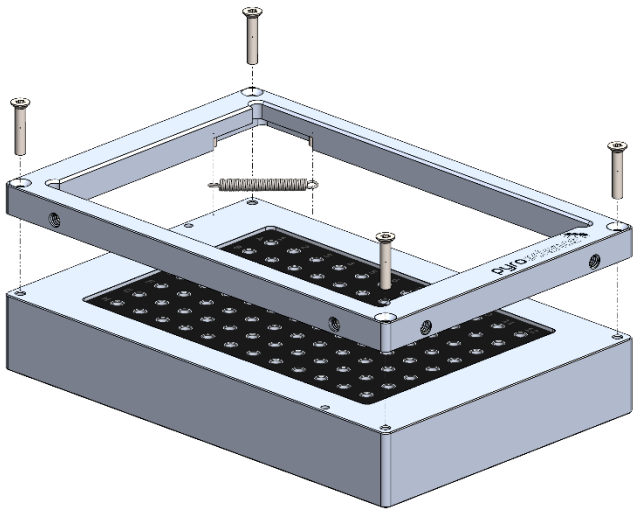
### Adjustment of custom sensor plates

Custom sensor plates that are smaller than the **PyroScience** microplates **OXMWP-x** can be adjusted manually in the plate holder frame using the 4 adjustment screws. The screws are located in the frame of the **FirePlate-O2** at position A12, H1 & H12. For adjustment, a 2mm hexagonal wrench (Hex 2) is required. Ensure that each well /sensor spot is centered over the respective optical channel of the **FirePlate-O2**. Be careful when tightening the adjustment screws, microplates and other multi well plates can break.

© PyroScience GmbH

**Note**: The **FirePlate-O2** can compensate small misalignments between sensor spot and channel position.

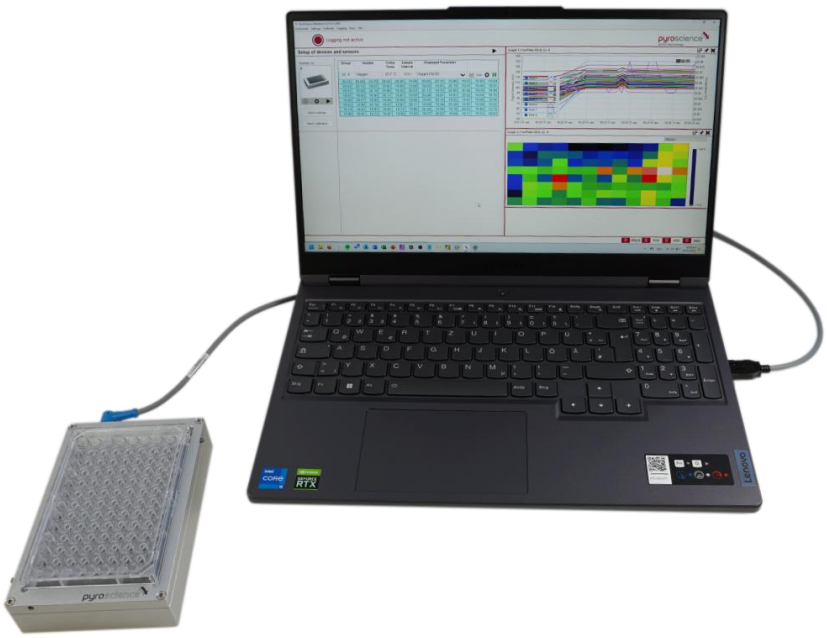
For mounting custom sensor solutions on the **FirePlate-O2** it is possible to remove the spring used for fixing the sensor plates. For this, unscrew the frame on top of the **FirePlate-O2** and remove the spring from the two pins. Please note that repeated assembly and disassembly is not recommended, as the thread locker will lose its function.



**Important:** The sensor plates should be securely attached to the **FirePlate-O2** to prevent slippage of the plate. Unstable mounting and positioning may result in a loss of sensor signal, hindering reliable measurements!

## 4.3 Connecting the FirePlate-O2 to a Windows PC

Connect the **FirePlate-O2** meter to a USB-port of the Windows PC/laptop (Windows 7, 8, 10 & 11) with the included cable (M8 connector to USB, cable length 3 m). For this, plug the round connector (M8 Male 4 pole) of the cable into the M8 connector of the **FirePlate-O2** and secure it using the locking screw. Connect the USB connector of the cable to the computer.



It is recommended to disable all energy saving options including standby modes as well as automatic Windows updates to avoid interruption of ongoing measurements.

# 5 OPERATION OF THE FIREPLATE-O2 WITH THE PYRO WORKBENCH SOFTWARE

For details on the installation and operation of the **Pyro Workbench** software, please also refer to the **Pyro Workbench** Manual. For measurements of respiration rates, we recommend to use our Python tool **ResPyrometry**. Sensor settings and calibration need to be realized with the **Pyro Workbench** software.

## 5.1 Sensor Settings

The **Settings Wizard** guides the user through the device configuration. The **Settings Wizard** can be opened by clicking on the device picture, the little gear symbol underneath or via the menu bar at the top of the main window.

### Configuration of Sensor Groups

Up to four different sensor groups can be configured separately.

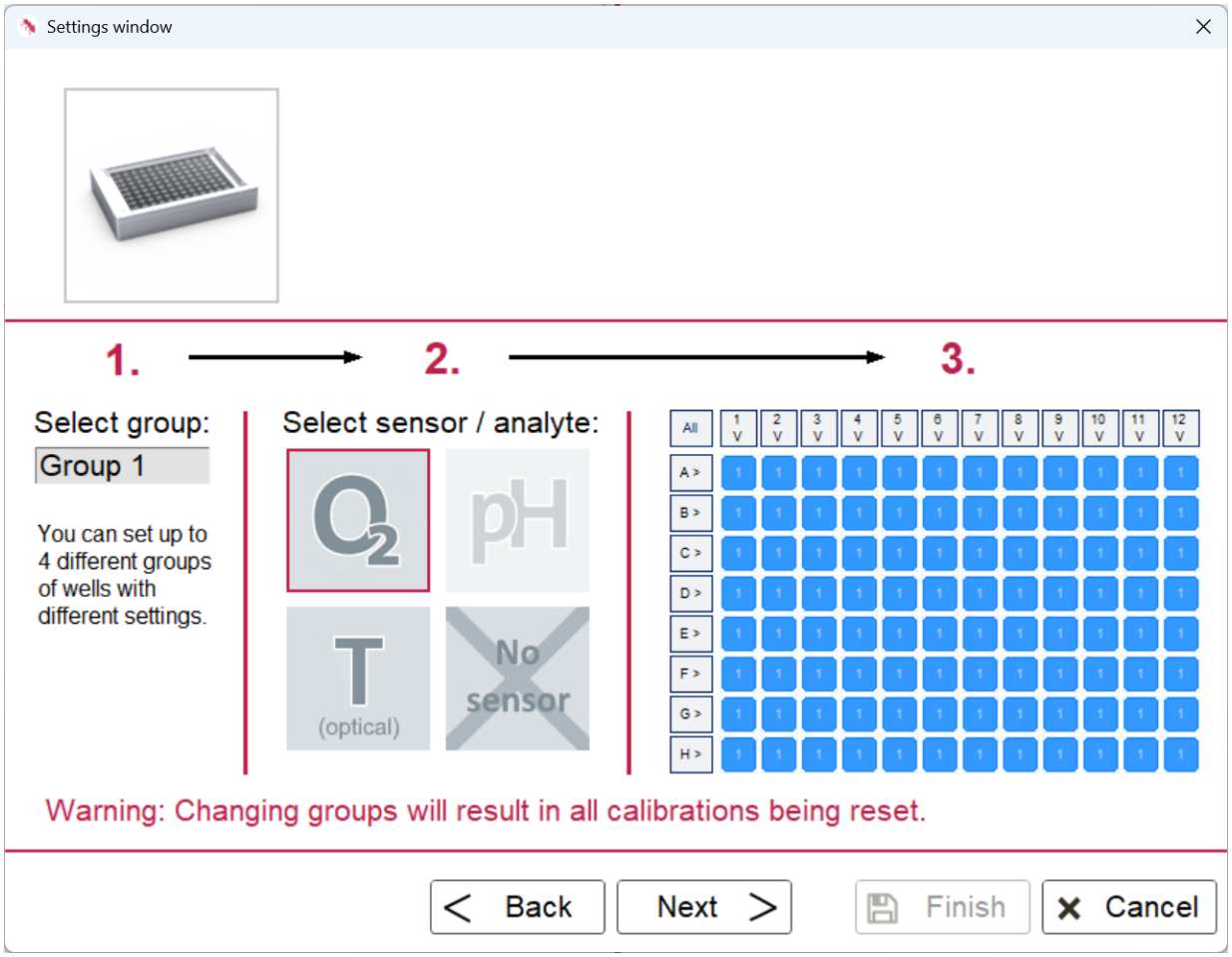



*Figure 1: Settings window for setup of sensor groups.*

Sensor groups can be defined e.g. in case of different sensor types, analytes or sample intervals.

In this first step of the configuration the user needs to define a group number (1.), the analyte (oxygen or temperature) (2.), and the optical channels of the sensor group (3.) for each required sensor group. The optical channels of each group can be selected manually by clicking on single wells. By clicking on the labels of the rows and columns, the complete row or column can be selected at once.

After configuration of the sensor groups and the corresponding optical channels, the **Sensor Settings** are defined individually for each sensor group.

### Entering the Sensor Settings

For each group, the settings procedure can be performed individually. The following parameters must be determined for each group:

1) **Sensor Code**
2) type of medium (gas or water)
3) oxygen unit
4) sample interval
5) measuring mode (from low drift to low noise)
6) environmental conditions during the measurement (including compensation temperature, pressure conditions.

Every **PyroScience** sensor comes with an individual **Sensor Code**, containing important information for optimal sensor settings and for calibration. The sensor code is written on the aluminum bag of the contactless sensor (e.g. **OXMWP-96F**). The first letter of the sensor code defines the sensor type. Therefore, it is important to enter the **Sensor Code** of the connected sensor into the **Sensor Settings** of the respective software.


The **Measuring Mode** can be adjusted gradually between low drift and low noise of the sensor signal by moving the arrow with the mouse along the scale. Typically, an intermediate mode is default.

The **Conditions in the Sample** during calibrations and measurements must be determined. There are three important parameters to be considered, which can be automatically compensated:

- Temperature
- Atmospheric Pressure
- Salinity

© PyroScience GmbH

## Temperature

Several options for **Temperature Compensation** of optical oxygen sensors are available:

- **Internal Temperature Sensor** (Case Temperature of the **FirePlate-O2**)
- **Fixed Temperature (°C)** (must be entered, kept constant and controlled!)
- **Optical Temperature Channel** (its group number must be selected). This option is only available for the measurement with oxygen nanoprobes or sensor spots in combination with temperature sensor spots **TPSP5**.

If **Internal Temperature Sensor** or **Optical Temperature Channel** is selected, automatic compensation of temperature changes on the respective oxygen sensor readings is activated. The **Compensation Temperature** will be displayed in the corresponding group panel of the main window.

**Note**: If **Optical Temperature Sensor** was selected, a temperature sensor spot has to be fixed in a temperature control well or vial. This temperature sensor needs to be exposed to the same sample/calibration standard and conditions as the sensors used for oxygen measurements/ calibration.

**Important**: For precise absolute oxygen measurements using the **Internal Temperature Sensor**, please ensure that the **FirePlate-O2** is equilibrated to the temperature of the environment. The internal temperature sensor is integrated in the inside of the device. Hence, changes of the temperature of the environment result in delayed changes of the internal temperature reading.

If a **Fixed Temperature** was selected, the temperature in the sample/calibration standard must be measured, adjusted and kept constant (needs to be controlled)! Ensure constant and defined conditions and equilibration of the **FirePlate-O2**!

## Atmospheric Pressure

Another parameter, which has to be defined in the settings is the atmospheric pressure. Atmospheric pressure can be compensated:

- by the **Internal pressure sensor** for automatic compensation of pressure changes, e.g. caused by weather changes,
- by entering a **Fixed Pressure (hPa)**: The actual pressure at the sensor position needs to be determined with e.g. a barometer and adjusted manually (default: 1013 hPa), or

© PyroScience GmbH

- by entering the **approximate elevation (m) above sea level**. Note that this option takes only the elevation-dependent pressure change into account, but not the variations due to actual weather conditions. Thus, determining the actual atmospheric pressure with a barometer gives more precise results.

## Salinity

The **Salinity (g/L)** of the environmental sample (based on seawater salinity) is only relevant if a **concentration unit** for dissolved oxygen **DO** measurements was selected (e.g. **mg/L** or **µmol/L**). The sample salinity needs to be measured and entered, e.g. in case of saline water/seawater. For measurements in gas samples this value has no relevance (and is not active).

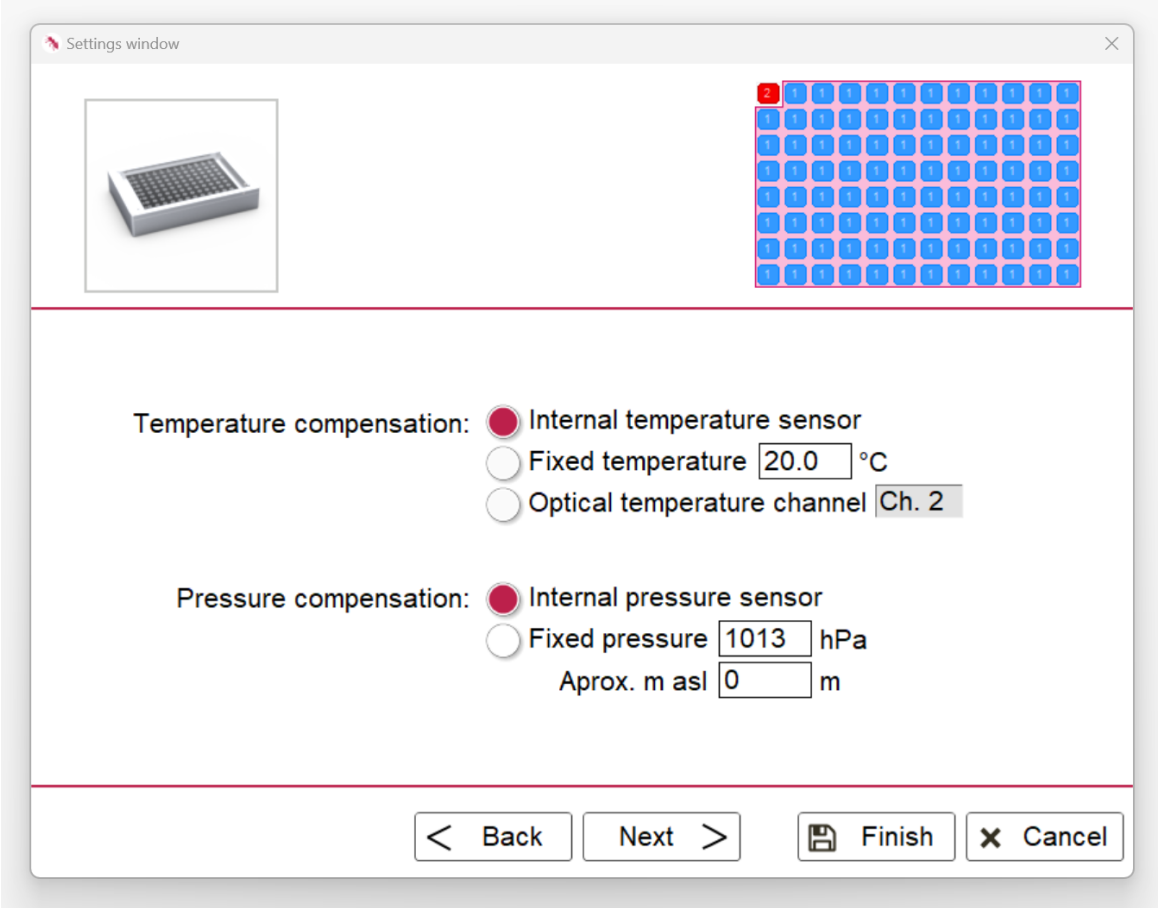



*Figure 2: Settings window for temperature and pressure compensation.*

## 5.2 Sensor Calibration

The calibration of the sensors is mandatory before starting the measurements. The software indicates which optical channels are not calibrated. The **Calibration Wizard** guides the user through the calibration procedure. The **Calibration Wizard** starts by clicking the **Cal.** button in the respective group panel of the main window.

### 5.2.1 Calibration Options

The calibration of oxygen sensors with the **FirePlate-O2** can be performed in different ways. It is possible to choose between a **Manual Multi-Channel Calibration** or **1-Click Batch Calibration**. For both calibration methods a **1-point calibration** is required, a **2-point calibration** is optional. With **Copy Calibration** a calibration from one channel can be copied to other wells of the same sensor group.

**Calibration modes**:

- **Manual Multi-Channel Calibration:** This is the most accurate calibration option. All wells of a sensor group will be calibrated individually. The upper calibration (calibration at air or in saturated water) is required. This calibration method is recommended for an accurate oxygen measurement.
- **1-Click Batch Calibration** (only applicable for calibration in water)**:** This is the quickest and most easy calibration option for calibrations in water (e.g. for **OXNANO** applications). Only certain wells are used for the calibration and the obtained values will be copied to all remaining wells of the same sensor group. The software selects the wells for calibration automatically based on the position of the selected sensor group and informs the user about the required calibration solution.

With **Copy Calibration** a valid calibration from one channel can be copied to other wells of the same sensor group (both calibration points, 21 % and 0% are copied to the other channel).

© PyroScience GmbH

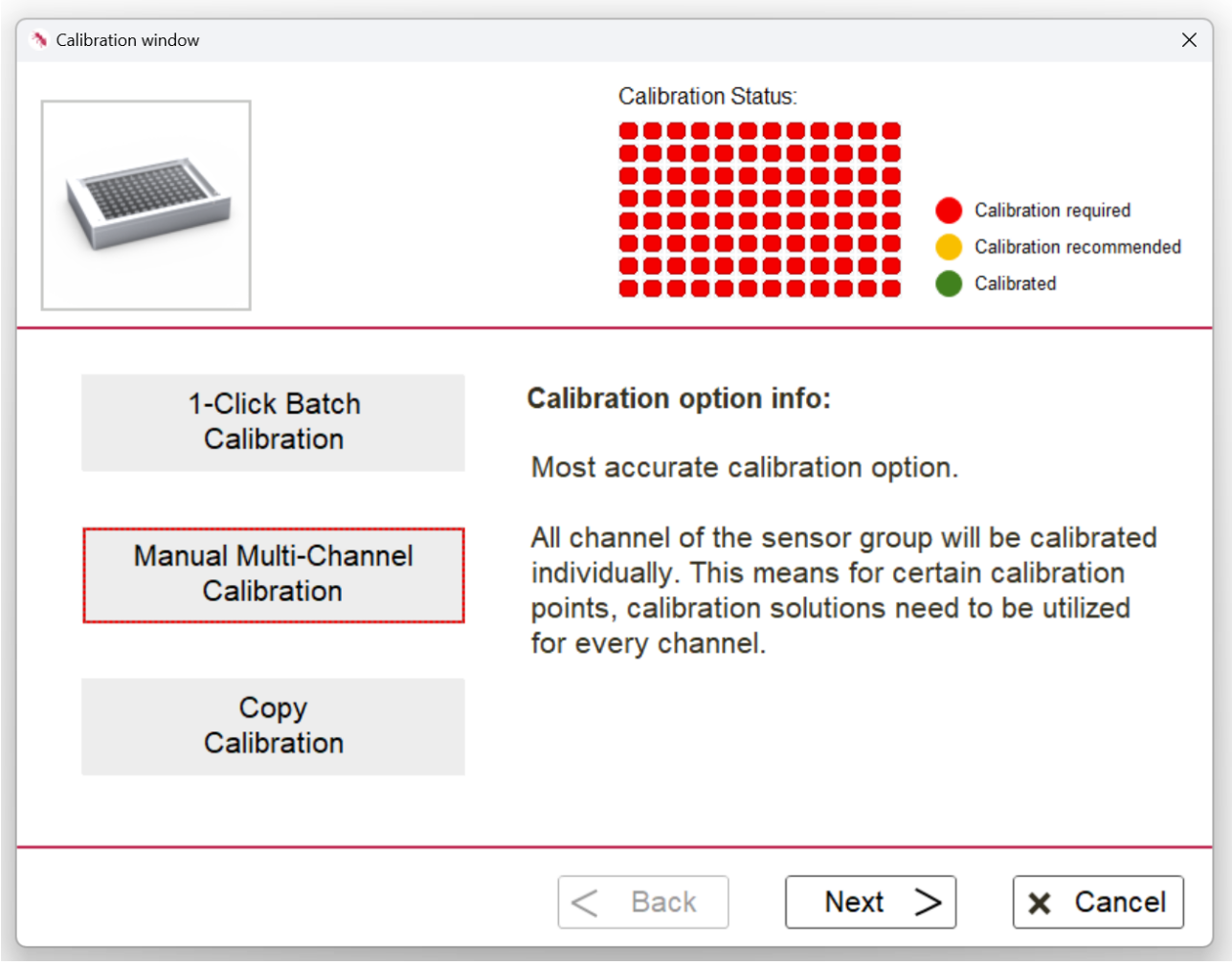



*Figure 3: Calibration window for selection of the calibration mode*

## Calibration points:

- **1-point calibration (required):** upper calibration at ambient air or in air saturated water
- **2-point calibration (optional):** upper AND 0% calibration; recommended for measurements from air saturation/21% to low $O_2$ and for accuracy measurements

The upper calibration can be performed at air or in air saturated water. For both options, please assure aerated conditions.

For sterile microplates with integrated mini spots (e.g. **OXMWP-96F** and **OXMWP-96R**), we highly recommend to perform a 1-point calibration in ambient air to prevent contamination hazards.

For information on the preparation of aqueous calibration standards (air saturated water and de-oxygenated water) as well as 0% calibrations in gas, please refer to the **Oxygen Sensor** Manual.

> **Note**: Performing the upper calibration in ambient air prevents from contamination hazards and is recommended. Ensure constant conditions during calibration! Always close the sensor plates with the dark lit for calibration and measurement!

With **Copy Calibration** a valid calibration from one channel can be copied to other wells of the same sensor group.

Depending on the application, the upper calibration point can also be user-defined via a **Custom Calibration** (only for advanced users, please refer to the **Oxygen Sensor** Manual).

### 5.2.2 Calibration Procedure

Calibration should be performed following the instructions of the software (**Pyro Workbench**). A one-point calibration close to environmental conditions is obligatory.

> **Important**: Ensure temperature equilibration of sensor plate and the **FirePlate** meter! The sensor plate (e.g. **OXMWP**) and **FirePlate-O2** must be **placed for >30 min. under constant environmental conditions (temperature, humidity etc.)** before the calibration is performed. Close the plate with the black lid during calibration to avoid impacts of ambient light.

Before starting a calibration, the calibration medium (ambient air is highly recommended) and the calibration temperature must be selected and the correct humidity needs to be entered.

> **Note**: For precise calibrations at ambient air, the humidity needs to be determined with an external hygrometer and entered for the calibration.

© PyroScience GmbH

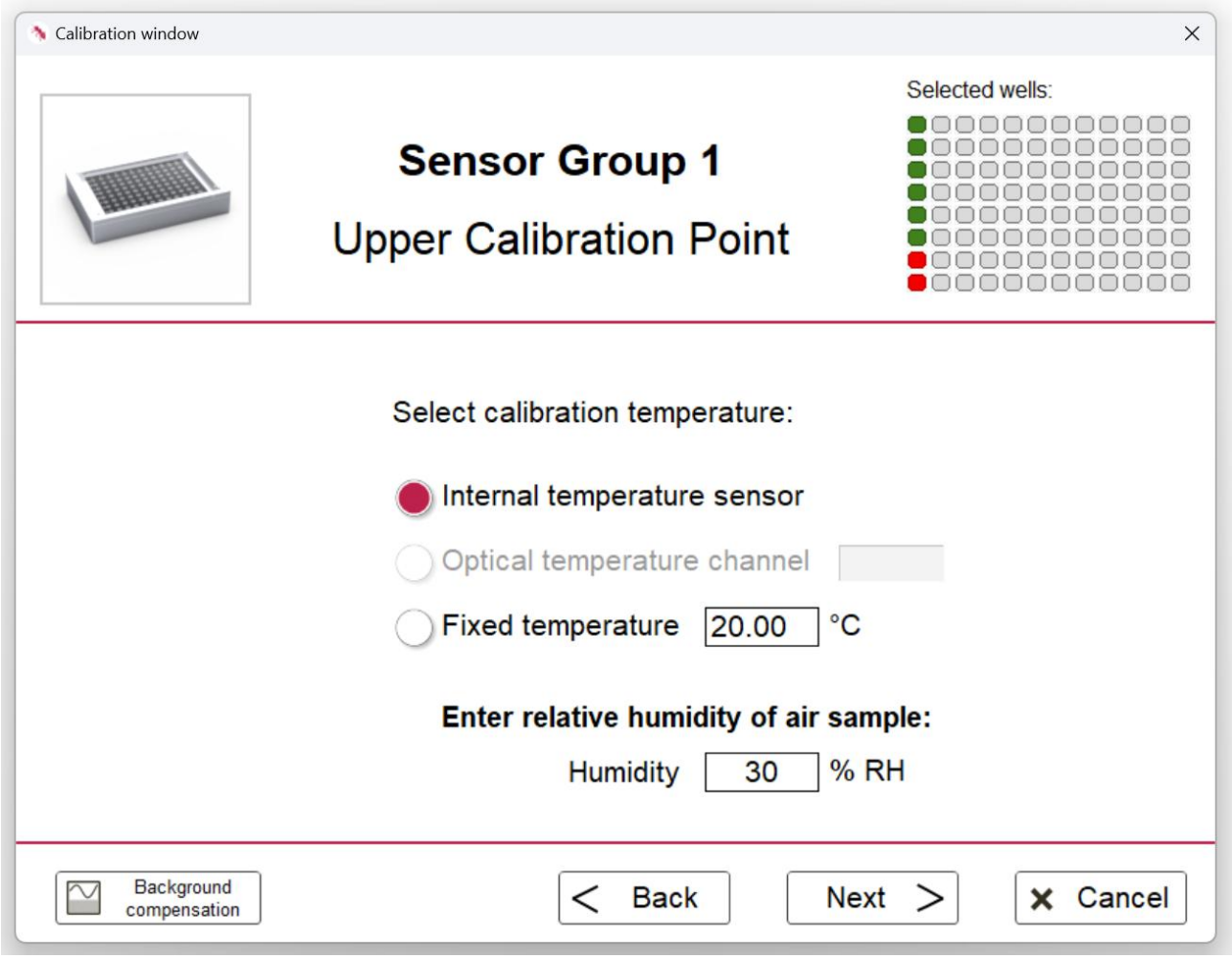



*Figure 4: Calibration window for selection of calibration temperature & humidity*

For calibration, the **dry** oxygen sensor, optionally together with the **dry** optical temperature sensor, is simply exposed to ambient air.

Each time a new calibration standard is used, wait until the sensor reading is stable by observing the graph and the numerical display of the oxygen sensor reading. A color code for the multiwell scheme indicates for every well individually if the sensor reading is stable. Ensure also stable temperature readings of the **Internal** or **Optical Temperature Sensor**, indicated as Compensation Temperature (°C) in the graph. If all sensor readings of a sensor group are stable, the **Take Value** button is enabled. After pressing the **Finish** button, the calibration is applied to all channels of the sensor group. The calibration procedure can take up to two minutes depending on the sensor settings.

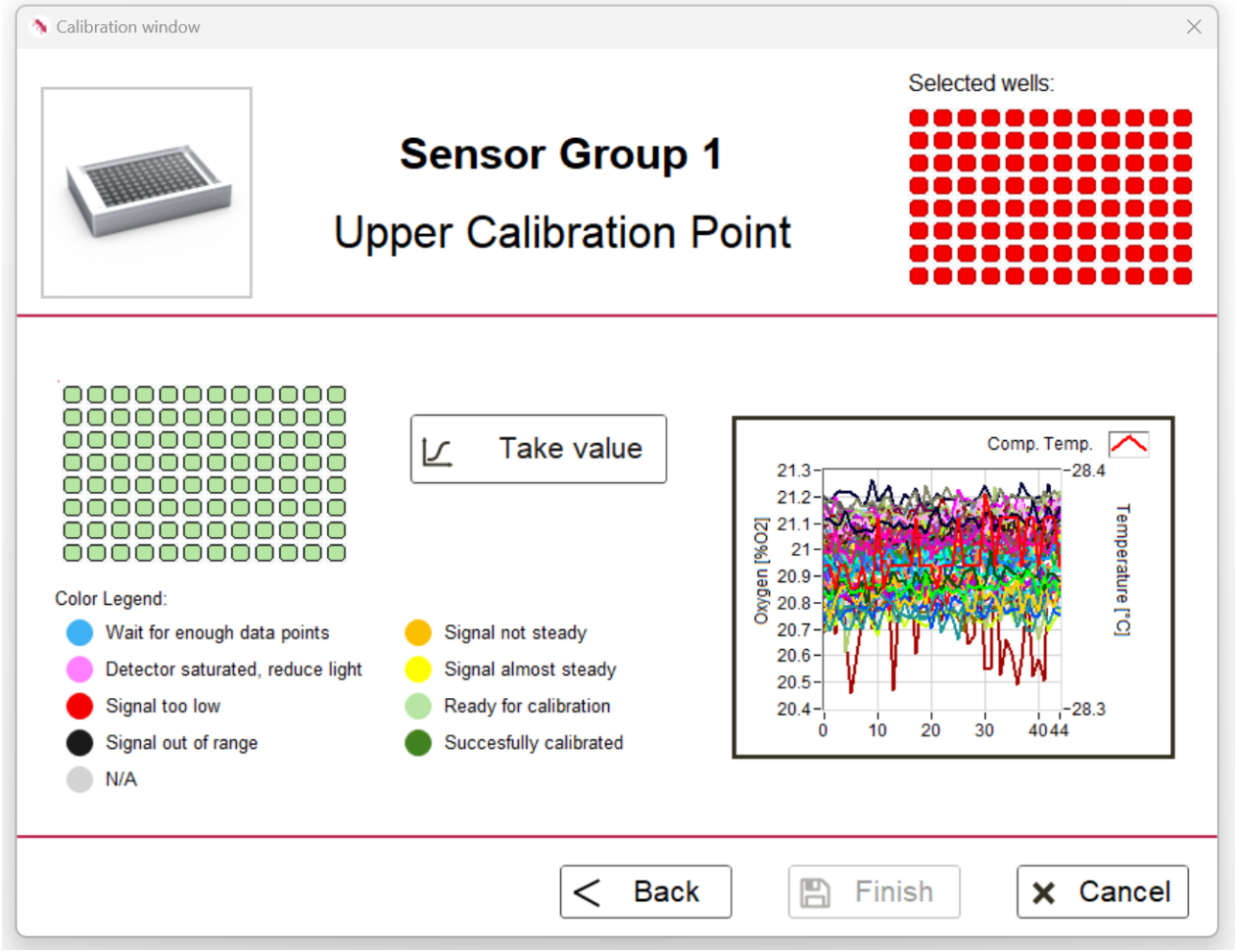



*Figure 5: Calibration window to check stable sensor readings and to take the calibration value*

For precise calibrations in ambient air, it is important that the oxygen sensor minispots are **completely dry**. Wet sensor surfaces will cause undefined humidity levels. And even worse, the evaporation of water drops would cool down the sensor surface causing undefined temperatures.

### 5.2.3 Background Compensation

For measurements and calibration with custom sensor solutions (e.g. custom sensor plates with oxygen sensor spots or oxygen nanoprobes, samples with coloured media), a manual background compensation can be required. For this, place the plate or vial with the medium, but without sensor on the **FirePlate-O2** and perform a manual background compensation by clicking on **Background compensation** (see Figure 4) in the lower left corner of the calibration window. For further details, see chapter 4.4 of the **Oxygen Sensor** Manual.

## 5.3 Measurements and Logging with the Pyro Workbench Software

For oxygen measurement and data logging with oxygen microplates, the plates need to be closed with the black lid to avoid interference with ambient light. Custom applications with **Oxygen Nanoprobes** should also be protected from ambient light.

For measurements of respiration rates, we recommend using our Python tool **ResPyrometry** (free for download on the **FirePlate** webpage).

### 5.3.1 Measurements

A measurement is started by clicking on the **Play** button in the respective group panel of the main window. The **Play** button underneath the device picture and the **Play** button above the group panels start the measurement of all sensor groups at once. During active measurement, the play button turns to a **Pause** button. By clicking on the **Graph** button on the group panel, different options for live data representation can be selected.

- Graph: The standard graph shows the sensor readings of all channels of the selected sensor group in one graph. The sensor readings are plotted against time.
- Heatmap: The sensor readings of all channels of the selected sensor group are shown in a heatmap. The heatmap is updated after every new sensor reading.

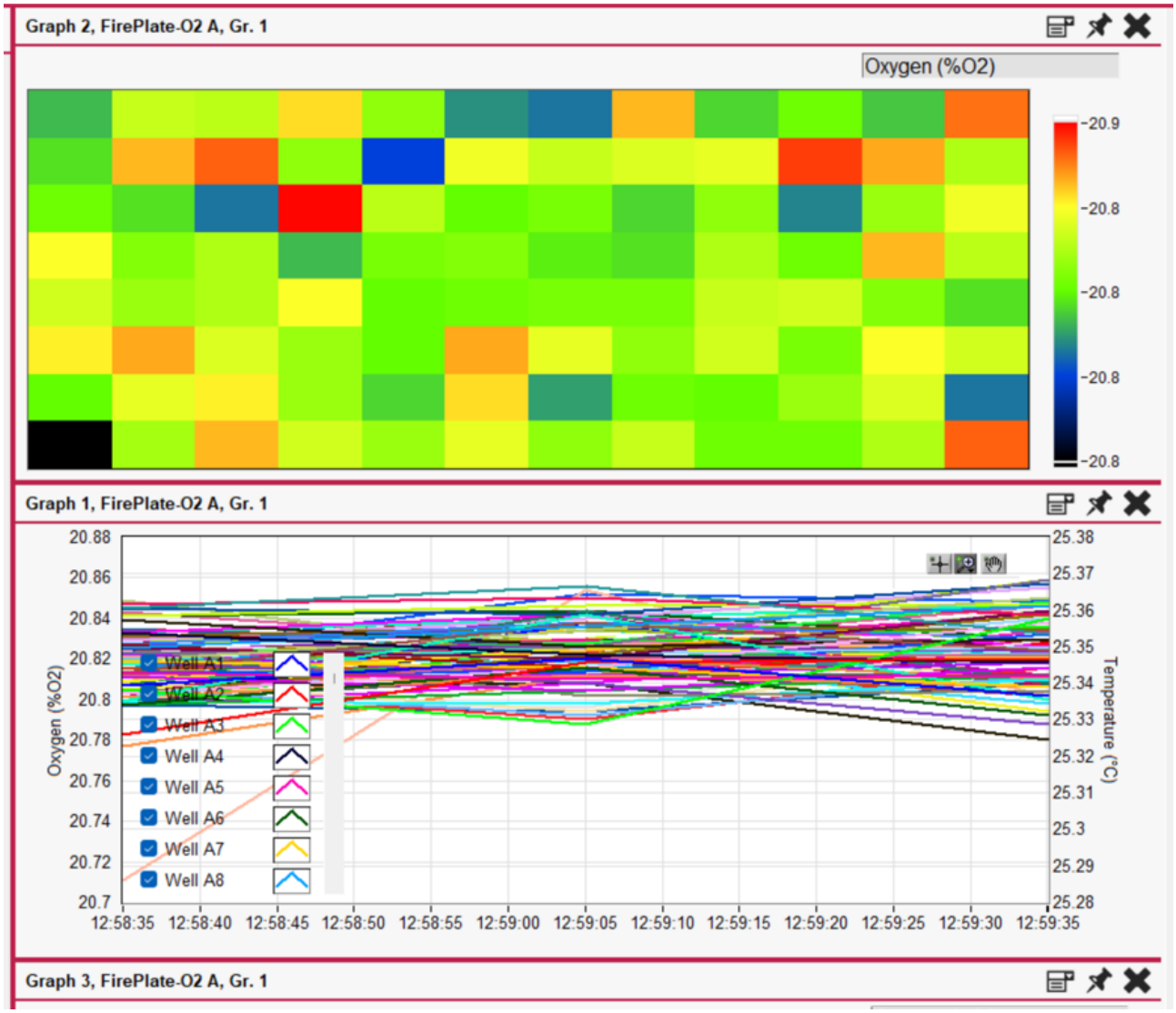



*Figure 6: Heatmap and standard graph representation of sensor readings*

- Multigraph: Every single sensor is represented in its own graph. A single sensor can be represented individually by single clicking on the graph in the multi-graph representation. The sensor readings are plotted against time.

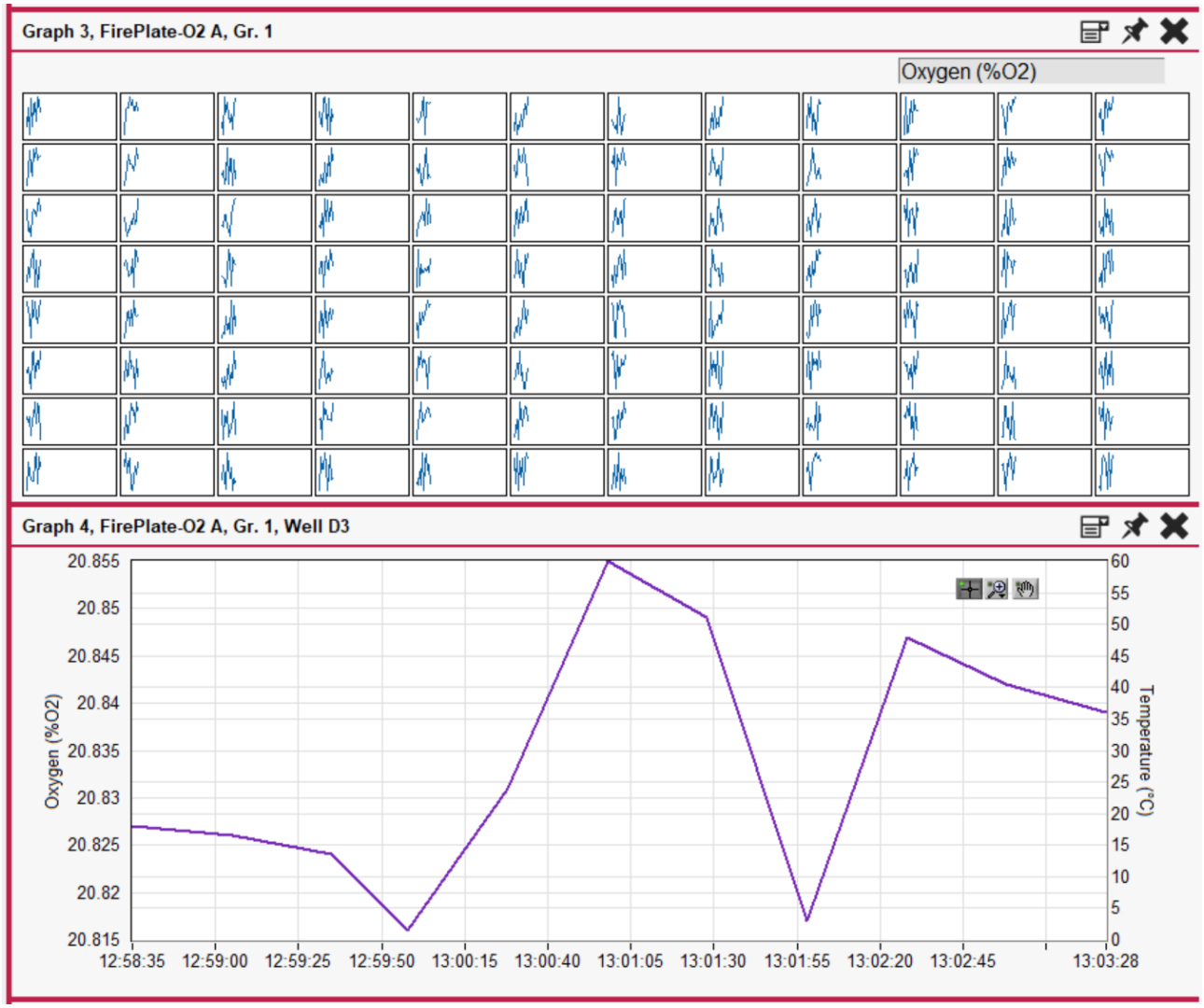



*Figure 7: Multigraph representation of sensor readings*

Each graph window provides additional functions. By clicking on the upper and/or lower limit of the y-axis, a custom value can be entered. The graph is then automatically rescaled.

The graph window offers three different scaling options, which are in the top right corner:

• Cross icon : Default mode; displays the complete graph with automatic scaling.
• Magnifying glass icon : Provides access to various zoom functions.
• Hand icon : Allows panning of the plot while the axis scaling is adjusted automatically.

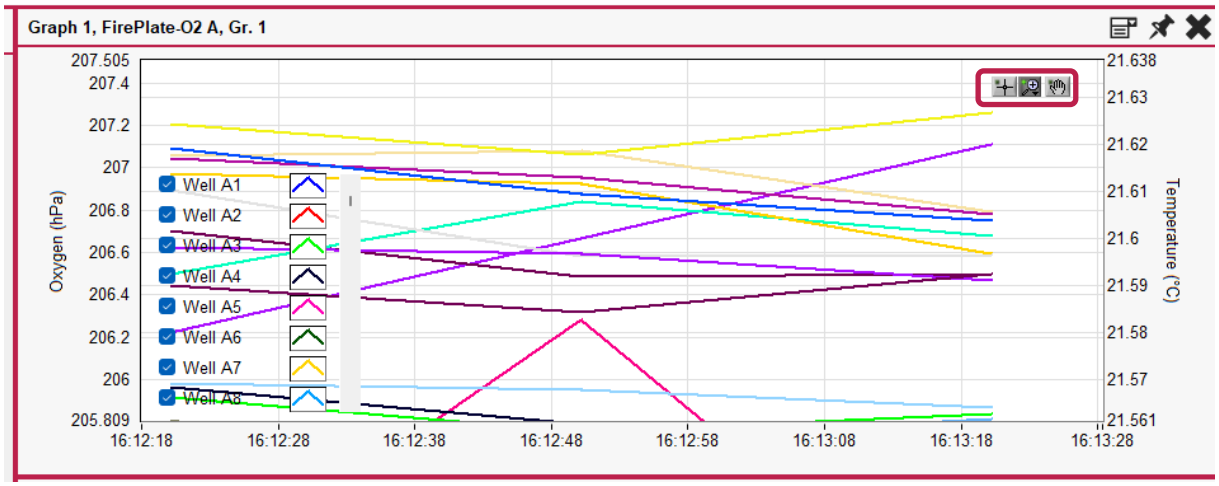



*Figure 8: Magnified section of sensor readings, tools for scaling options in the top right corner*

### 5.3.2 Data Logging and Text Files

Data Logging can be started by clicking on the **Record** button in the upper left corner. The software generates a log folder which includes a *.pyr* file for the use of the **Pyro Data Inspector**. In addition, several text files are generated and stored in the same Windows folder. These text files contain different representations of the measured data as well as metadata related to settings and calibration.

| Name | Date modified | Type | Size |
|---|---|---|---|
| MeasurementData | 15/01/2026 09:04 | File folder | |
| 2026-01-15_090413_Log_WB_2508_FP96.pyr | 15/01/2026 09:05 | Data Inspector File | 112 KB |
| 2026-01-15_090413_Log_WB_2508_FP96.txt | 15/01/2026 09:05 | Text Document | 91 KB |
| Abbr_A_FirePlate-O2_(A Gr.1)_Oxygen.txt | 15/01/2026 09:05 | Text Document | 1 KB |
| Abbr_A_FirePlate-O2_(A Gr.2)_OpticalTe... | 15/01/2026 09:05 | Text Document | 1 KB |
| Graph01.png | 15/01/2026 09:05 | PNG File | 29 KB |
| Graph02.png | 15/01/2026 09:05 | PNG File | 5 KB |

*Figure 9: Workbench log folder*

**Measurement Data folder**: This folder contains individual text files for each configured sensor group. At the top of each file, the settings and calibration data for all optical channels within the corresponding sensor group are listed. Below this configuration section, the measurement data and associated raw data are provided. Each measurement entry includes a time stamp. The header of each data column identifies both, the measured parameter, and the optical channel. An example header is shown below:

**Oxygen (%air sat.) [A Gr.1.B1 Main]**

The elements of the header are defined as follows:

**Oxygen (%air sat.)** describes the measured parameter and the corresponding unit.

**A** defines the device. If multiple devices are connected the devices are numerated with A, B, C and so on

**Gr.1** is the defined sensor group. In this case sensor group 1

**B1** is the well position of the optical channel used for measurement

The optical channels are numbered according to a 96-well microplate layout, ranging from well A1 to H12.

**Status Legend:** The text file “StatusLegend” provides explanations of the status codes used in the logfiles.

**Text files in main folder:** One text file contains the measurement data and corresponding raw data for all sensor groups combined. As with the individual sensor group files, the settings and calibration metadata are listed at the top of the file, and the column headers follow the same structure as those in the measurement data folder. In addition, simplified and abbreviated text files are generated for each sensor group. The filenames of these files always begin with “Abbr”. These abbreviated files do not contain settings data, calibration data, or raw data. They include only the sensor readings with corresponding time stamps. The column headers are simplified and indicate only the well position.

**Graphs:** All graphs that are open during data logging are saved as *.png* files.

© PyroScience GmbH

# 6 DATA POST PROCESSING WITH THE DATA INSPECTOR TOOL

## 6.1 Post processing with the Data Inspector Tool

***.pyr*** files generated during measurement can be loaded in the **Pyro Data Inspector**. The **Pyro Data Inspector** is installed with the **Pyro Workbench** software and provides powerful data processing steps such as smoothing, drift compensation and the calculation of respiration rates. The obtained data as well as the processed data can be easily compared and visualized in graphs. The processed data can be exported into a variety of standard data file formats such as *.txt or *.xls for further data analyses. For the analysis of large data sets, please refer to chapter 6.2 for alternative post processing options.

The following data processing steps are applicable on the **FirePlate-O2** measurement data:

- **Smoothing**: Smoothes the measured data by calculating mean values within a defined range.
- **Linear drift compensation**: If an external reference value is known at the end of the experiment, the linear drift compensation adjusts the measured values to the external correct last value.
- **Subtract blank**: Subtracts two data sources from each other.
- **Average data**: Calculates the average of two data sources.
- **Cut data**: Certain parts of data sources can be selected and cut from the original data source.
- **Respiration rates**: Calculation of continuous respiration rates based on a linear regression on the bases of the prior n oxygen values.
- **Linear respiration rates**: Calculation of single linear respiration rates in a customer selected data section.
- **Change oxygen unit**: Calculates the raw data of a data source into another oxygen unit.
- **Recalculate oxygen**: Calculates the measured oxygen units based on adjusted calibration values, temperature, and pressure compensation.

Depending on the processing step, this could be either measured or already processed data. Additionally, certain requirements need to be matched. The requirements are listed by the software in the corresponding process step window. The measured data can be

represented in a standard graph or in a multigraph (see chapter 0). A data processing step is always performed on the data of a whole sensor group. The processed data and the measured data can be exported by clicking on the **Data Export** button in the menu bar at the top of the main window. The output folder will contain a single subfolder for every selected data source and a combined data file, which contains all selected data. For more detailed information about the **Pyro Data Inspector** and the integrated processing steps, please refer to the Manual "**Pyro Workbench** & **Data Inspector**" which is provided on our website.

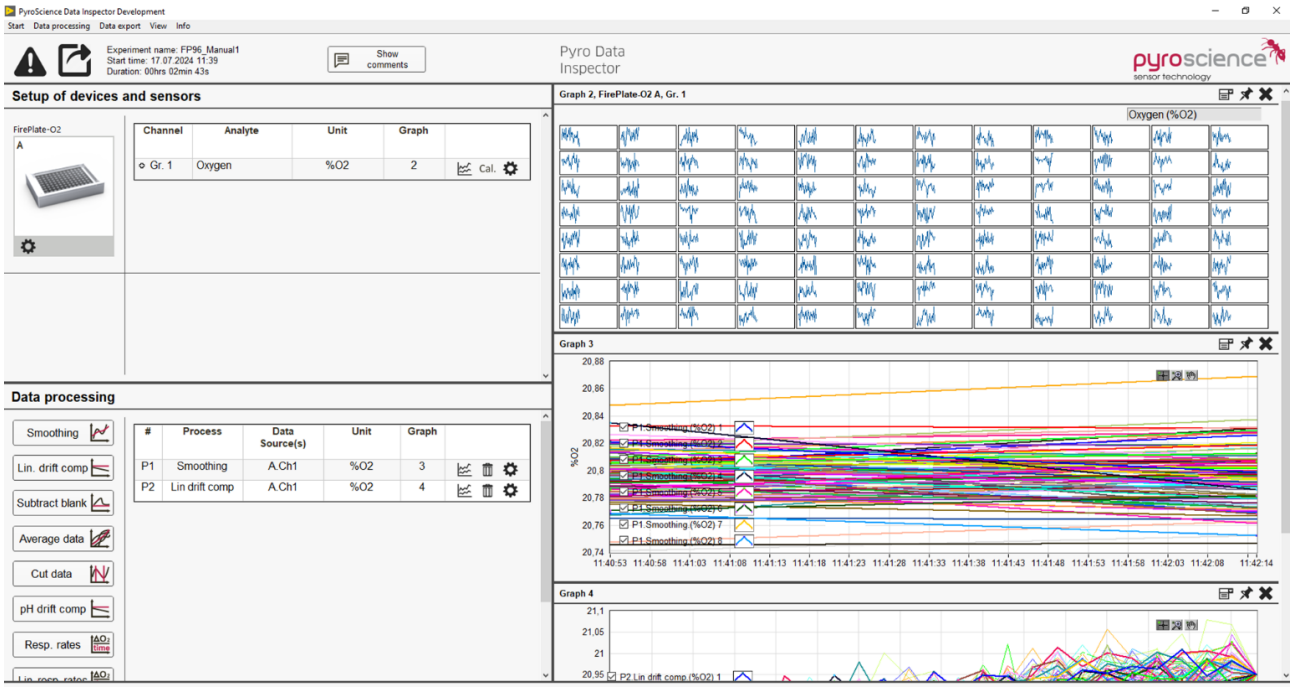



*Figure 10: Main window of Pyro Data Inspector with representation of processed data 6.2 Other post processing options*

## 6.2 Other post processing options

The generated *.txt* log files from **PyroWorkbench** and **PyroDataInspector** can be easily read using data analysis tools such as Python, MATLAB, and R. These tools enable users to perform custom calculations and create graphical representations tailored to their specific requirements.

PyroScience provides a Python library that simplifies the reading of the Pyro Workbench log files and includes the functions **Change oxygen unit** and **Recalculate oxygen unit**, which are also available in the **PyroDataInspector**. The library, named **pyrotoolbox**, can be installed using the *pip install* command. The library documentation

is available on pypi.org. Example Python code demonstrating data post-processing with **pyrotoolbox** can be downloaded from our website, e.g. here. Information on other python libraries is available upon request.

# 7 OPTICAL SENSORS FOR FIREPLATE-O2 AND SENSOR APPLICATION

The **FirePlate-O2** is compatible with different contactless optical oxygen sensors and optical temperature sensor spots from **PyroScience**. The following compatible sensor types are available:

| Sensor | Item | Analyte | Application |
|---|---|---|---|
| **Nanoprobes** | OXNANO | O2 | aqueous solutions & microfluidics |
| **Sensor Spots** | OXSP5… | O2 | water & gas |
| | TPSP5… | **Temp.** | |
| **Sensor Plates** | OXMWP… | O2 | water & gas |

**water**=water, seawater, aqueous solutions

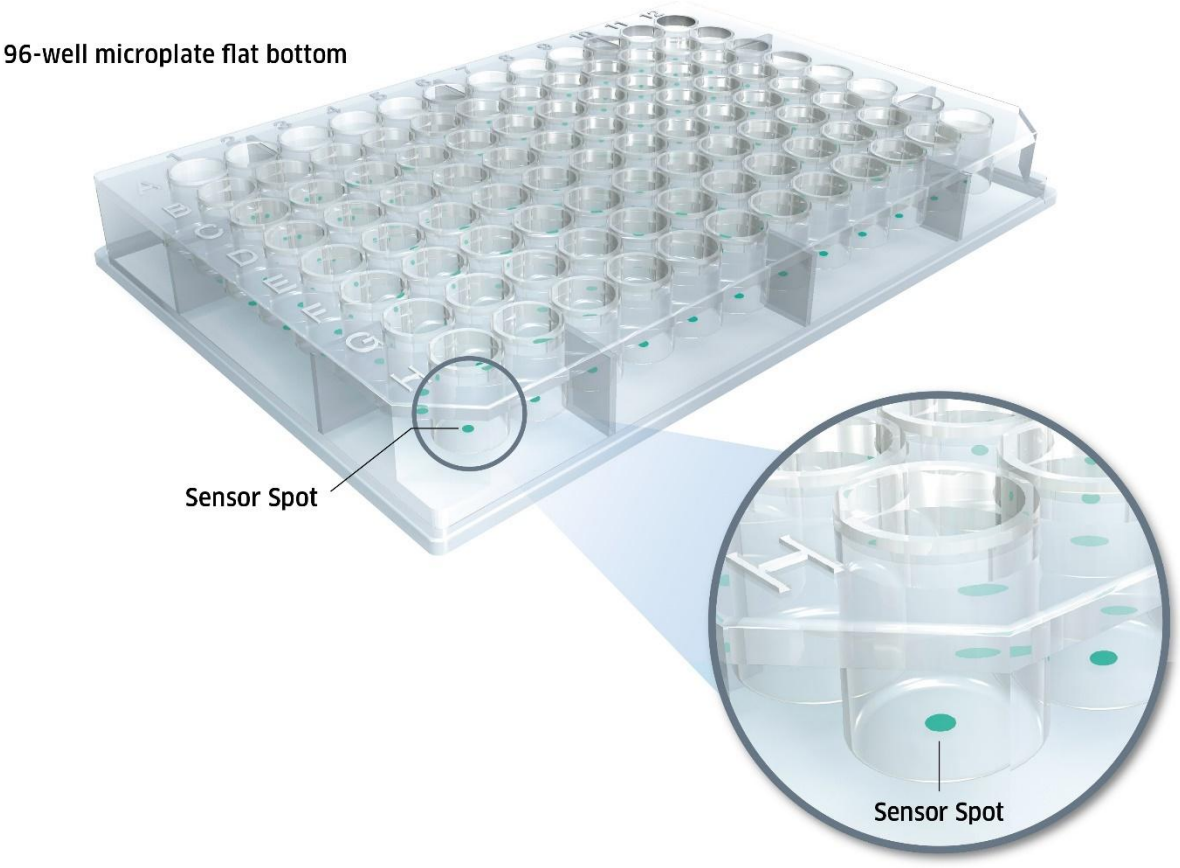
For general information on the oxygen sensors including the sensing principle, definition of oxygen units etc., please refer to the **Oxygen Sensor** Manual. For information on the sensor specifications, please view the download tab of the respective sensor webpages.

## 7.1 Oxygen Sensor Microplates

PyroScience 96-well oxygen sensor microplates OXMWP are equipped with integrated oxygen minispots at the bottom of each well. The sensor microplates are based on untreated polystyrene plates and available with flat bottom (OXMWP-96F) or round bottom (OXMWP-96R). They come with a dark universal lid, which is needed to avoid impact of ambient light on calibrations and measurements.

Oxygen sensor microplates can be applied in gas phases, water and aqueous solutions. Organic solvents (like e.g. acetone), bleach and gaseous chlorine ($Cl_2$) induce interferences with the sensor reading and potentially destruction of the sensor. No cross-sensitivity is found for pH 1-14, $CO_2$, $CH_4$, $H_2S$ and any ionic species.

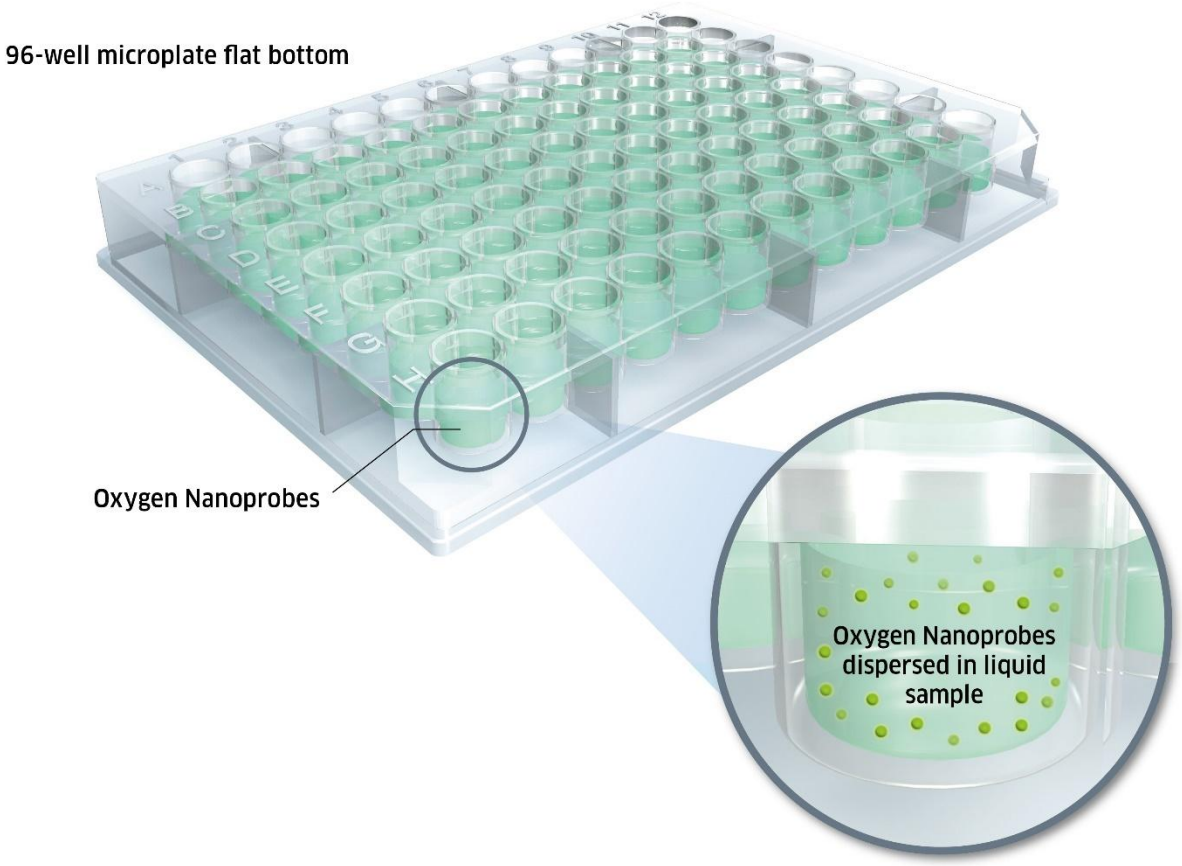
Oxygen sensor microplates OXMWP are delivered sterile.



## 7.2 Oxygen Nanoprobes OXNANO

**PyroScience** oxygen nanoprobes **OXNANO** allow dissolved oxygen (DO) measurements in liquid samples within closed transparent systems (plastic or glass) like e.g. multi well plates. They are perfectly dispersible in aqueous solutions or culture media and enable batch calibration. Organic solvents (like e.g. acetone), bleach and gaseous chlorine ($Cl_2$) induce interferences with the sensor reading and potentially destruction of the sensor. No cross-sensitivity is found for pH 1-14, $CO_2$, $CH_4$, $H_2S$ and any ionic species.

Please find detailed information on the application of sensor spots in the respective sensor leaflets and the Sensor Manual.



## 7.3 Oxygen & Temperature Sensor Spots

**PyroScience** oxygen sensor spots and temperature sensor spots can be mounted into custom multiwell plates (12, 24 or 96 well plates) or glass vials and can be used for temperature compensated oxygen measurements in gas phases, water and aqueous solutions. Organic solvents (like e.g. acetone), bleach and gaseous chlorine ($Cl_2$) induce interferences with the sensor reading and potentially destruction of the sensor. No cross-sensitivity is found for pH 1-14, $CO_2$, $CH_4$, $H_2S$ and any ionic species.

Please find detailed information on the application of sensor spots in the respective sensor leaflets and the Sensor Manual.

## 7.4 Overview of Sensor Applications

| Sensor item | Sensor-specific application instructions |
|---|---|
| OXMWP… | **Application**: water & gas<br>**Calibration**: 1- or 2-point calibration*<br>**Sterilization**: Short-term 70% ethanol, short-term 70% isopropanol, ethylene oxide (EtO, EO) sterilization (details on request), UV-sterilization (details on request)<br>**Note**: Remove air bubbles from sensor surface |
| OXSP5… | **Application:** water & gas<br>**Calibration:** 1- or 2-point calibration*<br>**Features:** optical isolation<br>**Sterilization:** ethylene oxide (EtO), 70% ethanol (EtOH), 70% isopropanol (ISPP), can be autoclaved few cycles at 121°C for 15 min with special precautions (details on request)<br>**Note:** Mind air bubbles! Glue carefully with silicone glue and let dry for 24h. |
| OXNANO | **Application:** water/aqueous samples<br>**Calibration:** 2-point calibration in application medium<br>**Sterilization:** can be autoclaved few cycles at 121°C for 15 min with special precautions (details on request)<br>**Note:** Manual background compensation necessary in microfluidic applications. Not in colored, illuminated or fluorescing samples. |

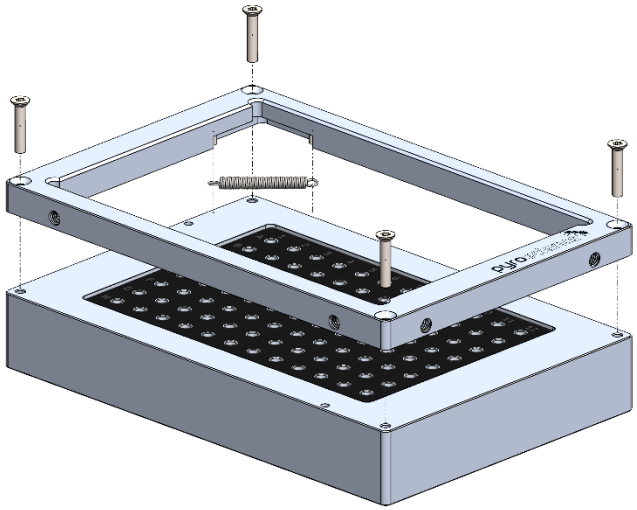
* Depending on application: 1-point for measurements around 21%/air saturation, 2-point for complete range between 0% and 21%/air saturation

# 8 STERILIZATION, CLEANING AND STORAGE

## 8.1 Cleaning of the FirePlate-O2 meter

For cleaning of the **FirePlate-O2** meter, the meter can be carefully wiped with 70% ethanol. Only in case of heavy contamination, can the plate holder frame be demounted for cleaning. For this, unscrew the frame on top of the **FirePlate-O2** and optionally remove the spring from the two pins. The surface of the **FirePlate-O2** can be cleaned by careful wiping with ethanol, the frame, screws and spring can be cleaned in ethanol as well.

> Please note that repeated assembly and disassembly is not recommended, as the thread locker will lose its function.



## 8.2 Sterilization of OXMWP

Oxygen sensor minispots integrated in microplates (e.g. **OXMWP-96F** and **OXMWP-96R**) can be sterilized with short-term 70% ethanol, short-term 70% isopropanol, ethylene oxide (EtO, EO) sterilization (details on request) and UV-sterilization (details on request).

**Note:** **OXMWP-96F** and **OXMWP-96R** are delivered sterilized and generally not intended for reusage. Repeated sterilization may influence the sensor performance and adhesion of the oxygen sensor minispots negatively. The minispots may detach from the substrate! After sterilization a re-calibration of the sensor plates is required!

**Important:** do not use bleach, acetone or any solvent/agent not approved by **PyroScience**!

## 8.3 Cleaning and Storage of OXMWP

After finalization of the measurements, the oxygen sensor minispots should be rinsed carefully with demineralized water. After cleaning, let the microplate dry in a dry, dark and secure place at room temperature. Place the microplate in the light protecting overpackaging.

A signal drift of the sensor can indicate photo-bleaching of the oxygen-sensitive **REDFLASH indicator** depending on the ambient light intensity, as well as the intensity of the excitation light and the sample frequency. This can necessitate new calibration of the sensor and possibly also a re-adjustment of the **Sensor Settings**.

Store the sensor in a dry, dark and secure place at room temperature.

# 9 SPECIFICATIONS OF FP96-O2

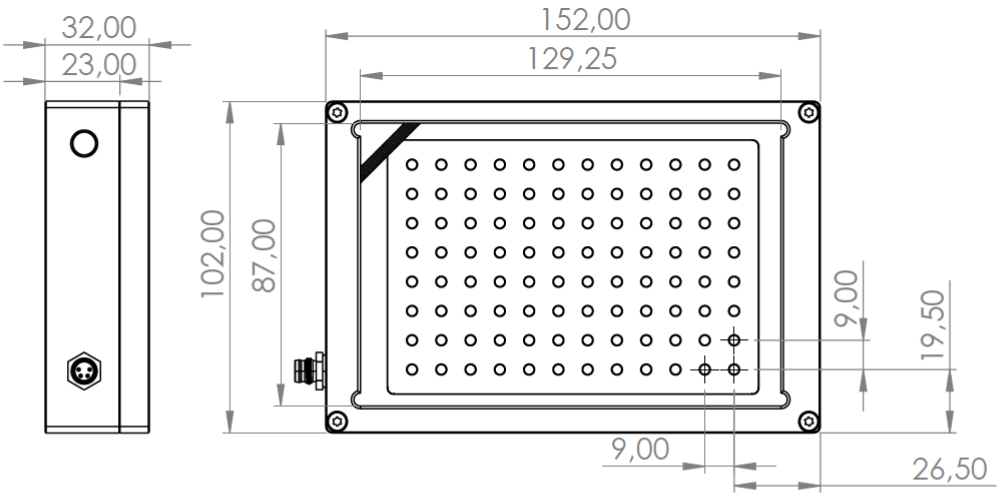
For sensor specifications and response times, please refer to the webpages of the different sensor types.

| Specifications | |
|---|---|
| **Weight** | ca. 670 g |
| **Dimensions (LxWxH)** | 162 x 102 x 32 mm |
| **Optical sensor channels** | 96 |
| **Optical sensor connector** | contactless |
| **Compatible optical sensors** | **OXMWP**, **OXNANO**, **OXSP5-…**, **TPSP5-…**from **PyroScience** |
| **Integrated sensors** | Temperature, ambient pressure |
| **Measuring principle** | REDFLASH technology from **PyroScience** |
| **Max. sampling rate** | 10-20 samples per second for one active channel, 1 sample every 3-5 seconds for 96 active channels (depending on settings) |
| **Logging software** | **Pyro Workbench** (free download) |
| **System requirements** | USB 2.0, Windows 7/8/10/11, min 1 GB disk space 4GB RAM, min. 1366x768 pixel |
| **Power supply** | 5VDC from USB |
| **Average current during measurement** | 15 mA – 30 mA at 25°C |
| **Connector** | M8 Male 4 pole (USB adapter cable included) |
| **Operating / storage temperature** | 0-50°C / -10-60°C |
| **Max rel. humidity** | Non-condensing conditions |
| **Internal temperature sensor* range; resolution; accuracy** | 0°C- 50°C; 0.012°C; typ. ±0.5°C |
| **Internal Pressure sensor range; resolution; accuracy** | 300-1100mbar; 0.11mbar; typ. ±6mbar |

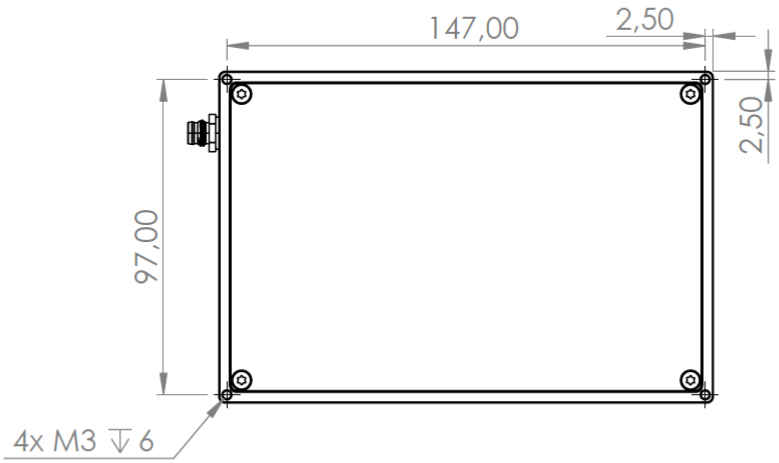
*Please note, that the optical sensors have a different temperature range

# 9.1 Dimensions

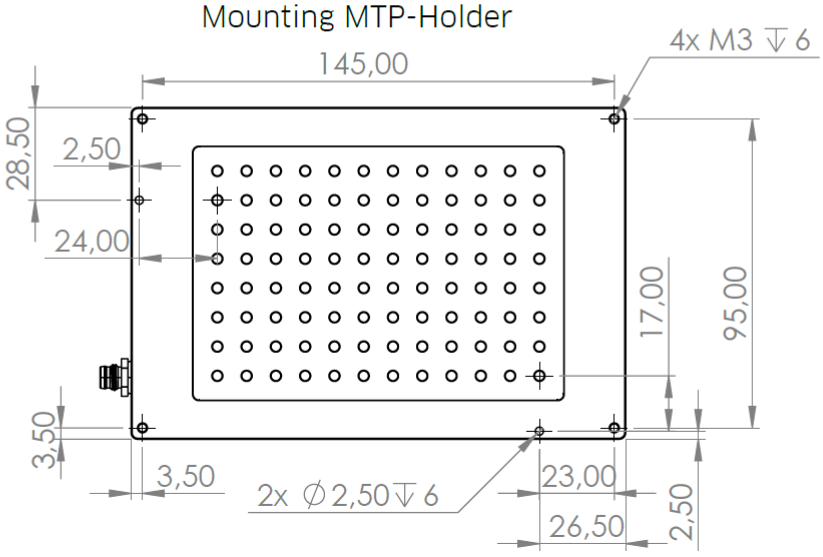
## 9.1.1 FirePlate-O2 (FP96-O2)



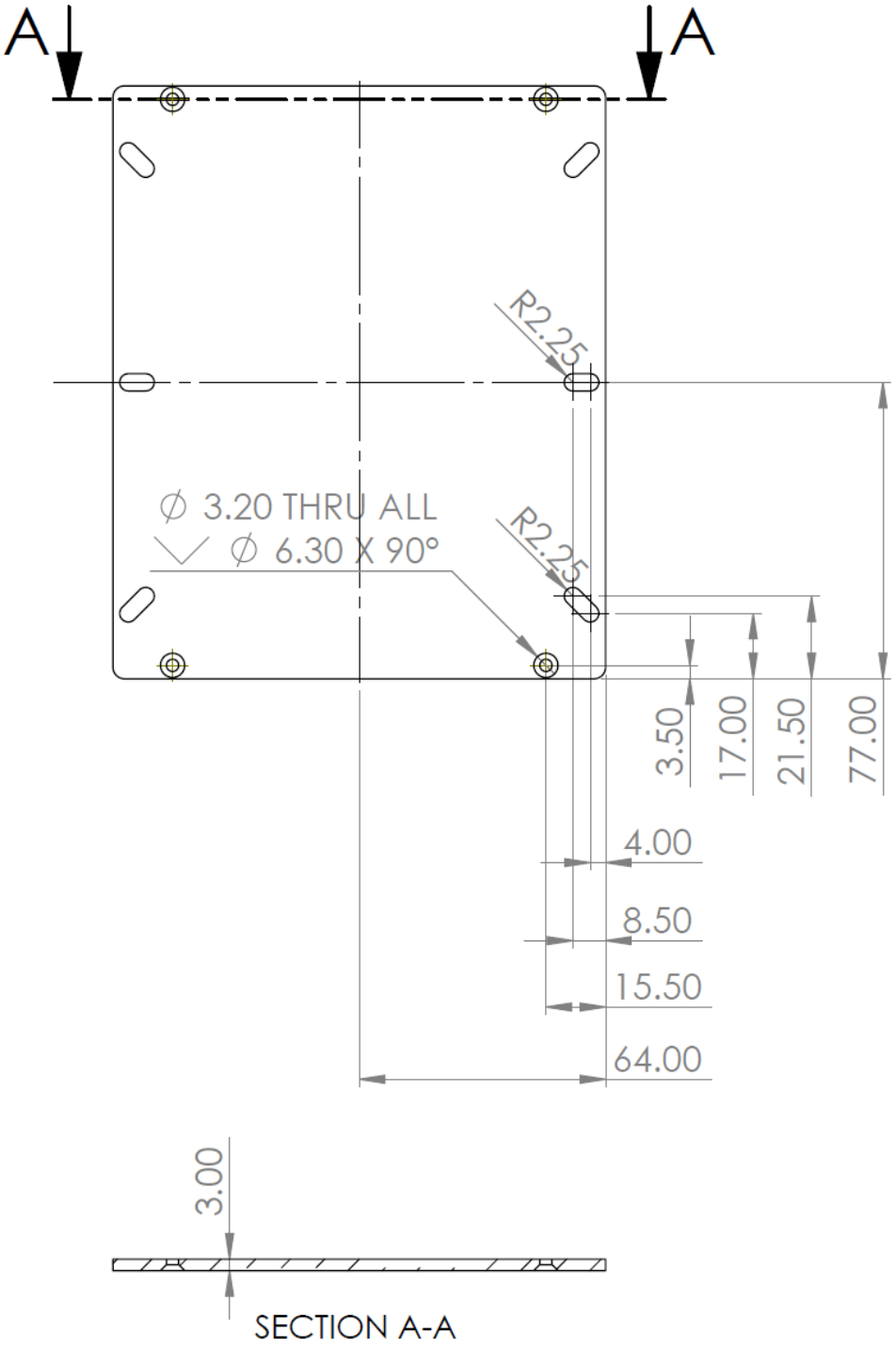

Mounting Threads Bottom




Mounting MTP-Holder



### 9.1.2 Adapter Plate (FP96-ADPT1)



# 10 RELATED DOCUMENTS

Detailed instructions for using the **Pyro Workbench** and application of optical oxygen and temperature sensors:

- manual for logger software "**Pyro Workbench & Data Inspector**" (Windows)
- manual for optical oxygen and temperature sensors from **PyroScience**

# 11 WARNINGS & SAFETY GUIDELINES

**Before using the FirePlate-O2 and its sensors, read carefully the instructions and user manuals.**

In case of problems or damage, disconnect the instrument 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!

**The FirePlate-O2 is not watertight, is sensitive to corrosive conditions and to changes in temperature causing condensation. Avoid any condition (e.g. direct sunlight) causing a heating of the device above 50°C (122°F) or below 0°C (32°F). Avoid any elevated humidity causing condensing conditions.**

Handle the sensors with care. **Prevent mechanical stress (e.g. scratching) to the sensing surface.**

**Calibration and application of the sensors is on the user's authority, as well as data acquisition, treatment & publication!**

PyroScience **oxygen sensors and read-out devices 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 examinations on humans, **not** for human-diagnostic or therapeutic purposes. The sensors **must not** be brought in direct contact with foods intended for consumption by humans.

**FirePlate-O2 and optical sensors should be used in the laboratory by qualified personnel only, following the user instructions and the safety guidelines of the manual, as well as the appropriate laws and guidelines for safety in the laboratory!**

**Keep the sensors and the fiber-optic meter FirePlate-O2 out of reach of children!** Store the oxygen sensors in a secure, dry and dark place at room temperature.

© PyroScience GmbH

# CONTACT

**PyroScience GmbH**
Kackertstraße 11
52072 Aachen
Deutschland

Tel.: +49 (0)241 5183 2210
Fax: +49 (0)241 5183 2299
info@pyroscience.com
www.pyroscience.com