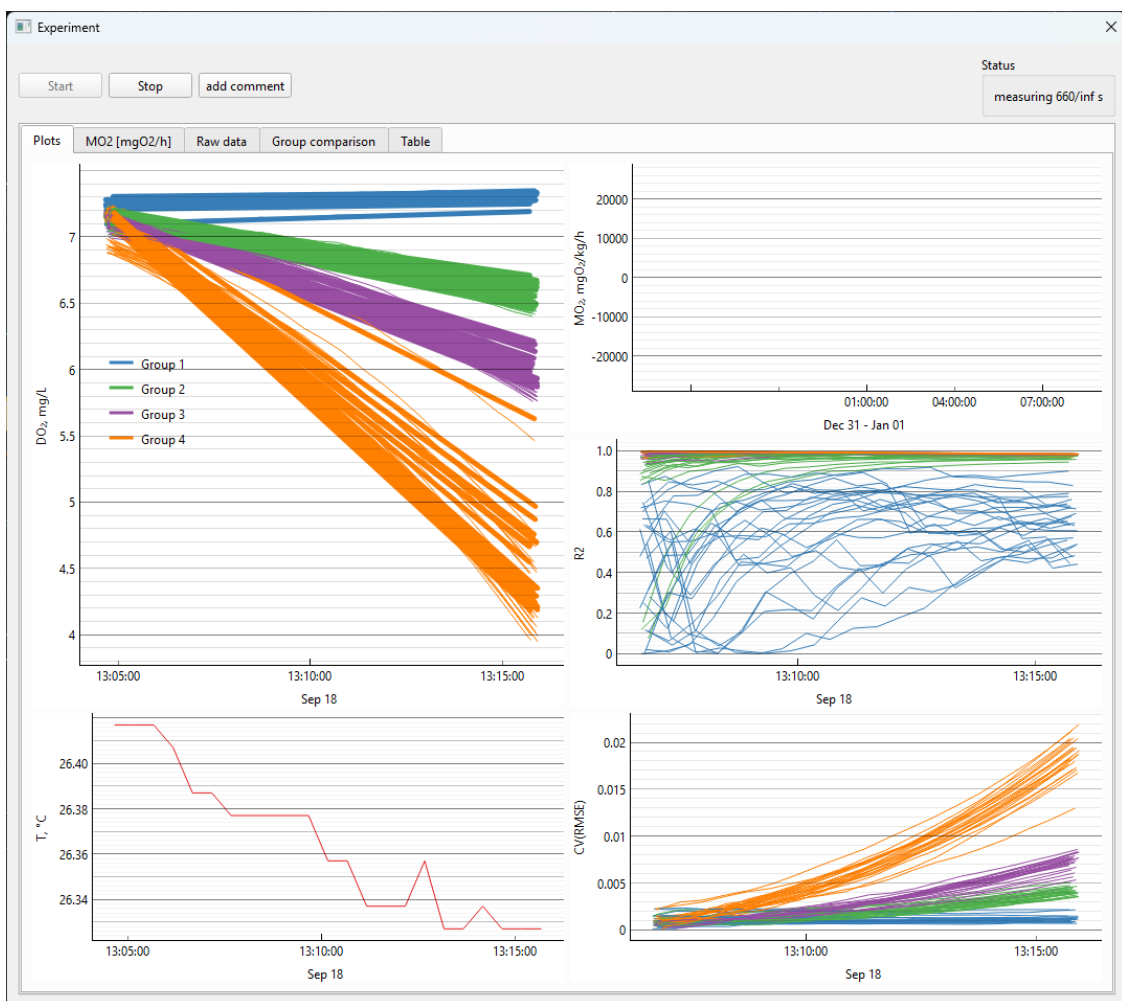


ResPyroMetry

Software tool for respiration rate measurements with oxygen sensor solutions from PyroScience

QUICKSTART MANUAL

O₂



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Software tool for respiration rate measurements with oxygen sensor solutions from PyroScience

Document Version 1.01

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1 INTRODUCTION

ResPyroMetry is a python-based software tool with advanced functionality for measurements and determination of oxygen consumption and production rates with oxygen sensor solutions from **PyroScience**. The tool enables three methods of respiration rate measurements:

- Closed Respirometry
- Intermittent Flow Respirometry
- Swim Tunnel Respirometry

Oxygen measurements are triggered automatically according to the entered settings, and the software calculates and plots oxygen consumption rates, as well as R2 and CV(RMSE) as metrics for evaluating the quality of regression models.

For intermittent flow and swim tunnel respirometry, the software tool can control flush pumps in combination with an additional software from MicroDAQ (details on the installation in chapter 1.2).

1.1 Technical Requirements

| | Minimal requirements | Recommended requirements |
|-------------------------|---|--|
| Operating system | Windows 7 / 8 / 10 / 11 (but not Windows RT) | 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 |

1.2 Installation

Important: Do not connect the **PyroScience** device to your PC before the **Pyro Workbench** software has been installed. The software will install automatically the appropriate USB-driver. After installation of the software, first connect a supported device and then open the **Pyro Workbench** software.

Installation steps:

- Please download the latest version of **Pyro Workbench** software from the downloads tab of your purchased device on www.pyroscience.com
- Unzip and start the installer and follow the instructions
- Please download the latest version of **ResPyroMetry** software from the downloads tab of your purchased device on www.pyroscience.com
- Optional for intermittent and swim tunnel respirometry using pumps: Install software from <https://microdaq.com/mwdownloads/download/link/id/1141>
- After successful installation, a new program short-cut "**Pyro Workbench**", "**Pyro Data Inspector**" will be available. "**ResPyroMetry**" can be opened by clicking on the installer.

1.3 Supported Devices

All lab oxygen meters from **PyroScience** based on firmware 4 are compatible with **ResPyrometry** software. This includes:

- the multi-channel Oxygen Plate Reader **FP96-02** for measurements with up to 96 channels for microrespirometry
- the oxygen meter **FireSting-02 (FSO2-C1, FSO2-C2, FSO2-C4)**
- the multi-analyte meter **FireSting-PRO (FSPRO-1, FSPRO-2, FSPRO-4)**

2 CONFIGURATION WITH PYROWORKBENCH

Please use the **Pyro Workbench** Software for setup and calibration of the oxygen sensors. Refer to **Pyro Workbench & Data Inspector** manual for more information on the software. The manual can be found in the downloads tab of your purchased device on www.pyroscience.com.

Definition of groups for measurements in multi-well plates with FP96-02

For measurements with the **FirePlate-02**, the wells of the microplates can be divided into up to 4 groups. Sensor groups can be defined e.g. in case of different sensor types, analytes or sample intervals. Please refer to the **FirePlate-02** manual for detailed information.

The screenshot shows the 'Settings window' for configuring a multi-well plate. It is divided into three main sections:

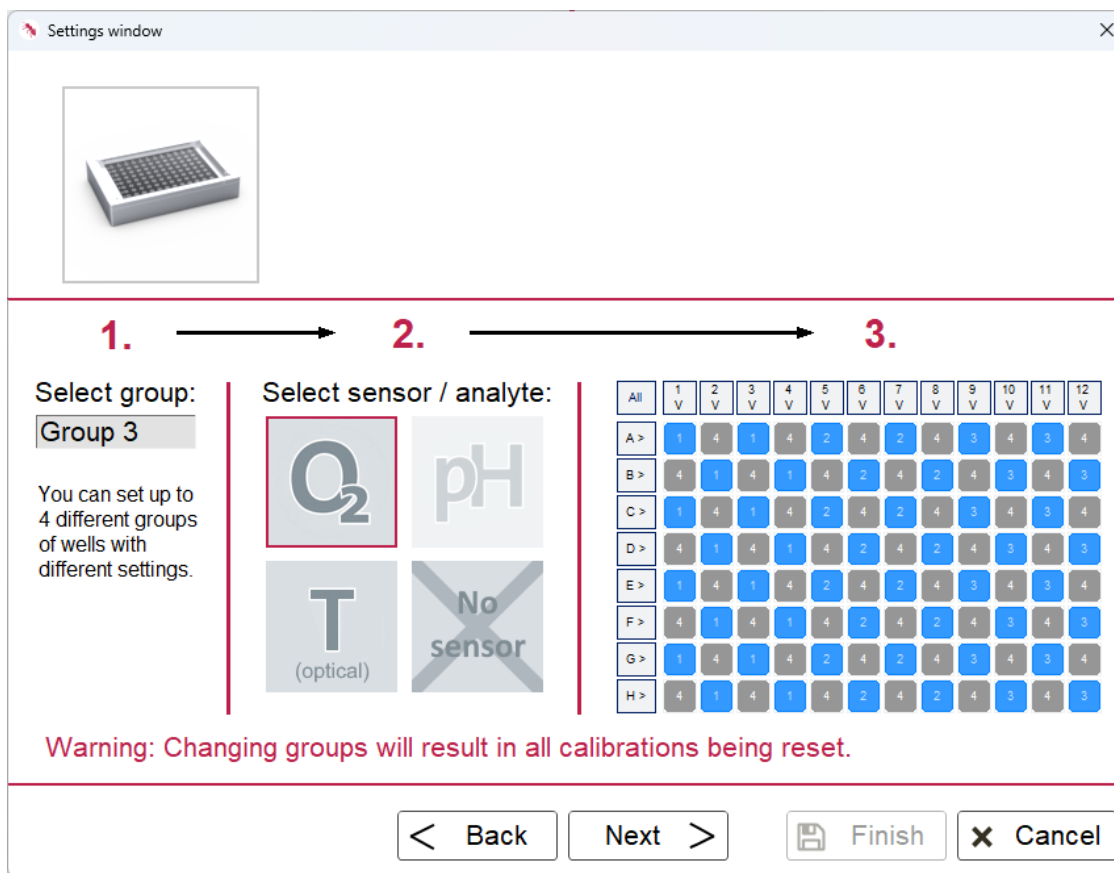
- 1. Select group:** A dropdown menu is set to 'Group 1'. Below it, a note states: 'You can set up to 4 different groups of wells with different settings.'
- 2. Select sensor / analyte:** Four options are shown: O_2 (selected with a red border), pH, T (optical), and No sensor (crossed out).
- 3. Well configuration:** A grid of 96 wells (8 rows A-H, 12 columns 1-12) is shown. Each well has a 'Type' label (V) and a number (1-4). Wells 7-12 in rows A-G are highlighted in red, indicating they belong to a different group.

A warning message at the bottom reads: 'Warning: Changing groups will result in all calibrations being reset.'

Navigation buttons at the bottom include '< Back', 'Next >', 'Finish' (with a save icon), and 'Cancel' (with an X icon).

Within the **ResPyrometry** software, different parameters can be defined for each well or for the entire pre-defined groups of wells. This includes e.g. the biomass, density of the biomass and volume of the samples.

If you have a multi-well-plate (MWP) with less than 96 wells or want to deactivate certain channels, this can be done here. For our 48 well glass plates for microrespiration rate measurements, a respective scheme of wells (checkerboard pattern) can be selected:



Calibrate the sensor as usual according to the Oxygen Sensor manual and the sensor leaflets. For microplates like **OXMWP96**, we recommend calibrating only the upper calibration point in air with the "Manual Multi-Channel Calibration".

Note: For best accuracy shield the sensor from ambient light during calibration and measurement.

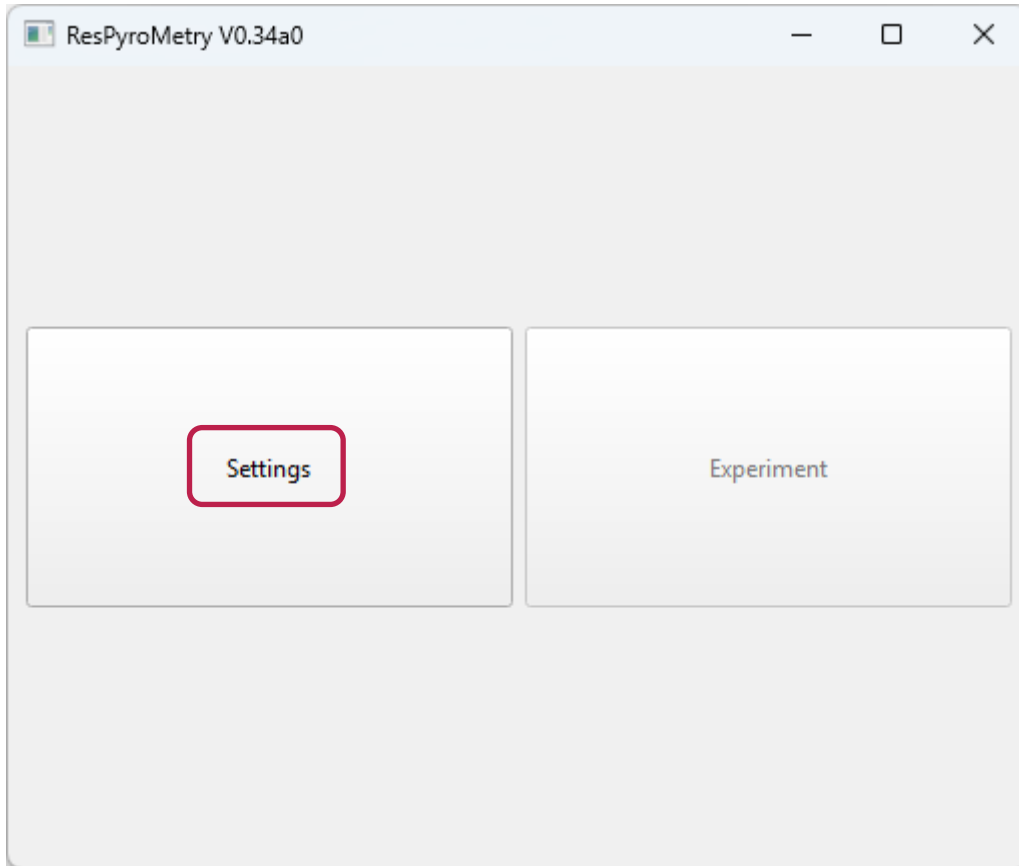
After calibration of the sensors, close the **PyroWorkbench** software.

Close **PyroWorkbench** after setup and calibration of the sensors. **ResPyroMetry** cannot connect to the **PyroScience** meters if it is connected to **PyroWorkbench**.

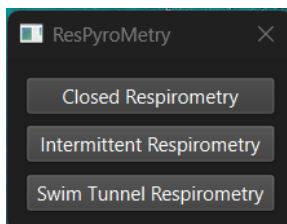
3 CONFIGURATION IN RESPYROMETRY

Start **ResPyroMetry** (this might take some time).

Click on **Settings**:



Choose the required respiration measurement mode.



3.1 Closed Respirometry

For respiration rate measurements in closed chambers, including micro well plates, select "Closed Respirometry". Here, the following needs to be configured:

- Data directory
- Experiment name
- Measurement protocol including
 - Waiting duration: fixed wait time before the measurement starts
 - Continuous measurement: the measurement will run until you stop it manually
 - Fixed measurement duration: if you want to stop the experiment after a pre-defined time
 - Sampling interval: time interval between the measurements. If you use all 96 channels of the **FirePlate-02**, the minimum is 10 s. **Recommended: 30 s**

The screenshot shows the 'Settings' window with the following configuration options:

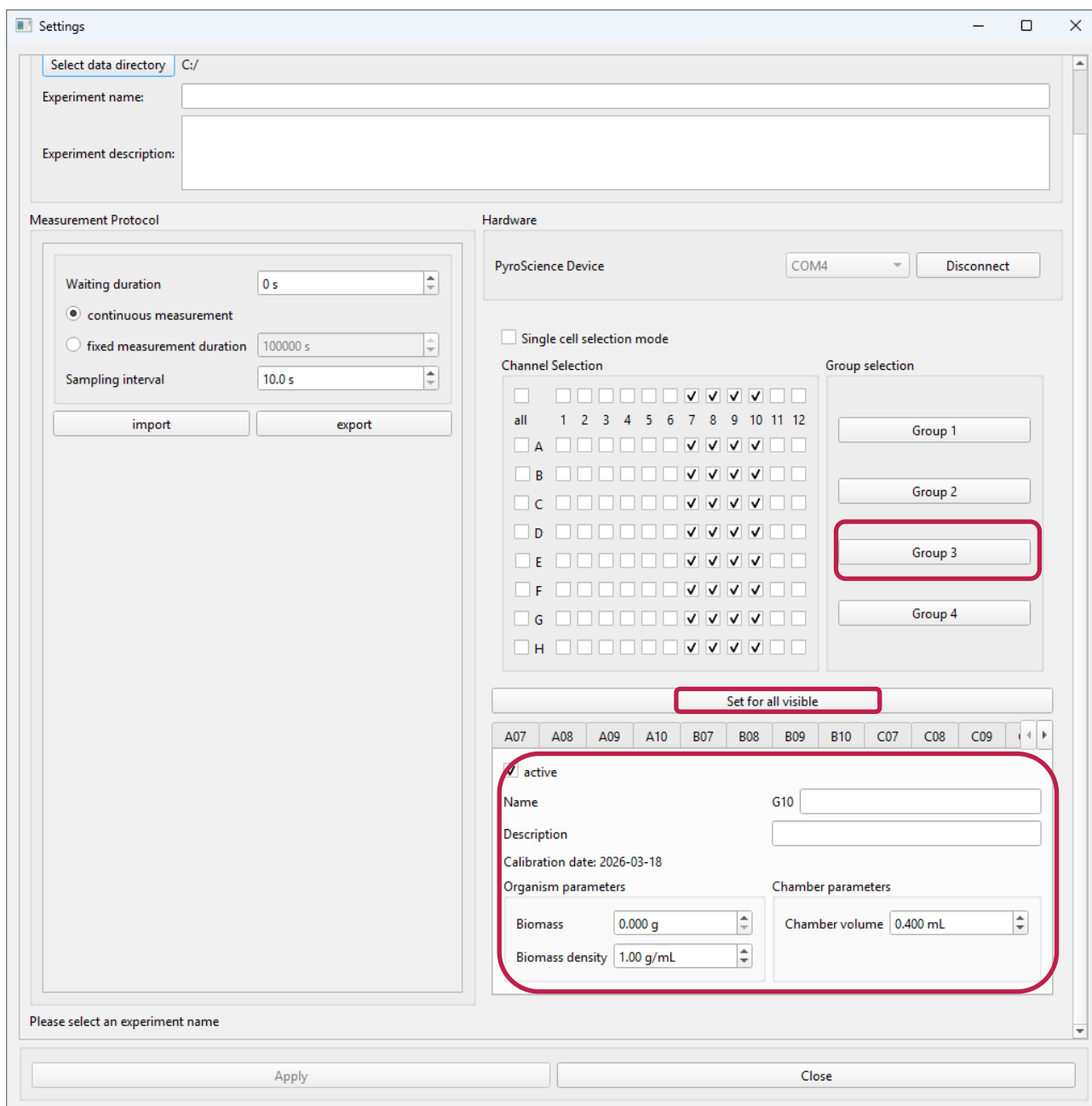
- Experiment type:** Single Shot
- Logging:**
 - Select data directory: please choose a directory
 - Experiment name: [text input field]
 - Experiment description: [text input field]
- Measurement Protocol:**
 - Waiting duration: 0 s
 - Measurement type:
 - continuous measurement
 - fixed measurement duration: 100000 s
 - Sampling interval: 1.0 s
 - Buttons: import, export
- Hardware:**
 - PyroScience Device: COM4 (dropdown menu) [Connect button]
 - Set for all visible: [button]
 - Ch 0:
 - active
 - Name: [text input field]
 - Description: [text input field]
 - Organism parameters:
 - Biomass: 0.000 g
 - Biomass density: 1.00 g/mL
 - Chamber parameters:
 - Chamber volume: 0.000 mL

Buttons at the bottom: Apply, Close

Now, select the correct COM-Port and connect the device by clicking on "Connect". The device configuration will be loaded.

In the next step the individual channels or the previously defined groups can be configured. The definition of groups is possible and recommended for measurements with microplates with the FirePlate-O2 and must be done within the **PyroWorkbench** software (see chapter 2).

First, select a group by clicking on the group number, or a well/number of wells by clicking on the wells. You also have the option to activate all wells or a row by clicking in the top line.



Click on Set for all visible and enter the following parameters:

- Name of the well/group of wells
- Optionally: Description of the well/ group of wells

- Biomass of the test organisms in g
- Biomass density in g/mL
- Chamber volume in mL

Configure the other channels/ wells/ groups accordingly.

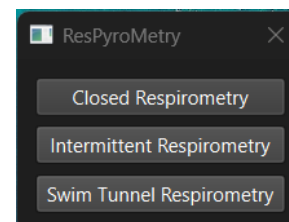
After completing the setup click. "Apply" to close the Settings window.

3.2 Intermittent Flow Respirometry

For intermittent flow or “stopped flow” respiration rate measurements, select "Intermittent Respirometry".

Here, the following needs to be configured:

- Data directory
- Experiment name
- Measurement protocol including
 - Flushing duration: fix flushing time
 - Waiting duration: fixed wait time before the measurement starts
 - Measurement duration: fix duration of each measurement
 - Sampling interval: time interval between the collected data points
 - Activate “Measure during flush and wait” if required and select the respective Sampling interval
 - If applicable, fix the number of cycles
 - If applicable, define a “Special initial cycle”



Settings

Experiment type: Stopped Flow

Logging

Select data directory C:/

Experiment name:

Experiment description:

Measurement Protocol

Flushing duration 60 s

Waiting duration 10 s

Measuring duration 120 s

Sampling interval 1.0 s

Measure during flush and wait

Sampling interval 5 s

Fixed Number of cycles

5

Special initial cycle

Use different timings for the first cycle

Flushing time 1 s

Waiting time 1 s

Measuring time 15 s

Please select an experiment name

Apply

After finishing the measurement protocol, connect the PyroScience Device (choose the correct COM port) and the Pump switch.

Now, enter the parameters of your chamber and organism:

- Name of chamber
- Optionally: Description
- Fish weight of the test organisms in g
- Fish density in g/mL
- Chamber volume in mL

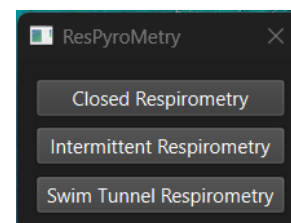
After completing the setup click: "Apply" to close the Settings window.

3.3 Swim Tunnel Respirometry

For swim tunnel respirometry, select "Swim Tunnel Respirometry".

Here, the following needs to be configured:

- Data directory
- Experiment name
- Measurement protocol including
 - Flushing duration: fix flushing time
 - Waiting duration: fixed wait time before the measurement starts
 - Measurement duration: fix duration of each measurement
 - Sampling interval: time interval between the collected data points
 - Activate "Measure during flush and wait" if required and select the respective Sampling interval
 - If applicable, fix the number of cycles
 - If applicable, define a "Special initial cycle"
 - Activate "Return to flush oxygen limit" and enter the respective Oxygen limit



The screenshot displays the 'Settings' window for a 'Swim tunnel' experiment. The 'Logging' section includes a 'Select data directory' button, an 'Experiment name' field, and an 'Experiment description' field. The 'Measurement Protocol' section is highlighted with a red rounded rectangle and contains the following settings:

- Flushing duration: 240 s
- Waiting duration: 60 s
- Measuring duration: 300 s
- Sampling interval: 10.0 s
- Measure during flush and wait
 - Sampling interval: 5 s
- Fixed Number of cycles
 - 5
- Special initial cycle
 - Use different timings for the first cycle
 - Flushing time: 1 s
 - Waiting time: 1 s
 - Measuring time: 15 s
- Return to flush oxygen limit
 - If the oxygen concentration is below this limit the cycle is finalized and the next cycle resumes with a flush.
 - Oxygen limit: 58.0 %airSat

Buttons for 'import' and 'export' are located below the 'Return to flush oxygen limit' section. An 'Apply' button is at the bottom of the window.

After finishing the measurement protocol, connect the PyroScience Device (choose the correct COM port), the Pump switch, "Cleware ADC", "MC1208 ADC" and a manual input, if applicable.

Hardware

| | | | | |
|--|-----------------|-----------------|----------------|-----------|
| PyroScience Device | COM4 | Disconnect | | |
| Pump switch | off | No device found | Connect | |
| <input checked="" type="radio"/> Cleware ADC | No device found | Connect | not calibrated | calibrate |
| <input type="radio"/> MCC1208 ADC | No device found | Connect | not calibrated | calibrate |
| <input type="radio"/> Manual input | manual input | not calibrated | calibrate | |

Now, enter the parameters of your chamber and organism:

- Name of chamber
- Optionally: Description
- Fish weight of the test organisms in g
- Fish density in g/mL
- Chamber volume in mL

Ch 0

active

Name

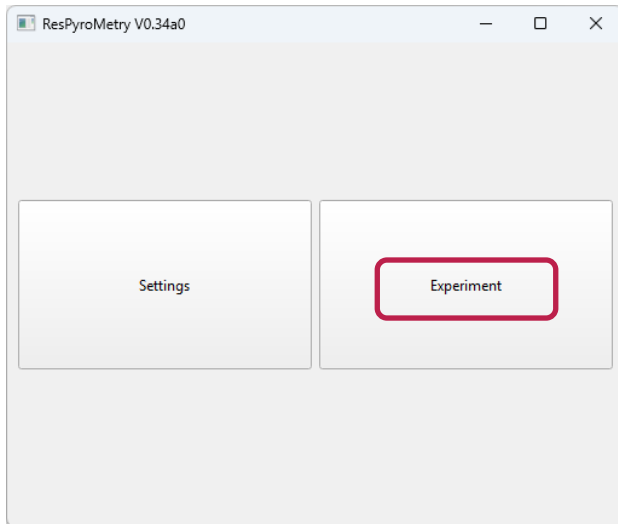
Description

| | |
|---|---|
| <p>Organism parameters</p> <p>Fish weight <input type="text" value="0.000 g"/></p> <p>Fish density <input type="text" value="1.00 g/mL"/></p> | <p>Chamber parameters</p> <p>Chamber volume <input type="text" value="0.000 mL"/></p> |
|---|---|

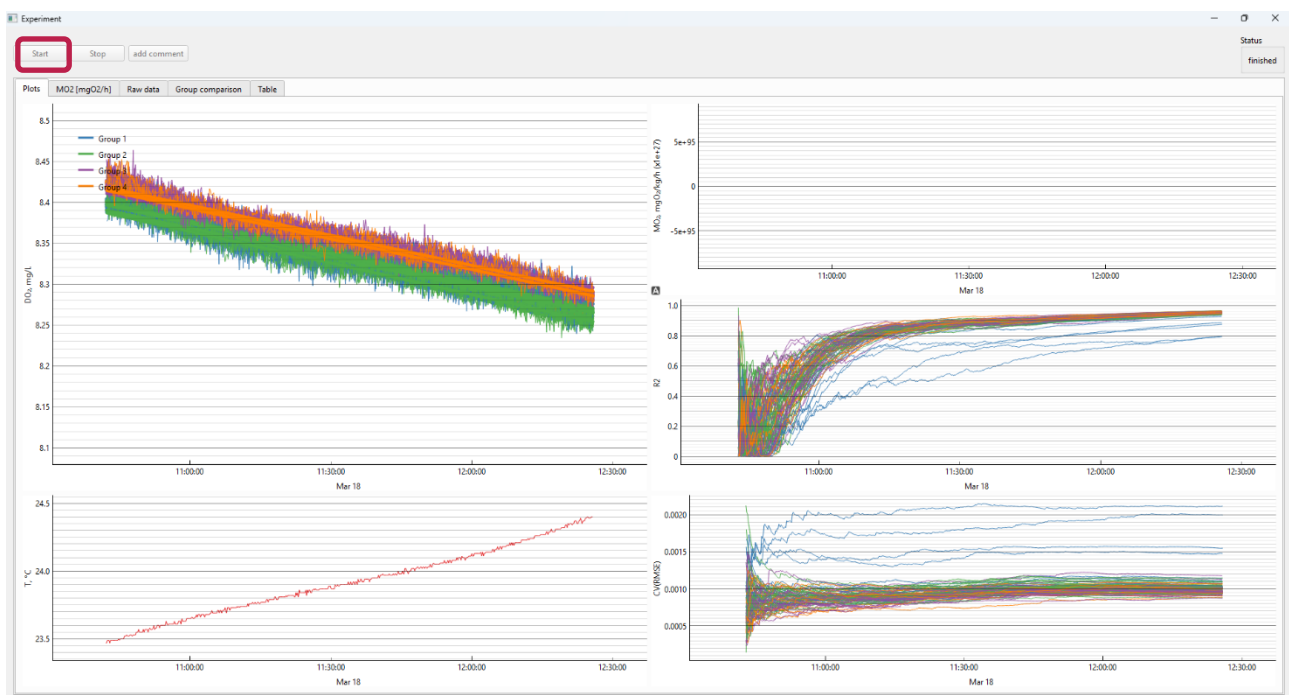
After completing the setup click. "Apply" to close the Settings window.

4 MEASUREMENTS WITH RESPYROMETRY

Click on "Experiment" to continue with the measurement.



The "Experiment" window opens. Click "start" when you are ready.



During the experiment the oxygen sensors are read out with the defined sampling interval and the respiration rate is fitted for each activated channel. R2 and CV(RMSE) as metrics for evaluating the quality of regression models.

The "Experiment" window will display the obtained data and aims to present you all necessary data to decide if the experiment is going well or if there is any problem.

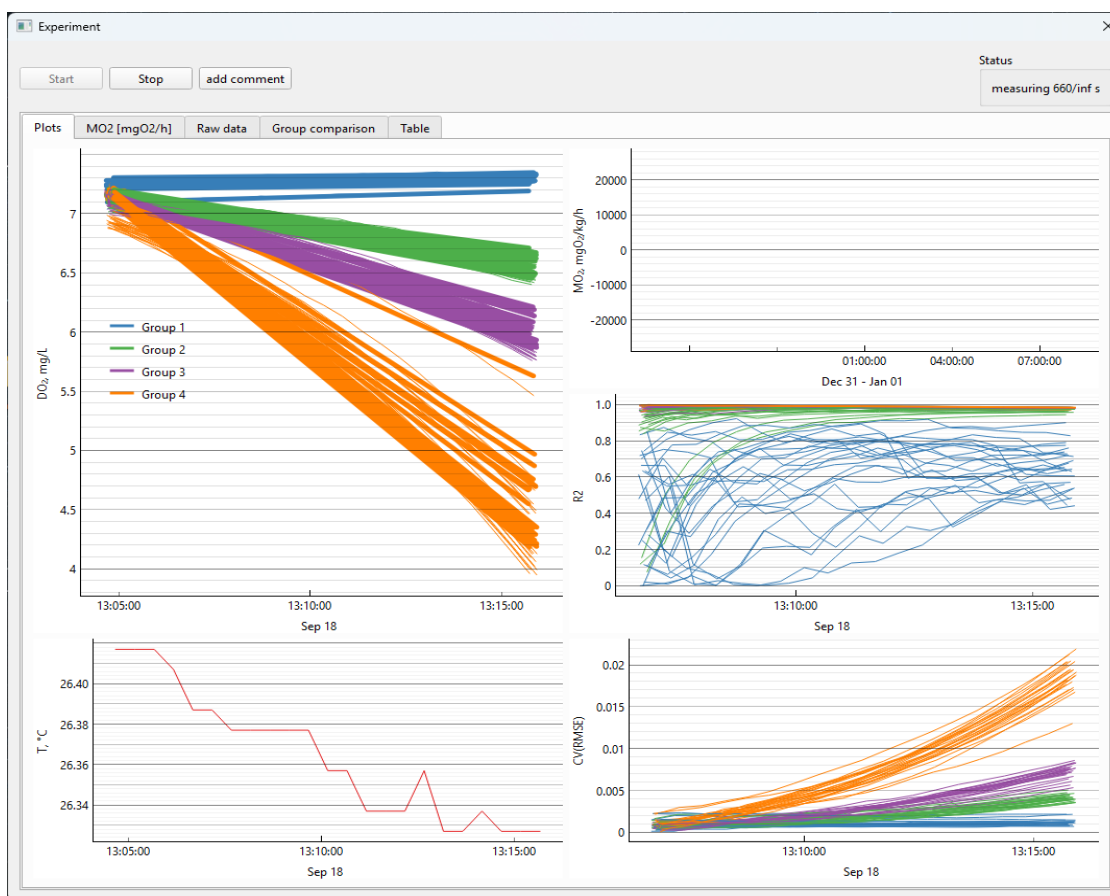
Press "Stop" to finish the experiment when enough data was collected. Stopping might take some time. Please be patient.

The "add comment" button allows you to add a note with timestamp to the experiment.

4.1 Displayed data

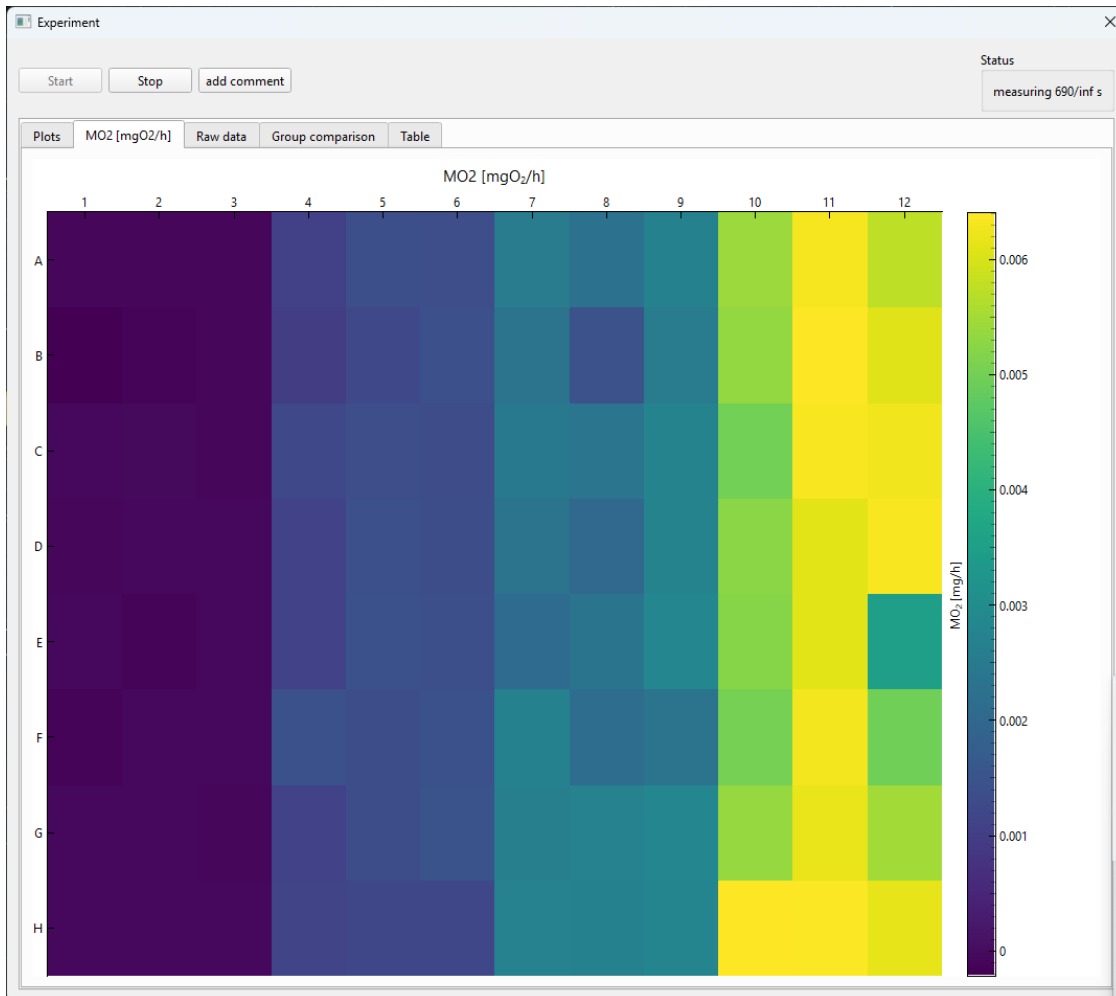
Overview-Page

This page presents you the measured DO-values (mg/L, fit-curves for respiration calculation (MO₂), temperature data and R2 and CV(RMSE) to assess the quality of the fit.



Respiration Heatmap

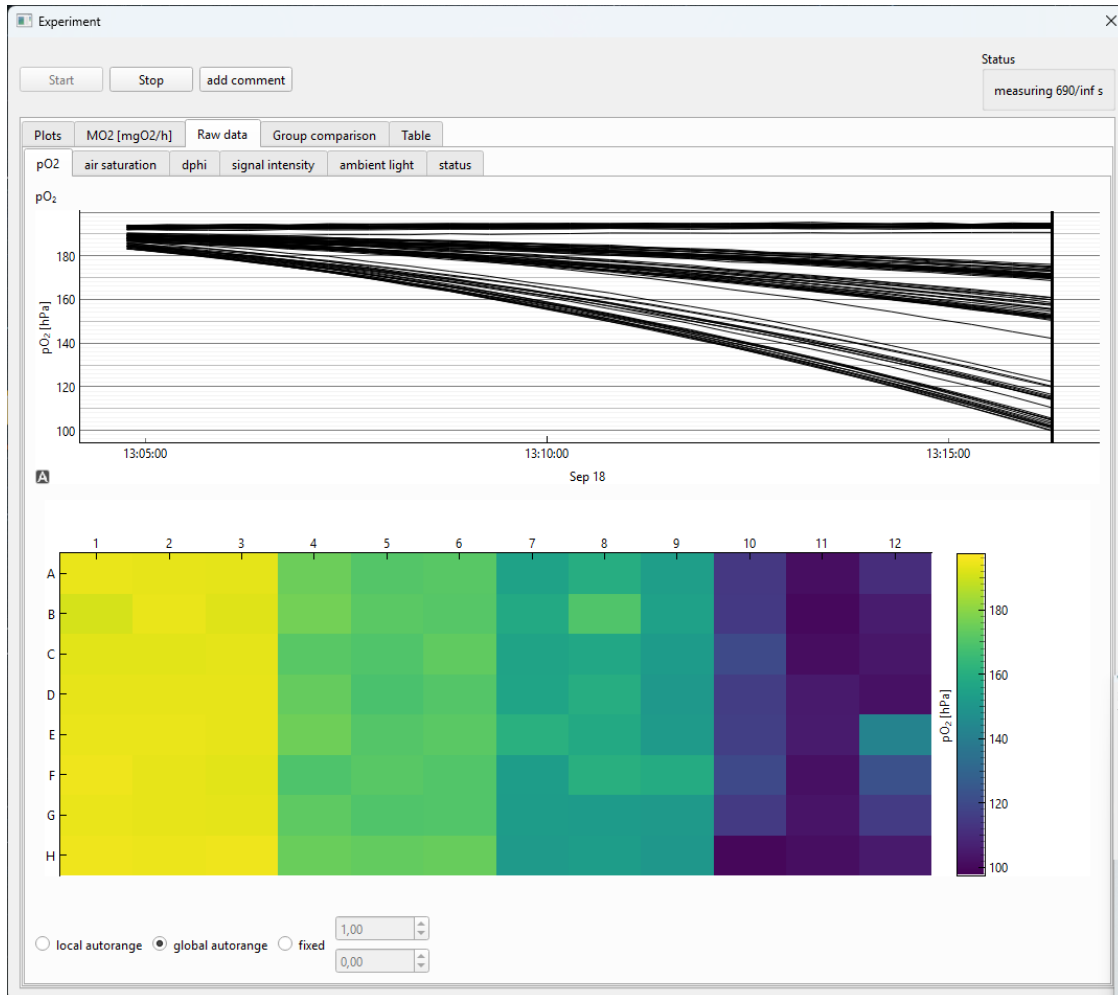
For measurements in microplates with the **FirePlate-O₂**, a heatmap gives an overview over the entire area of the MWP. The heatmap shows the respiration rate in the wells with a color code that adapts automatically to the measured oxygen concentrations.



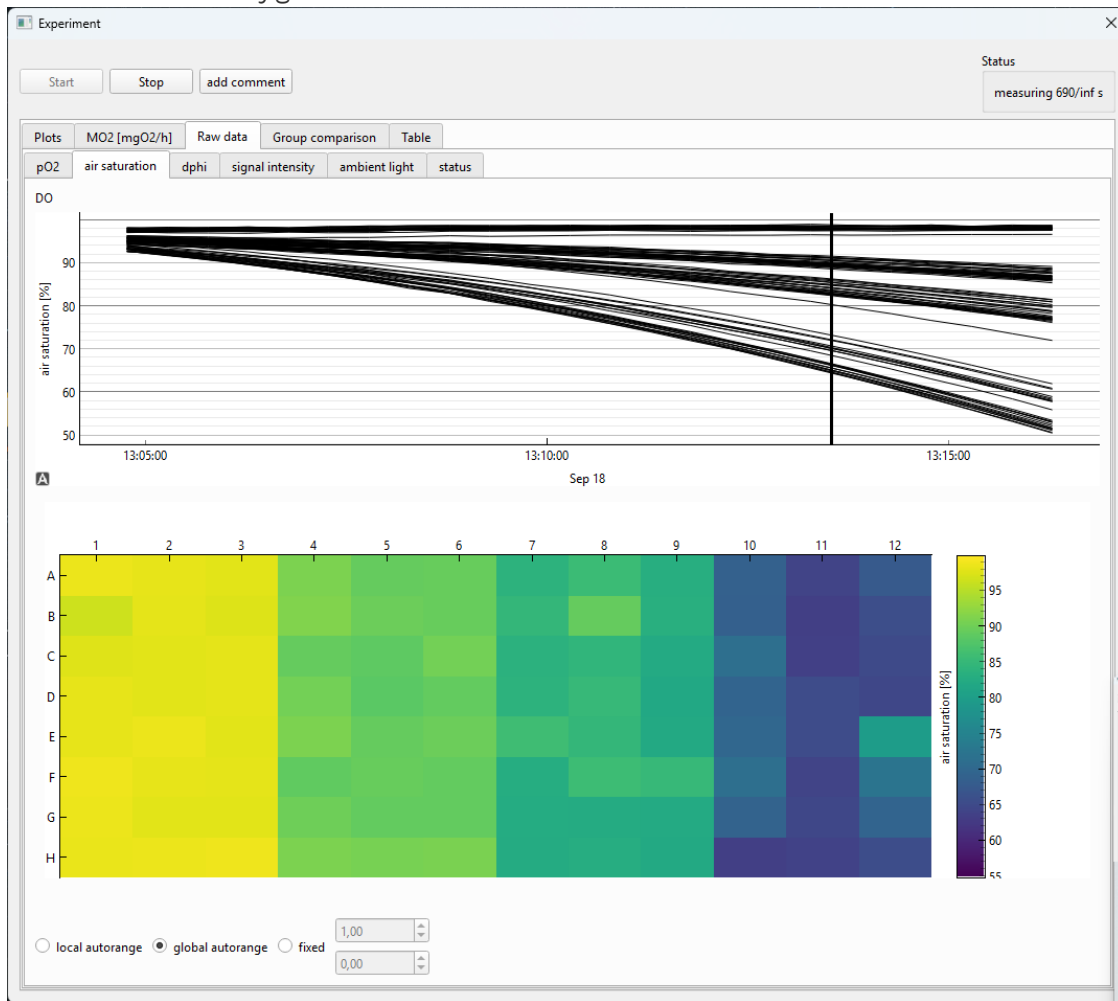
Raw-data

In this tab the raw measurement data is displayed in detail. This is especially useful for trouble shooting of measurements.

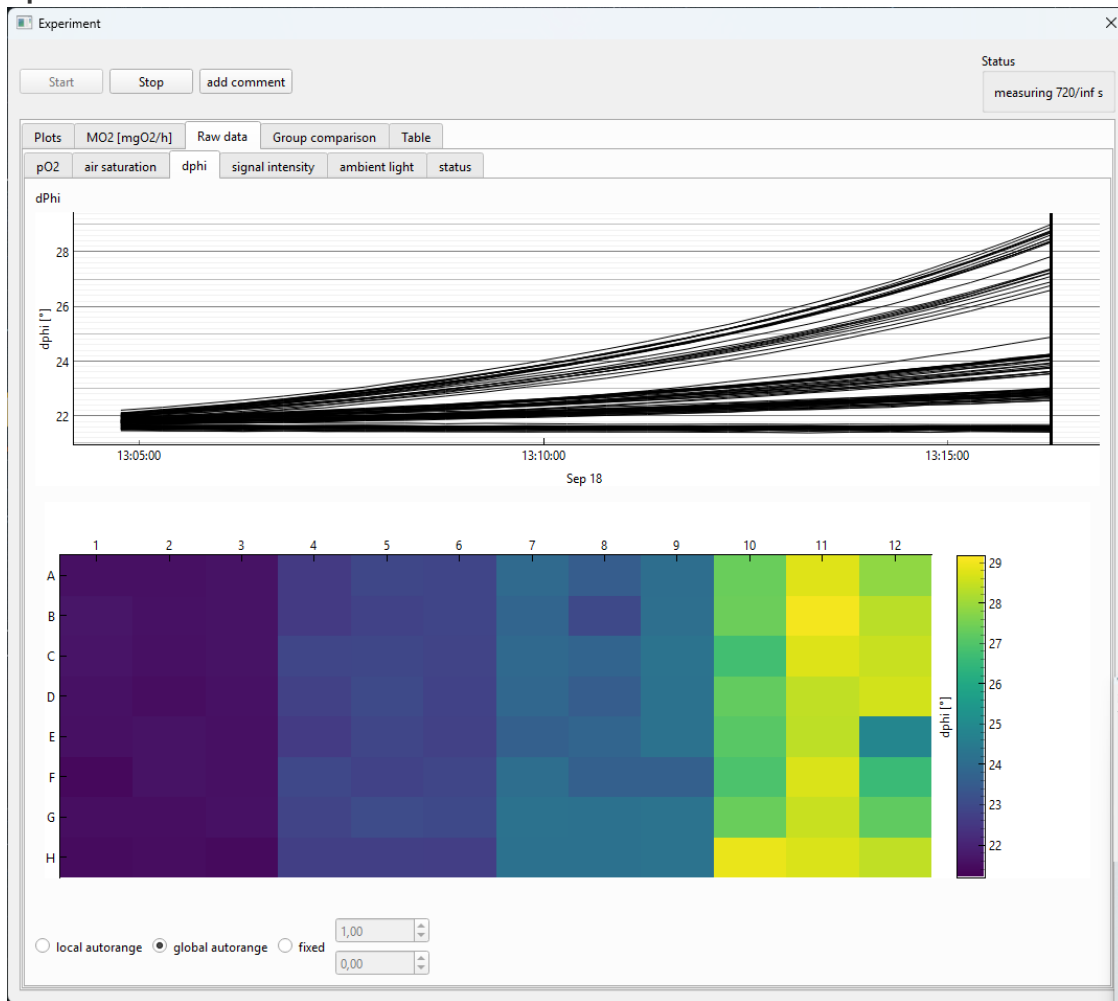
1. **pO₂**: Primary measurement value of the oxygen sensor for each channel



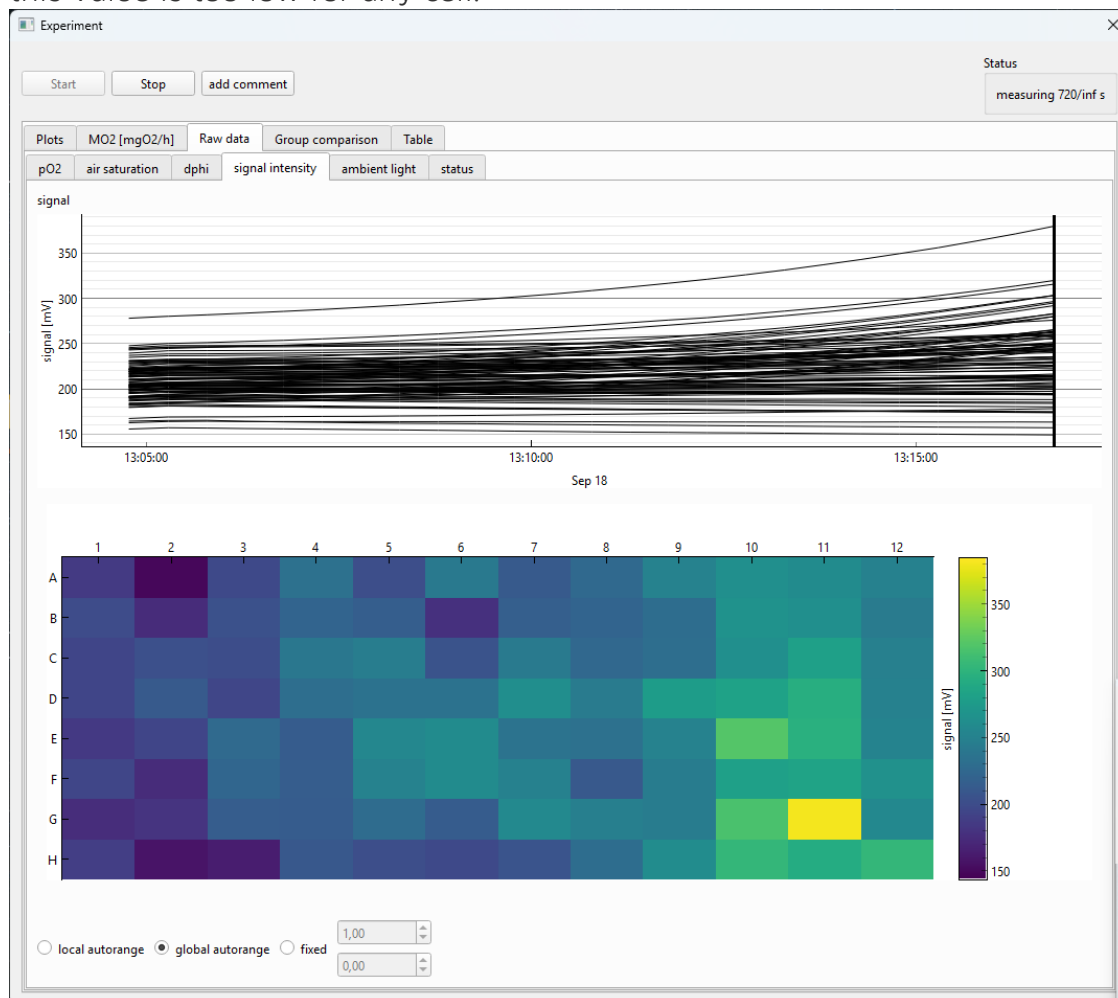
2. **air saturation:** oxygen saturation in %air saturation in the channels



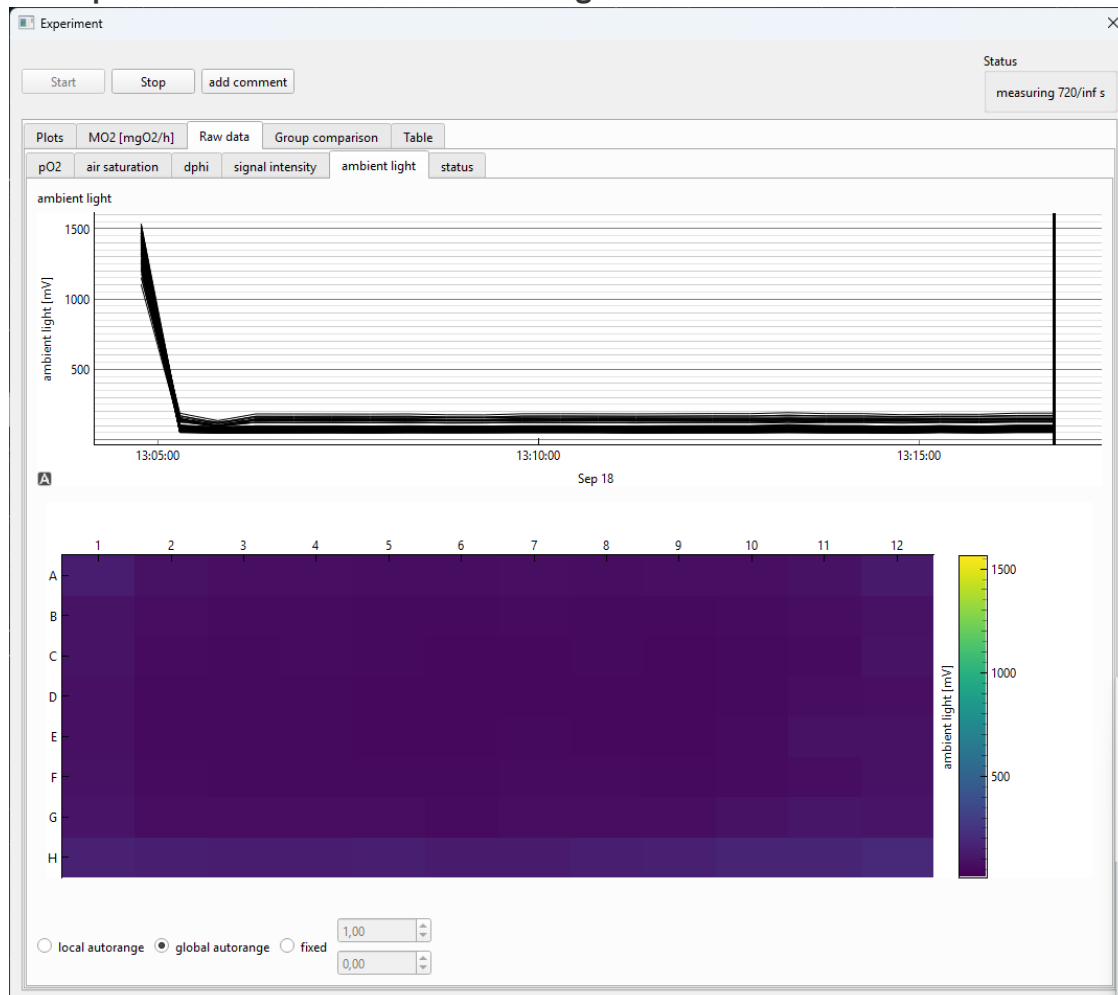
3. **dphi**: raw-value of the measurements of each channel



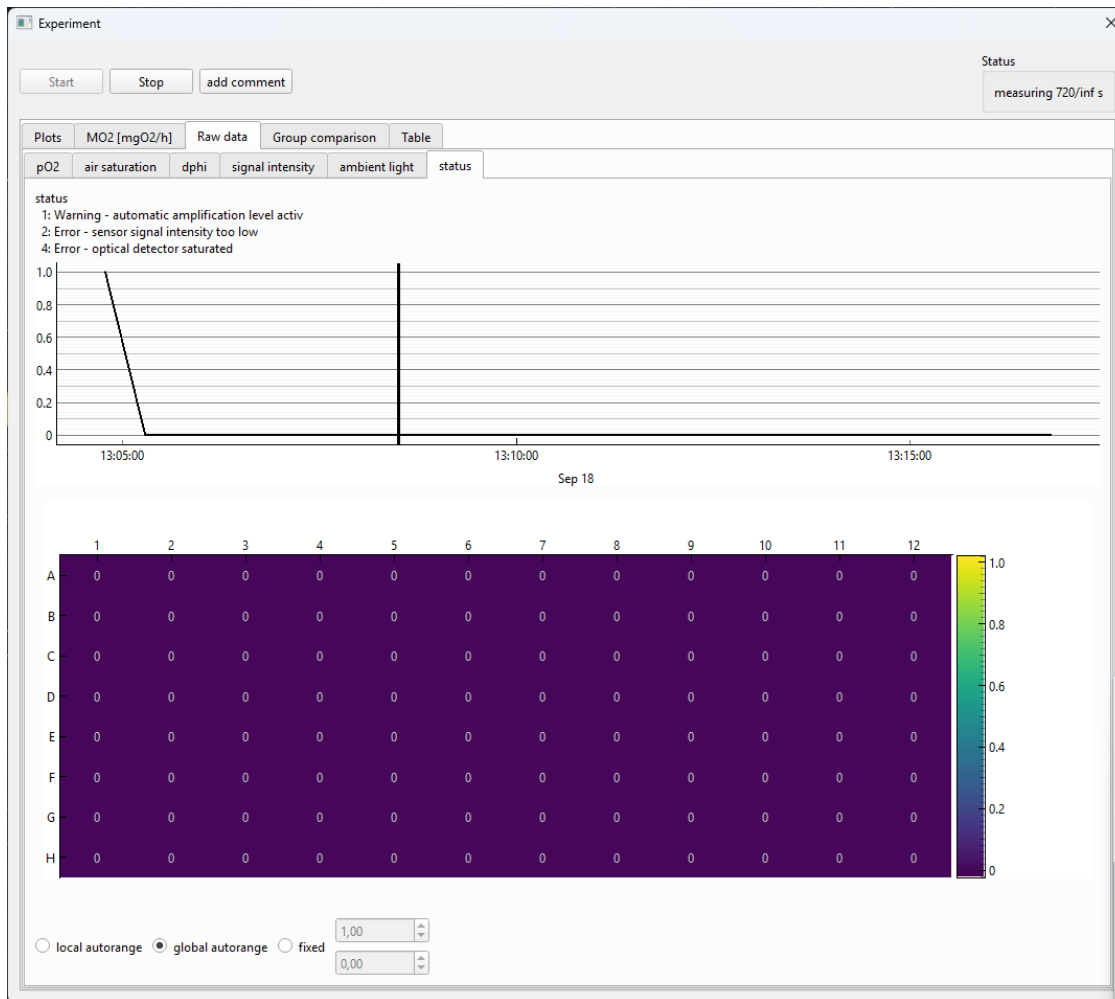
4. **signal intensity**: signal values in mV of each channel. Every channel must have a signal > 50 mV. In case of microplates, check the alignment or the sensor spot if this value is too low for any cell.



5. **ambient light:** Measures the ambient light detected in each channel. Typical lab lighting is usually tolerated by the device, but some lamps can interfere with the measurement. Direct sunlight can also interfere with the measurement, especially in case of sensors without optical isolation like **OXMWP** or **OXNANO**. **Cover the microplates to shield it from ambient light for best results.**



6. **status:** shows the typical problems or errors which can occur during a measurement.
- **automatic amplification level active** indicates that the device must adjust the amplification to avoid oversaturation of the detector. This typically leads to an offset in the calibration. Shield the device from ambient light or adjust the settings in Pyro Workbench.
 - **sensor signal too low:** the device cannot collect enough signal from a channel. In case of microplates, please check the adjustment of the MWP on the **FirePlate-O₂**, or if the sensor spot is missing/damaged. In case of oxygen sensor spots, please check if the fiber is in the correct position and in close contact with the wall. It is also possible to adjust the settings in **Pyro Workbench** (led intensity or amplification).
 - **optical detector saturated:** move the device out of the sun or add a cover.

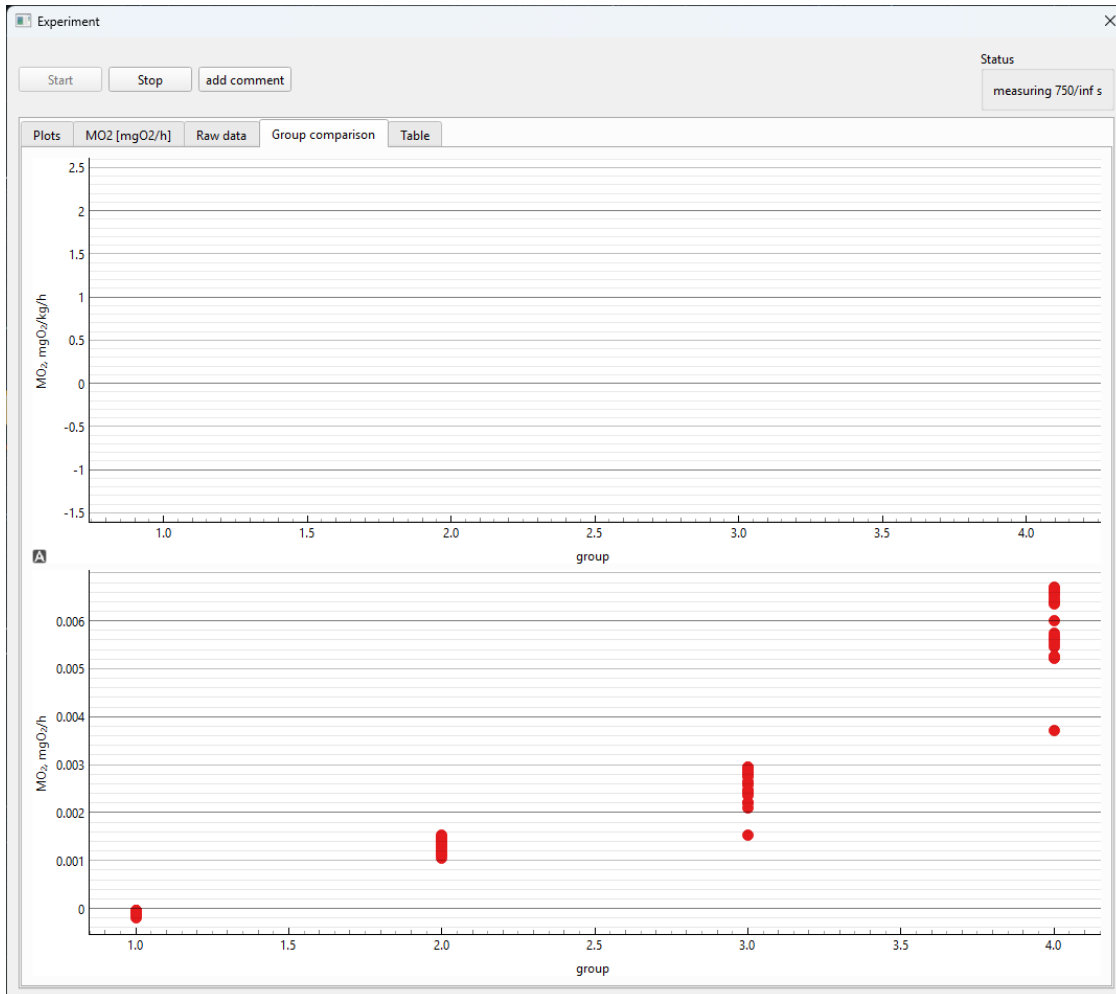


Hovering over a cell in the heatmap will highlight the trace in the plot above to allow easy location of interesting traces. (Clicking will fix this selection. Double click to remove the selection.)

The vertical bar in the chart can be moved to display the heatmap for previous data.

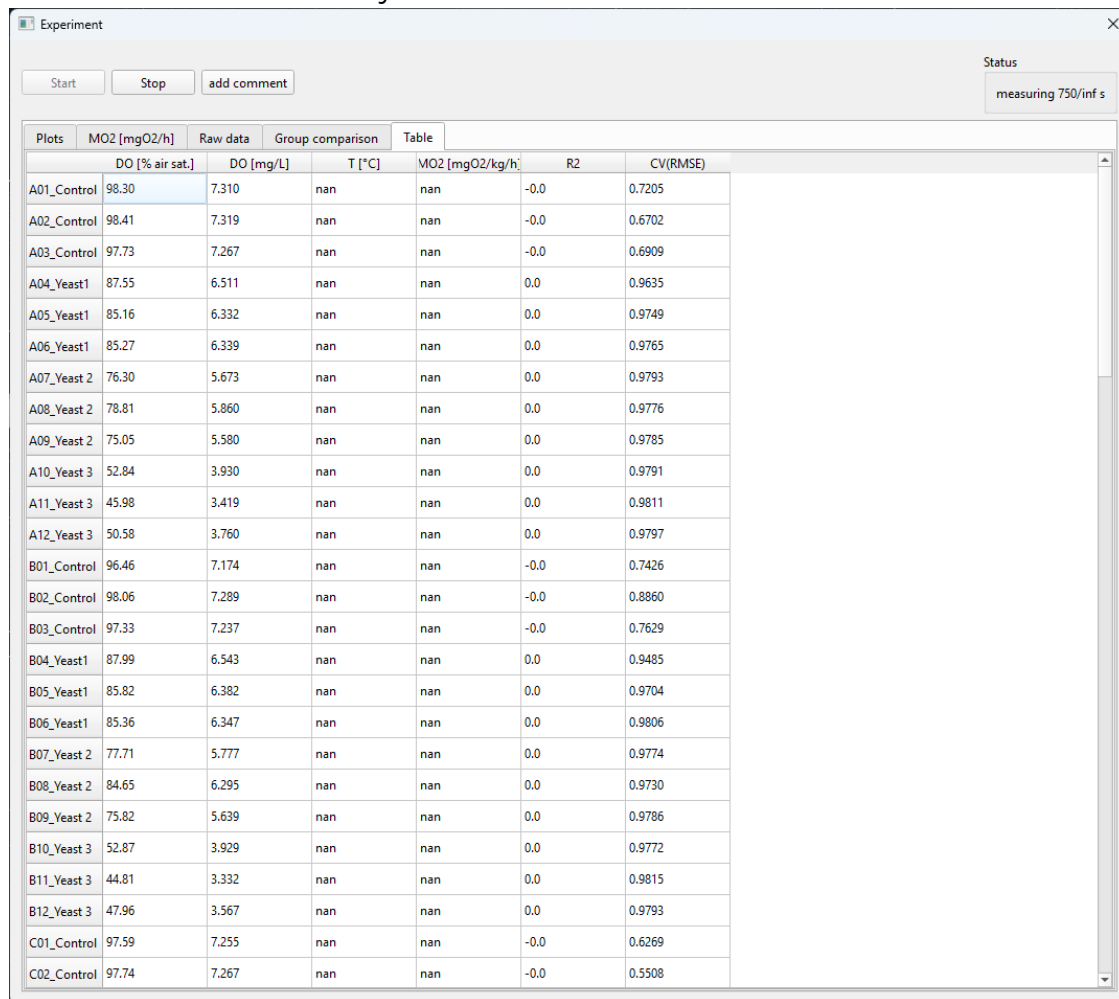
Group comparison

If multiple groups are defined for the MWP, the groups respiration data is plotted here.



Table

Current values for every activated channel.



The screenshot shows the 'Experiment' window with a 'Status' indicator 'measuring 750/inf s'. Below the status bar are buttons for 'Start', 'Stop', and 'add comment'. The main area contains a table with the following data:

| | DO [% air sat.] | DO [mg/L] | T [°C] | MO2 [mgO2/kg/h] | R2 | CV(RMSE) |
|-------------|-----------------|-----------|--------|-----------------|------|----------|
| A01_Control | 98.30 | 7.310 | nan | nan | -0.0 | 0.7205 |
| A02_Control | 98.41 | 7.319 | nan | nan | -0.0 | 0.6702 |
| A03_Control | 97.73 | 7.267 | nan | nan | -0.0 | 0.6909 |
| A04_Yeast1 | 87.55 | 6.511 | nan | nan | 0.0 | 0.9635 |
| A05_Yeast1 | 85.16 | 6.332 | nan | nan | 0.0 | 0.9749 |
| A06_Yeast1 | 85.27 | 6.339 | nan | nan | 0.0 | 0.9765 |
| A07_Yeast 2 | 76.30 | 5.673 | nan | nan | 0.0 | 0.9793 |
| A08_Yeast 2 | 78.81 | 5.860 | nan | nan | 0.0 | 0.9776 |
| A09_Yeast 2 | 75.05 | 5.580 | nan | nan | 0.0 | 0.9785 |
| A10_Yeast 3 | 52.84 | 3.930 | nan | nan | 0.0 | 0.9791 |
| A11_Yeast 3 | 45.98 | 3.419 | nan | nan | 0.0 | 0.9811 |
| A12_Yeast 3 | 50.58 | 3.760 | nan | nan | 0.0 | 0.9797 |
| B01_Control | 96.46 | 7.174 | nan | nan | -0.0 | 0.7426 |
| B02_Control | 98.06 | 7.289 | nan | nan | -0.0 | 0.8860 |
| B03_Control | 97.33 | 7.237 | nan | nan | -0.0 | 0.7629 |
| B04_Yeast1 | 87.99 | 6.543 | nan | nan | 0.0 | 0.9485 |
| B05_Yeast1 | 85.82 | 6.382 | nan | nan | 0.0 | 0.9704 |
| B06_Yeast1 | 85.36 | 6.347 | nan | nan | 0.0 | 0.9806 |
| B07_Yeast 2 | 77.71 | 5.777 | nan | nan | 0.0 | 0.9774 |
| B08_Yeast 2 | 84.65 | 6.295 | nan | nan | 0.0 | 0.9730 |
| B09_Yeast 2 | 75.82 | 5.639 | nan | nan | 0.0 | 0.9786 |
| B10_Yeast 3 | 52.87 | 3.929 | nan | nan | 0.0 | 0.9772 |
| B11_Yeast 3 | 44.81 | 3.332 | nan | nan | 0.0 | 0.9815 |
| B12_Yeast 3 | 47.96 | 3.567 | nan | nan | 0.0 | 0.9793 |
| C01_Control | 97.59 | 7.255 | nan | nan | -0.0 | 0.6269 |
| C02_Control | 97.74 | 7.267 | nan | nan | -0.0 | 0.5508 |

5 LOGGED DATA

Data is stored in the directory selected at the beginning of the setup.

The most important file in this directory is **"overview.csv"**. This file contains the final fitted respiration rates and other useful information on every channel.

| channel | cycle | start_time | initial_DO | %airsat | final_DO | %airsat | mean_temperature | respiration_mg/kg/h | respiration_mg/h | r2 | cv_rmse |
|---------|-------------|----------------------|------------|---------|------------------|---------|------------------|---------------------|-----------------------|--------------------|---------------------|
| 1 | A01_Control | 02025-09-18 13:04:40 | 97.899 | 98.332 | 26.3532857142857 | nan | | | -3.98683764033142E-05 | 0.498876533711406 | 0.00115142887534842 |
| 2 | A02_Control | 02025-09-18 13:04:40 | 97.935 | 98.259 | 26.351 | nan | | | -0.000108087988031086 | 0.808147708302997 | 0.0015220285195207 |
| 3 | A03_Control | 02025-09-18 13:04:40 | 97.08 | 97.764 | 26.3564285714286 | nan | | | -5.11760503689309E-05 | 0.643341373130946 | 0.0011050364739166 |
| 4 | A04_Yeast1 | 02025-09-18 13:04:40 | 95.471 | 82.094 | 26.355514285714 | nan | | | 0.00142300015674398 | 0.962826416652821 | 0.0087469454257239 |
| 5 | A05_Yeast1 | 02025-09-18 13:04:40 | 95.618 | 78.763 | 26.3535714285714 | nan | | | 0.00177697877298213 | 0.972067535249028 | 0.00960539790766102 |
| 6 | A06_Yeast1 | 02025-09-18 13:04:40 | 95.663 | 79.187 | 26.3558571428571 | nan | | | 0.00174134307204798 | 0.97456213858455 | 0.00894309859796036 |
| 7 | A07_Yeast2 | 02025-09-18 13:04:40 | 95.088 | 64.796 | 26.3552857142857 | nan | | | 0.00319772301653786 | 0.974842561320213 | 0.017523577697368 |
| 8 | A08_Yeast2 | 02025-09-18 13:04:41 | 95.609 | 67.86 | 26.3541428571429 | nan | | | 0.00289947946667993 | 0.971689231186092 | 0.0165353884552306 |
| 9 | A09_Yeast2 | 02025-09-18 13:04:41 | 95.25 | 62.69 | 26.3558571428571 | nan | | | 0.00343172814558717 | 0.973479447824008 | 0.0195003225441048 |
| 10 | A10_Yeast3 | 02025-09-18 13:04:41 | 93.352 | 27.2 | 26.355 | nan | | | 0.00693063962034904 | 0.973414678384205 | 0.0483633271722895 |
| 11 | A11_Yeast3 | 02025-09-18 13:04:41 | 93.023 | 17.083 | 26.3555714285714 | nan | | | 0.00796052564212532 | 0.976350737310934 | 0.0562386560510875 |
| 12 | A12_Yeast3 | 02025-09-18 13:04:41 | 94.015 | 23.84 | 26.3558571428571 | nan | | | 0.00734605898610271 | 0.973991176892898 | 0.051719635230016 |
| 13 | B01_Control | 02025-09-18 13:04:41 | 94.682 | 96.458 | 26.3558571428571 | nan | | | -0.000103562536247163 | 0.566398591534456 | 0.00266548510270339 |
| 14 | B02_Control | 02025-09-18 13:04:41 | 97.161 | 98.018 | 26.3552857142857 | nan | | | -8.34127716281148E-05 | 0.7487653656973 | 0.00139742893007229 |
| 15 | B03_Control | 02025-09-18 13:04:41 | 97.168 | 97.446 | 26.3581428571429 | nan | | | -4.94913771811448E-05 | 0.610345440528403 | 0.00115034566682201 |
| 16 | B04_Yeast1 | 02025-09-18 13:04:42 | 95.255 | 82.672 | 26.3535714285714 | nan | | | 0.00136281972032569 | 0.954729408130471 | 0.00925108127214551 |
| 17 | B05_Yeast1 | 02025-09-18 13:04:42 | 94.901 | 80.012 | 26.3538571428571 | nan | | | 0.00159743480663023 | 0.969756724711072 | 0.00895028627671769 |
| 18 | B06_Yeast1 | 02025-09-18 13:04:42 | 95.93 | 79.109 | 26.3532857142857 | nan | | | 0.00175802487773011 | 0.976740454523503 | 0.00862542945672798 |
| 19 | B07_Yeast2 | 02025-09-18 13:04:42 | 94.991 | 66.886 | 26.3594285714286 | nan | | | 0.00295933393295134 | 0.9727771233806 | 0.0167206763801189 |
| 20 | B08_Yeast2 | 02025-09-18 13:04:42 | 95.781 | 77.402 | 26.357514285714 | nan | | | 0.001919311575504424 | 0.96722587311138 | 0.0112872172435338 |
| 21 | B09_Yeast2 | 02025-09-18 13:04:42 | 94.718 | 64.194 | 26.3527142857143 | nan | | | 0.0032243402808581 | 0.974595673324778 | 0.0178518974048718 |
| 22 | B10_Yeast3 | 02025-09-18 13:04:42 | 92.492 | 27.299 | 26.3527142857143 | nan | | | 0.00685953426012255 | 0.972179131427892 | 0.0490329708360965 |
| 23 | B11_Yeast3 | 02025-09-18 13:04:43 | 92.636 | 15.568 | 26.3575714285714 | nan | | | 0.00809780560864626 | 0.97564353945184 | 0.0588728461842486 |
| 24 | B12_Yeast3 | 02025-09-18 13:04:43 | 93.124 | 19.761 | 26.3541428571429 | nan | | | 0.00773043447947806 | 0.974490505676012 | 0.0554591561066707 |
| 25 | C01_Control | 02025-09-18 13:04:43 | 96.954 | 97.585 | 26.3552857142857 | nan | | | -3.87491801278388E-05 | 0.469584682369755 | 0.00119542830679955 |
| 26 | C02_Control | 02025-09-18 13:04:43 | 97.354 | 97.524 | 26.3581428571429 | nan | | | -2.59721591496398E-05 | 0.303959000436933 | 0.00113964789101857 |
| 27 | C03_Control | 02025-09-18 13:04:43 | 97.133 | 97.629 | 26.3587142857143 | nan | | | -4.06294224739633E-05 | 0.441914019759432 | 0.00132991105266722 |
| 28 | C04_Yeast1 | 02025-09-18 13:04:43 | 94.425 | 78.588 | 26.3558571428571 | nan | | | 0.00161757742121941 | 0.967171381038848 | 0.0094802532292704 |
| 29 | C05_Yeast1 | 02025-09-18 13:04:43 | 94.853 | 78.455 | 26.3561428571429 | nan | | | 0.0017121530885622 | 0.974727086950459 | 0.00884604018317041 |
| 30 | C06_Yeast1 | 02025-09-18 13:04:44 | 96.204 | 80.105 | 26.3535714285714 | nan | | | 0.00170887536793809 | 0.972113895152248 | 0.0091972898766016 |
| 31 | C07_Yeast2 | 02025-09-18 13:04:44 | 94.954 | 64.907 | 26.3567142857143 | nan | | | 0.00316197440961525 | 0.973421534755119 | 0.017824585974398 |
| 32 | C08_Yeast2 | 02025-09-18 13:04:44 | 95.1 | 67.023 | 26.357 | nan | | | 0.00295991063723193 | 0.97748317473743 | 0.0151777041658904 |
| 33 | C09_Yeast2 | 02025-09-18 13:04:44 | 95.086 | 62.234 | 26.3558571428571 | nan | | | 0.00345750670061872 | 0.977372992642431 | 0.0182362636447821 |
| 34 | C10_Yeast3 | 02025-09-18 13:04:44 | 93.881 | 31.73 | 26.3564285714286 | nan | | | 0.00652791361897544 | 0.9700073065411651 | 0.0467851211144961 |
| 35 | C11_Yeast3 | 02025-09-18 13:04:44 | 92.623 | 17.359 | 26.3584285714286 | nan | | | 0.00791880349622329 | 0.977856347333592 | 0.0543857148109126 |

The raw measurement data of every channel can be found in the directory **"cycle data/cycle_000"**.

"firesting_setup.json" contains the setup and calibration of the FirePlate-O₂ or FireSting meter.

"settings.txt" contains the setup of your experiment.

6 GENERAL NOTES

Note: Disable Windows updates if you plan to run a long experiment.

RELATED DOCUMENTS

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

- manual for **FireSting-O2**, **FireSting-PRO** or **FirePlate-O2** meter
- manual for logger software "**Pyro Workbench & Data Inspector**" (Windows)
- manual for optical oxygen and temperature sensors from **PyroScience**

7 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!

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 examinations 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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