

Instruction Manual

SDR

SensorDish[®] Reader

**24-Channel Reader for Online-Monitoring of
pH and Oxygen**

Instruction Manual

SDR SensorDish[®] Reader

24-Channel Reader for Online-Monitoring of pH and Oxygen

Software version SDR_v37

PreSens Precision Sensing GmbH
Josef-Engert-Strasse 11
93053 Regensburg
Germany

Phone +49 941 942 72 100
Fax +49 941 942 72 111
Email info@PreSens.de
Internet www.PreSens.de

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1 Preface

The **SDR SensorDish® Reader** is an innovative system for measuring oxygen or pH in 24-well multidishes with integrated sensors (SensorDish®). One instrument is capable of determining both oxygen and pH, depending on the SensorDish® which is used: The OxoDish® contains an oxygen sensor at the bottom of each well, the HydroDish® a pH sensor. The SensorDish® Reader enables continuous monitoring of these parameters during cultivation of cells or bacteria in the incubator. It is an ideal tool for developing assays in the 24-well format as well as optimising culture conditions. Up to 10 SensorDish® Readers can be connected to one PC / Notebook and monitored simultaneously using one software.

About this manual

The following symbols and conventions are used in this manual:

BOLD Used for available menu, command and button selections

 Helpful information about a particular topic

! *Important information*

2 Safety Guidelines

**PLEASE READ THESE INSTRUCTIONS CAREFULLY
BEFORE WORKING WITH THIS INSTRUMENT.**

- ! The SensorDish® Reader must not be opened.*
- ! The SensorDish® Reader may only be operated by qualified personal.*

Any modification or repair must be carried out or authorised by PreSens and performed with ESD protection.

This instrument was developed for use in the laboratory. Thus, we must assume that, as a result of their professional training and experience, the operators will know the necessary safety precautions to take when handling chemicals.

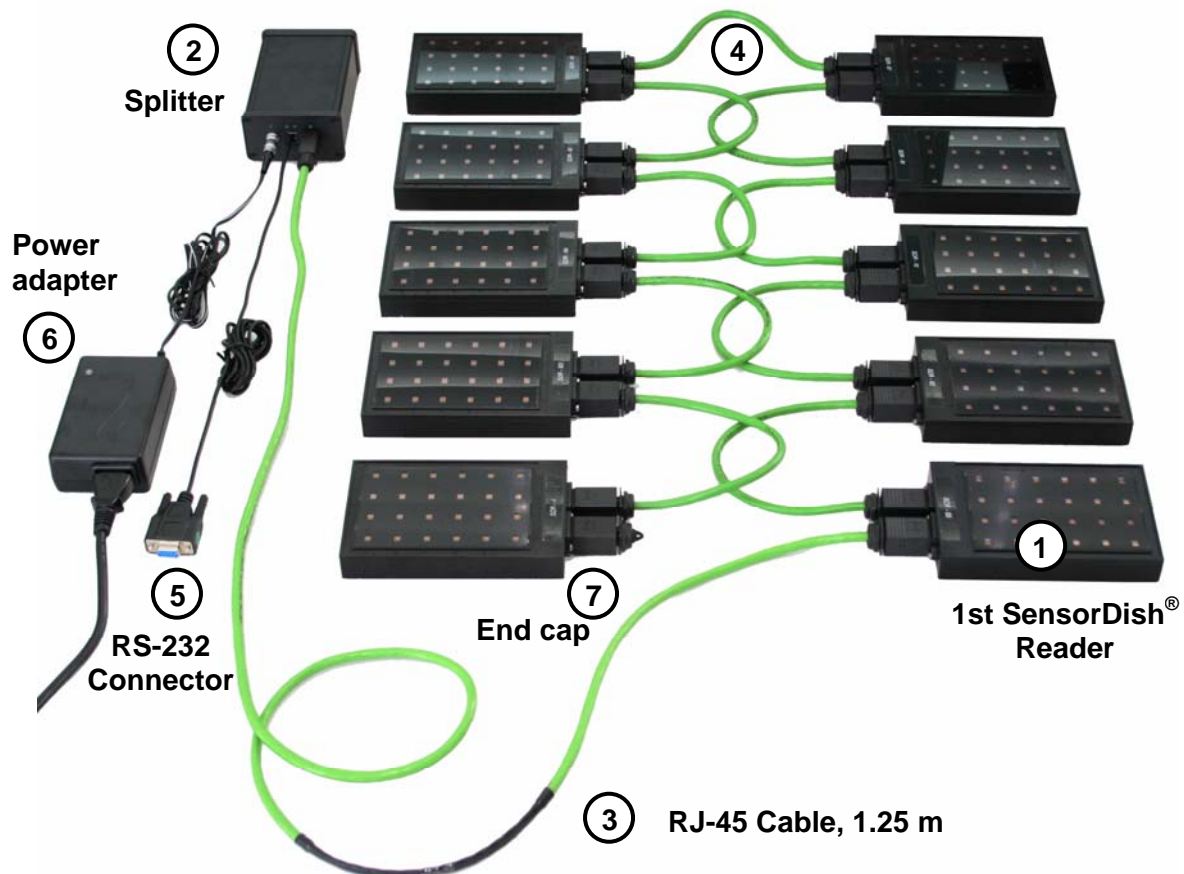
Keep the SensorDish® Reader and the equipment such as power supply and SensorDishes® out of the reach of children.

The SensorDish® Reader and the SensorDishes® must not be used for human-diagnostic or therapeutic purposes.

3 Description of the SensorDish® Reader

For operation, the SensorDish® Reader must be connected to a PC/Notebook with RS-232 interface. A USB-to-serial converter can be used if the PC / notebook is not equipped with an RS-232 com port. The SensorDish® Reader is controlled by a user-friendly software which also stores and visualises the measured data.

Up to 10 SensorDish® Readers can be combined in parallel to a multi-instrument set-up. A splitter is connected to the first SensorDish® Reader via an RJ-45 cable (1.25 m), to the PC via an RS-232 cable, and via the power adapter 24V to a suited power supply (100 – 240 V). Subsequent SensorDish® Readers are joined in series by RJ-45 cables (0.25 m).



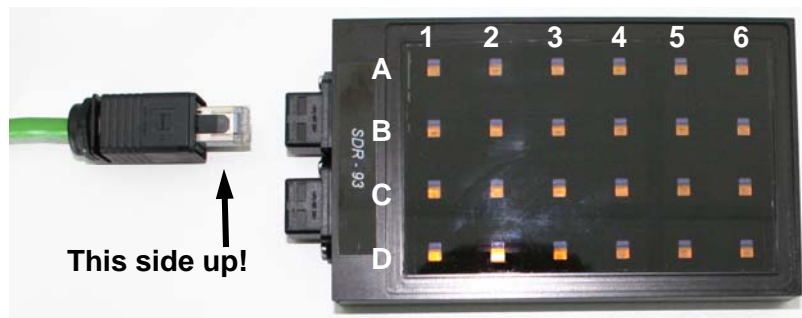
No.	DESCRIPTION	FUNCTION
1	SensorDish® Reader (SDR)	The SensorDish® Reader is placed below the SensorDish® in the incubator. The SensorDish® Reader and its connectors are waterproof (see <i>Technical Data, chapter 12</i>).
2	Splitter (SP)	Contains the power supply and controls the SensorDish® Readers. The splitter must NOT be run at high humidity. It is not waterproof. It has to be placed outside the incubator.
3	RJ-45 Connector cable SDR to SP	This cable connects the first SensorDish® Reader and the splitter; length 1.25 m. Its flat part can be clamped between the gaskets of the incubator door, if no cable penetration is available.
4	RJ-45 Connector cable SDR to SDR	These cables connect subsequent SensorDish® Readers; length 0.25 m

5	RS-232 Interface cable (male)	Connects the splitter and serial communication port of the PC/Notebook.
6	Power supply	18 - 24 V DC power supply.
7	Network terminator	End-cap for closing the second connector of the last SensorDish® Reader in the row. Without this end-cap, the SensorDish® Reader is not water-proof!

3.1 SensorDish® Reader

The SensorDish® Reader measures dissolved oxygen or pH of samples in an OxoDish® or HydroDish®, respectively. It has 24 channels and two RJ-45 plugs for data transfer and power supply. These plugs connect the first SensorDish® Reader to the splitter and subsequent SensorDish® Readers. Both plugs can be used equally. The cable is scope of supply.

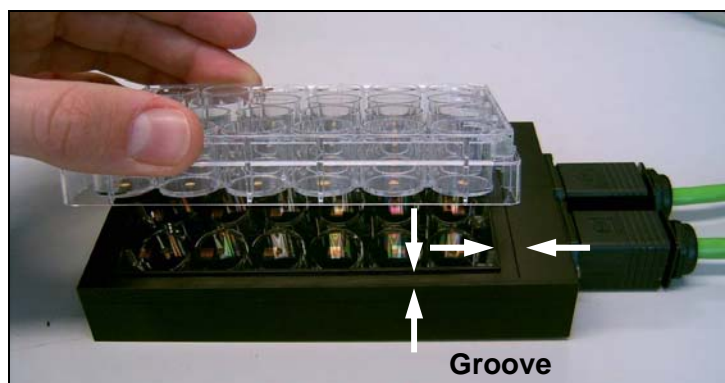
! Do not use other cables than the supplied ones!



Top view of the SensorDish® Reader. The well numeration A1 to D6 is engraved in the groove.

The SensorDish® is easily placed in the right position due to a groove in the housing of the SensorDish® Reader (see picture below).

! Please be sure that the SensorDish® rests in the groove properly, otherwise, the measurement signal will not be sufficient, which results in a bad resolution or even the message "NO SENSOR"!

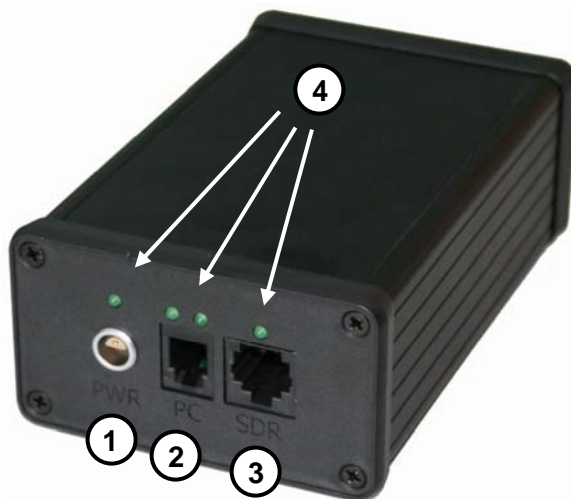


Placing a SensorDish® on the SensorDish® Reader. Please make sure that the SensorDish® rests into the grooves properly.

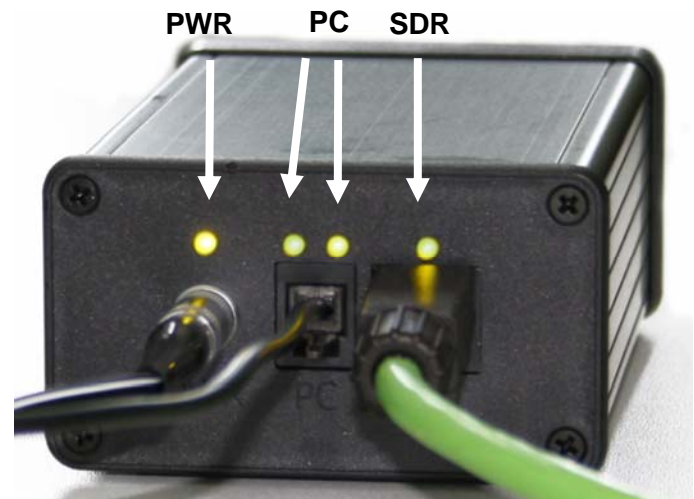
3.2 Splitter

There are three plugs on the splitter's front panel: Power supply (PWR), RS-232 connection (PC) and the connector for the first SensorDish® Reader (SDR), as well as four status LEDs.

The LED for power supply glows if the splitter is connected to power. The LEDs for connection to the PC are illuminated during data transfer from the splitter to the PC or vice versa. The LED regarding the connection to the SensorDish® Reader only glows at connection via the software and at measurement points.



Front panel of the splitter.



Control LEDs.

ELEMENT	DESCRIPTION	FUNCTION
1	Line adapter for power supply	Connector for 18-24V DC power supply (scope of supply).
2	RS-232 interface (RJ11)	Connects the device with an RS-232 data cable to your PC/Notebook (scope of supply).
3	Device connector (RJ-45)	Connects the splitter with the first SensorDish® Reader via RJ-45 (scope of supply).
4	Control LEDs	Show connection or data transfer. The LEDs are turned on or pulse green in case of an active line. LED functions: PWR – line power indicator PC – indicates communication in progress SDR – network/ SensorDish® Reader power indicator

4 Required Basic Equipment

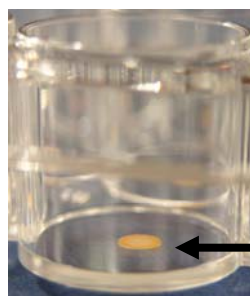
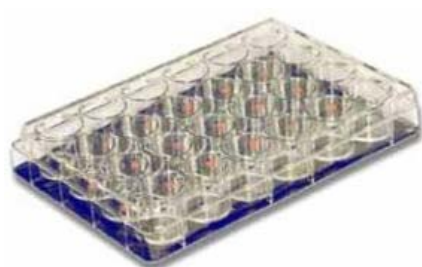
- Splitter v1.1 or higher*
- SensorDish® Reader * v3 or higher (parallel connection of up to 10 SensorDish® Readers possible)
- Software SDR_v37*
- PC / Notebook
System requirements: Win XP or Vista, minimum 1.5 GHz, 512 MB RAM, monitor resolution 1024x1280 or better (for an overview of all 24 channels on one screen)
- RS-232 cable with RJ-11 connector*
- 1 x RJ-45 - cable 1.25m and up to 9 x RJ-45 cable 0.25m*
- Network Terminator*
- Power adapter (output: 18-24V DC and min. 40 W)*
- SensorDishes®
 - HydroDish® (for measurement of pH)
 - OxoDish® (for measurement of oxygen)

*: Scope of supply

- ! *Please use either English (US) or German regional settings. A Project can only be opened again with the same regional setting as were used for measurement.*
- ! *Please switch off any energy saving items such as screen saver, monitor shutdown, hard disk shut down, standby mode or idle state.*
- ! *If you use a laptop, please disable switching to the standby mode at shutting the laptop.*
- ! *It is recommended to use your PC or laptop without any other programs (including internet) running. Especially programs using visual basic components might interfere. If you are connected to the internet, please disable automatic upload of Windows updates, for this will lead to shutdown of the SDR software if the update installation requires auto restart of your PC.*

5 SensorDish®

PreSens offers 2 types of SensorDishes®. These are 24-well multidishes with integrated optical-chemical sensors for pH (HydroDish®) or oxygen (OxoDish®).



sensor spot

24-well SensorDish® (here: OxoDish®) with integrated sensor spots at the bottom of each well.

SensorDishes® are disposables. They are delivered sterile but cannot be sterilised again. The surface treatment of the SensorDish® is similar to a Greiner Tissue Culture surface. They do not stand most organic solvents (up to 10% (v/v) ethanol, DMF, DMSO or acetone in aqueous solutions are possible). After an initial swelling time of approximately 10 minutes a stable signal is obtained. The signals of the integrated sensors are temperature-dependent. Calibration data of the SensorDishes® are uploaded via the SDR software from a data file delivered with the SensorDishes®.

! The SensorDish® has to be stored protected from sunlight at room temperature.

! The SensorDish® is a disposable and cannot be re-used.

📄 The SensorDish® is delivered gamma-sterilised. It does not show cytotoxic or cytostatic influence to cell cultures according to ISO 10993-5 (1999) and EN 30993-5 (1994).

📄 Please contact our service team in case your measurement temperature is not in the range of 15 to 45 °C.

	Measurement range	LOD	Resolution**	Accuracy**	Drift / 1000 measuring points**	Spot/Spot deviation**
HydroDish®	6.0-8.5	-	± 0.05	± 0.2	< 0.1	± 0.1
OxoDish®	0-250 % a.s.*	5 % a.s.	± 2% a.s.	± 5% a.s.	< 5% a.s.	± 5% a.s.

* a.s. = air saturation

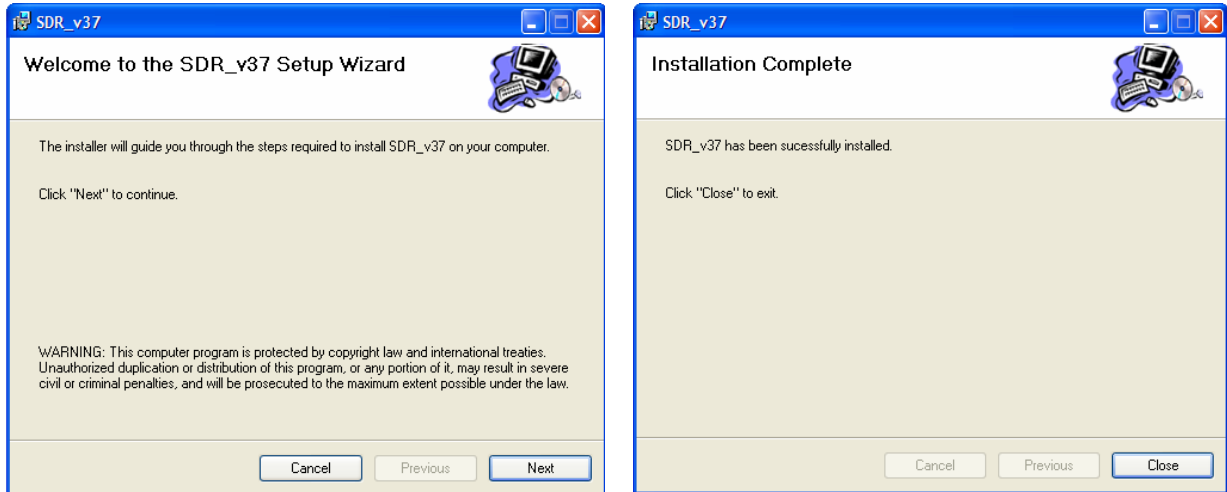
** At constant temperature, without ambient light; pH: at pH 7.2 or lower; DO: at 100 % a.s.

pH: In case of physiological ionic strength and non-fluorescent media; data were recorded with 40 mM PBS buffer, 140 mM ionic strength (with NaCl), containing 10 mg/l phenol red.

📄 Given values can vary in case of culture media (e.g. fluorescent components, high or low ionic strength), insufficient temperature control or ambient light (more than 300 Lux). For pH, a one-point recalibration is implemented in the software (see chapter 8.4, page 22).

6 Software Installation

Insert the supplied software CD into the CD drive. If the installation does not start automatically, please run the file *SDR_v37-SetUp.msi* and follow onscreen instructions:

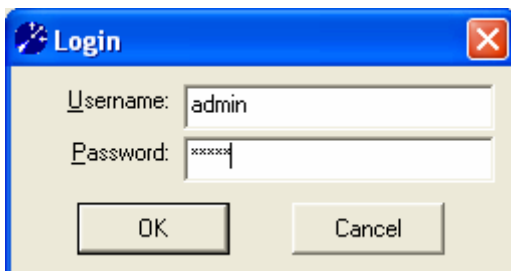


Screenshot of the first and last screen for installation of the software SDR_v37

Now the software is properly installed and you will find a shortcut on your desktop.

The software offers two levels:

- *User level* with only a reduced amount of functions and
- *Administrator level* for full functionality and control.

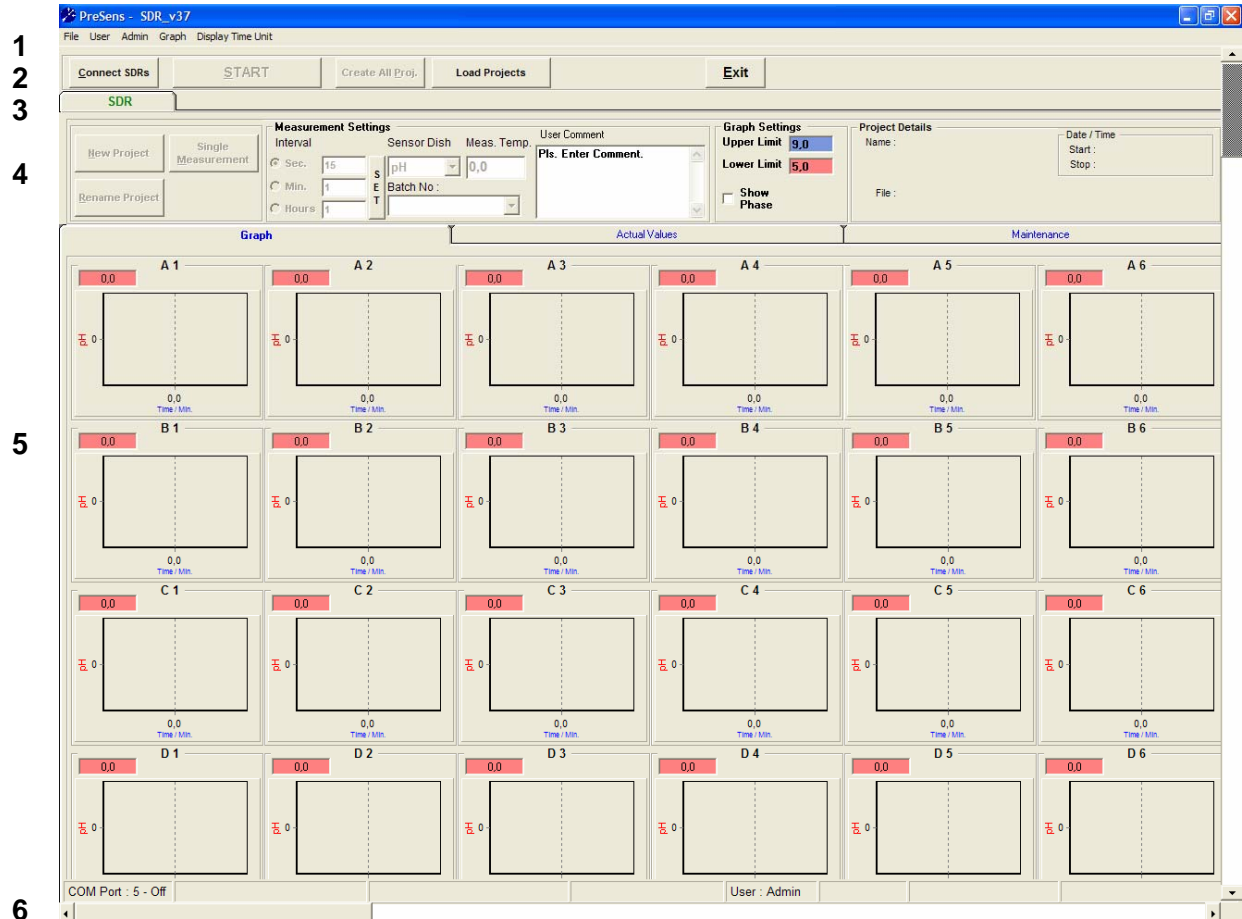


The default **Username** and the default **Password** for the administrator is **admin**. The administrator can change his password but not his user name. Furthermore, he can create new users with arbitrary user names and passwords. The user can change his password (see User, page 10).

! *Please consider upper and lower case!*

7 Functions of the Software

The software surface is divided into six sections as assigned in following screenshot:

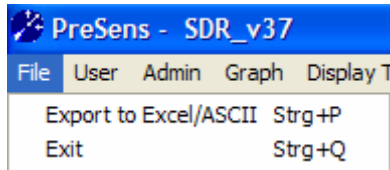


- 1 Menu bar
- 2 Control bar
- 3 SensorDish® Reader selection
- 4 SensorDish® Reader control bar
- 5 Result and Maintenance windows
- 6 Status bar

- 📄 This surface is shown after login. If you upload a previous Project, connect the SDRs or create a new Project, different buttons are shown and activated.
- 📄 To view all 24 channels on the screen like depicted above, a minimum resolution of 1024x1280 of your computer is needed. Furthermore, the dpi setting has to be set to 96 dpi. At lower resolution, only a part of the graphs is shown. The others can be accessed by scrolling.

7.1 Menu Bar

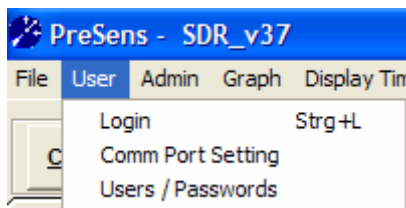
File:



Export to Excel/ASCII: Saves the actual data as an Excel or ASCII file.

Exit: Finishes the program.

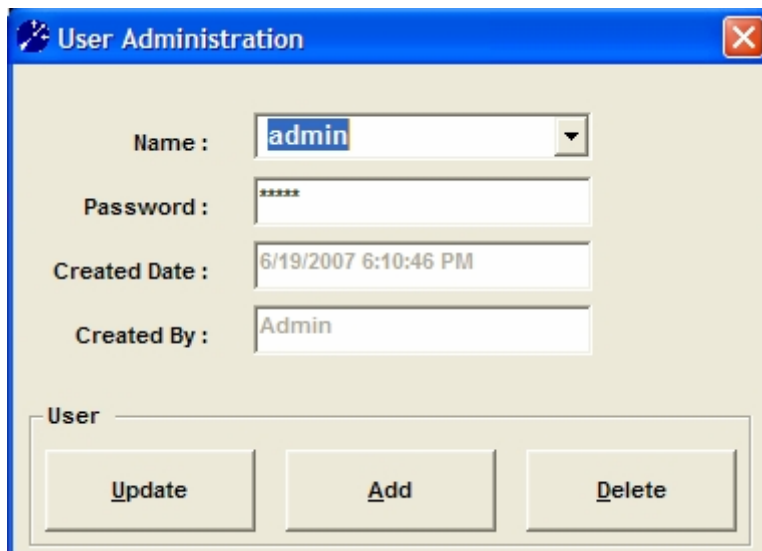
User:

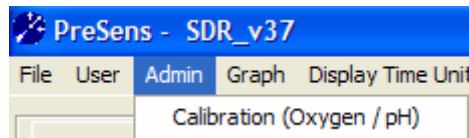


Login: Changes the user / administrator. For every user, an admin-defined password is required.

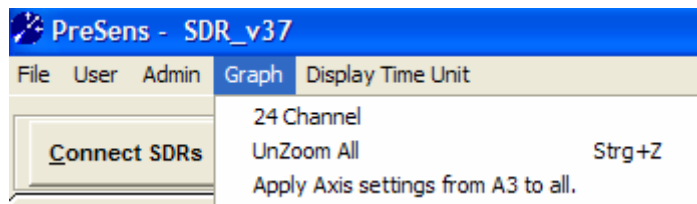
Comm Port Setting: Defines the serial communication port to which the splitter is connected. The active Comm Port is shown in the left corner of the status bar.

Users / Passwords: Here the admin or user can change (update) his password; the admin can also add or delete users.



Admin:

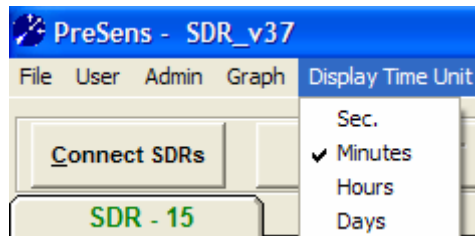
Calibration (Oxygen/pH) (Admin only): Here the administrator can upload calibration data sets for OxoDish® and HydroDish® batches. Each batch has different calibration data which are valid for every SensorDish® of this batch. The batch no. has to be chosen for every measurement in the Measurement settings (see chapter 8.5, page 25) before starting a measurement. Details on where to find and how to upload calibration data from batches can be found in chapter 8.3, page 21.

Graph:

24 Channel: Opens a window where all 24 channels of the active Project are displayed in one graph. It is only active when the SDRs are connected or a Project is uploaded and the **Graph** window (chapter 7.5.1, page 14) is activated.

UnZoom All: Restores the default (automatically created) axis settings of all 24 graphs in case changes have been made.

Apply Axis settings from A3 to all: Changes axis settings of the channel on which the user has clicked last (here: A3) to all other channels.

Display Time Unit:

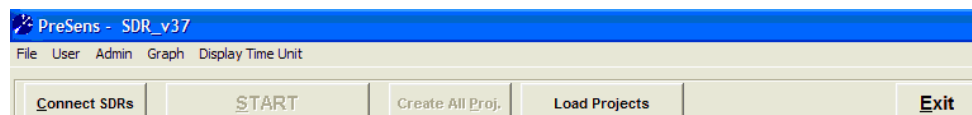
Defines the time unit of the x-axis. It can be changed during or after a measurement and is applied in the 24-channel overview, the **Detailed Graph** and the **24 Channel Graph** windows. However, for exporting the data to Excel or ASCII, the time unit is always seconds.

7.2 Control Bar

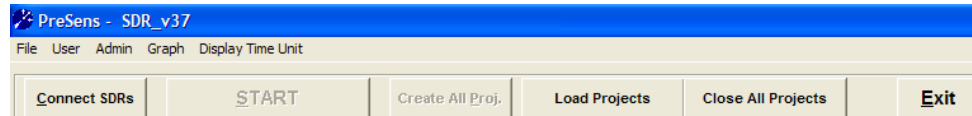
The view of the control bar differs. Depending on the status (connected or disconnected to the SDRs, project uploaded or running), buttons or menu items are activated or deactivated.

View of the Control bar...

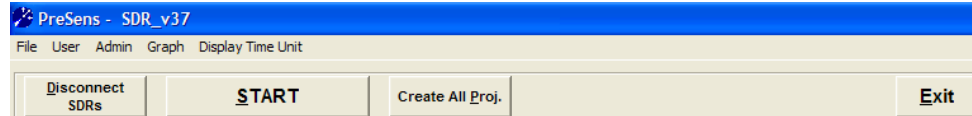
...after login
(not connected):



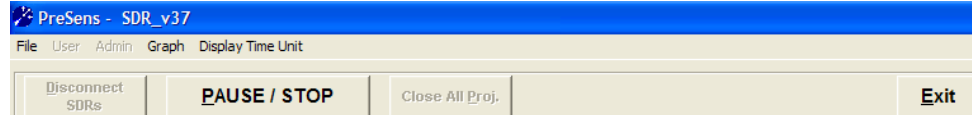
... with uploaded previous Projects:



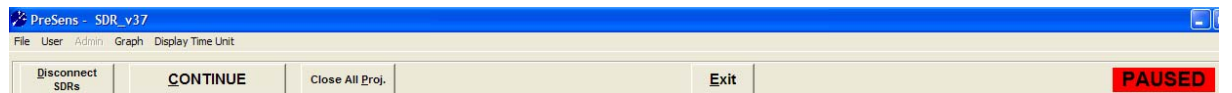
...after connection of the SDRs:



... at a running measurement:



... at a paused measurement:



Connect SDRs / Disconnect SDRs: Connects or disconnects all SensorDish® Readers to the PC.

START / PAUSE/STOP / CONTINUE: Starts/Stops the measurements of all SensorDish® Readers simultaneously.

- ☐ To start a measurement, a Project has to be created first for all connected SensorDish® Readers.
- ☐ When the button **STOP/PAUSE** is pressed, a blinking **PAUSED** sign appears at the upper right corner. Stopped measurements can either be closed to start a new Project, or continued.

Create All Proj.: Creates Projects for all connected SensorDish® Readers simultaneously: For each SensorDish® Reader a separate file is created. A prefix can be chosen for all files. The software automatically adds the serial number of the respective SensorDish® Reader at the end of the file name. This button switches to **Close All Proj.** after Projects have been created.

Close All Proj.: All Projects are closed simultaneously.

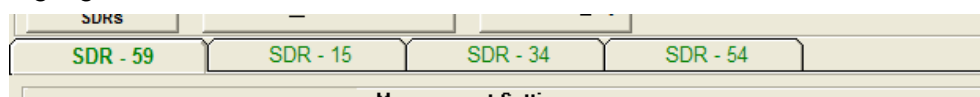
Load Projects: Uploads one or more saved Projects. For uploading more than one Project, please mark them simultaneously. Projects can also be uploaded successively. The maximum number of open Projects is 10.

- ! *Uploading previous Projects is only possible if the software is not connected to the SensorDish® Reader. Press Disconnect SDRs before uploading a saved Project.*
- ! *Load Projects always with the same regional settings as used at the measurement.*

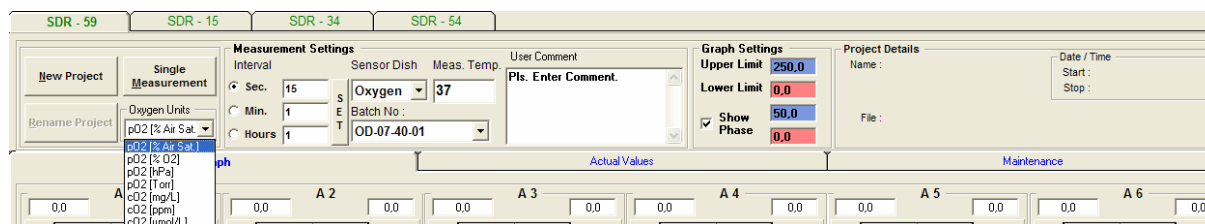
Exit: Terminates the program.

7.3 SensorDish® Reader Selection

Here you can switch between the SensorDish® Readers. Before connecting or uploading previous Projects, a blank sheet is shown (SDR). After connecting, one sheet per connected SDR is created, displaying the serial numbers for correlation. All settings in the SensorDish® Reader control bar as well as in the result and maintenance windows refer to the selected, highlighted SensorDish® Reader.



7.4 SensorDish® Reader Control Bar



New Project: Creates a new Project for the highlighted SensorDish® Reader. A dialog window opens for choosing the Project name and location. Switches to Close Project after a Project has been created.

Rename Project: Renames actual or previous Projects.

Single measurement: Performs one measurement for the actual SensorDish® Reader. These data are not stored, cannot be exported to Excel or ASCII and are deleted at switching to another SensorDish® Reader.

Oxygen units: Defines the unit in which the oxygen values are displayed. Following units are available: Oxygen partial pressure pO_2 in % air saturation, % oxygen, hPa, or Torr, and oxygen concentration cO_2 in mg/L, ppm or $\mu\text{mol/L}$. Changing the oxygen unit is also possible during a paused measurement and for an uploaded, previous Project. The oxygen values are exported to Excel or ASCII in the selected oxygen unit.

Interval: Select the measurement interval. An interval of at least 2 min is recommended for long-term measurements, fast kinetics can be followed up to a 15 second resolution. The interval can be changed during the measurement; the remaining time until the next measurement point then starts again from this new interval. The interval is the same for all connected SensorDish® Readers. If more than 1 SensorDish® Reader is connected, a message is displayed to prevent changing all intervals by mistake. Please press **SET** after changing the interval by typing in a different number.

Sensor Dish: Select between pH (HydroDish®) and oxygen (OxoDish®). This selection cannot be changed while a Project is running. The default setting is pH.

Batch No.: The batch no. of the respective SensorDish® is chosen before starting a measurement. The corresponding calibration data are used for calculation of pH or oxygen from the measured raw values. The batch no. of your SensorDish® is printed on its silver package and on the Calibration Data sheet delivered with the SensorDish®.

Meas. Temp.: Defines the measurement temperature. The measurement temperature cannot be changed while a Project is running.

! The measurement temperature is used for calculation of the oxygen values and choice of the correct calibration data set. It is NOT a measured temperature, but given by the user before starting the measurement. Please ensure that the temperature of your samples is kept constant during the measurement. If this is not so, you will see fluctuations in the measurement values.

User comment: Input window for a description of the experimental setup. The comment can also be added during measurement and is stored each time the measurement is stopped.

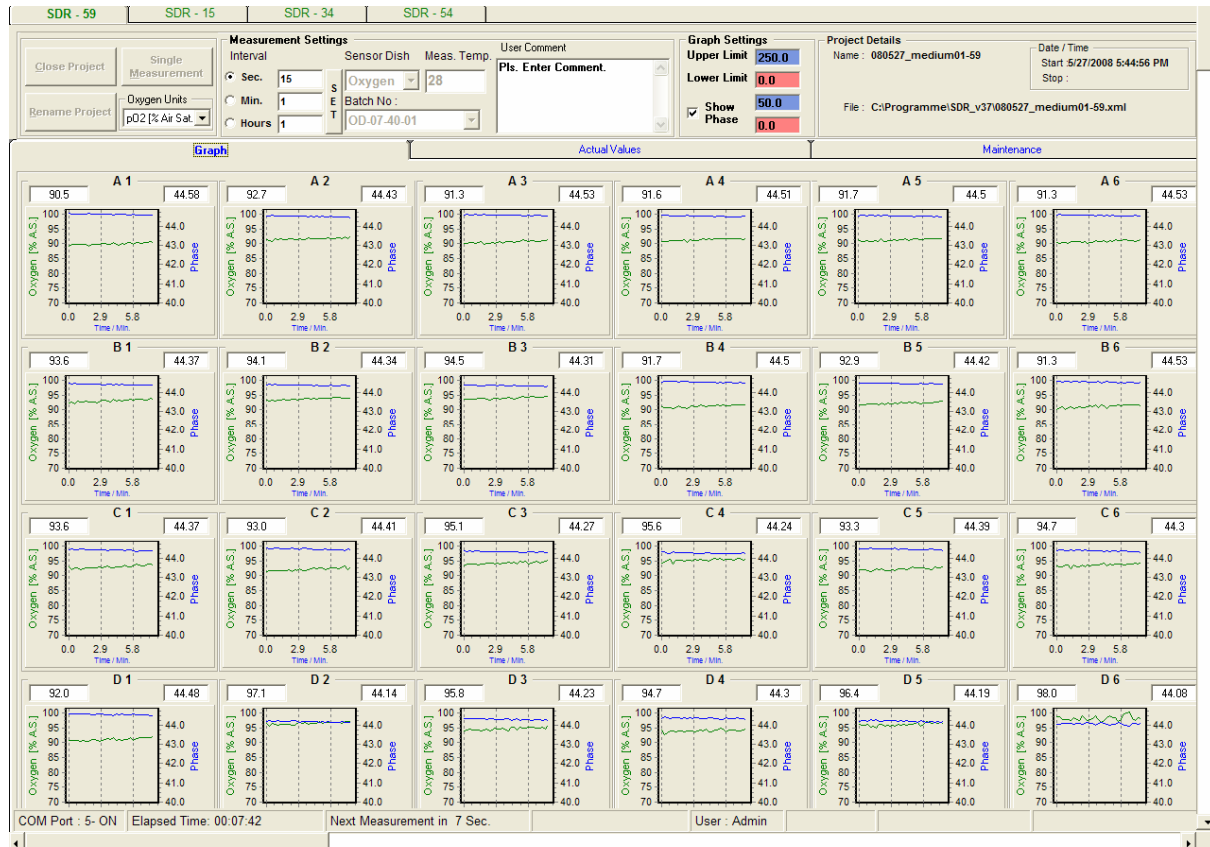
Graph settings: Defines upper and lower limit for colour changes in the display of the actual value in the **Graph** window as well as in the **Actual Values** window.

Show phase (Admin only): Shows the raw value (phase) in the graphs. As with the calculated parameters, graph settings are available for the phase values.

Project details: General information about the actual Project (name and path, start and stop time, last user) are displayed.

7.5 Result and Maintenance Windows

7.5.1 Graph Window



The time course of each well is shown in a separate graph. The green (for oxygen) or red (for pH) kinetics display the measured parameter (oxygen or pH). The actual value of this parameter is shown in the upper left corner of each graph. If **Show Phase** is activated in the SensorDish® Reader Control Bar, the raw values are displayed in the graphs (blue kinetics) with a corresponding second y-axis on the right, and the actual phase values are shown in the upper right corner.

The background colour of the actual value is adjusted to the Graph settings (user-defined upper and lower limit). If the calculated value is not within the sensor limits (oxygen: 0-250 % air saturation, pH: 5-9), or the amplitude of the sensor is too low, the actual value field will blink and show a message.

Messages:

pH < 5 / < 0 % a.s.

The calculated pH or oxygen value is below the limit.

pH > 9 / > 250 % a.s.

The calculated pH or oxygen value is higher than the limit.

no sensor

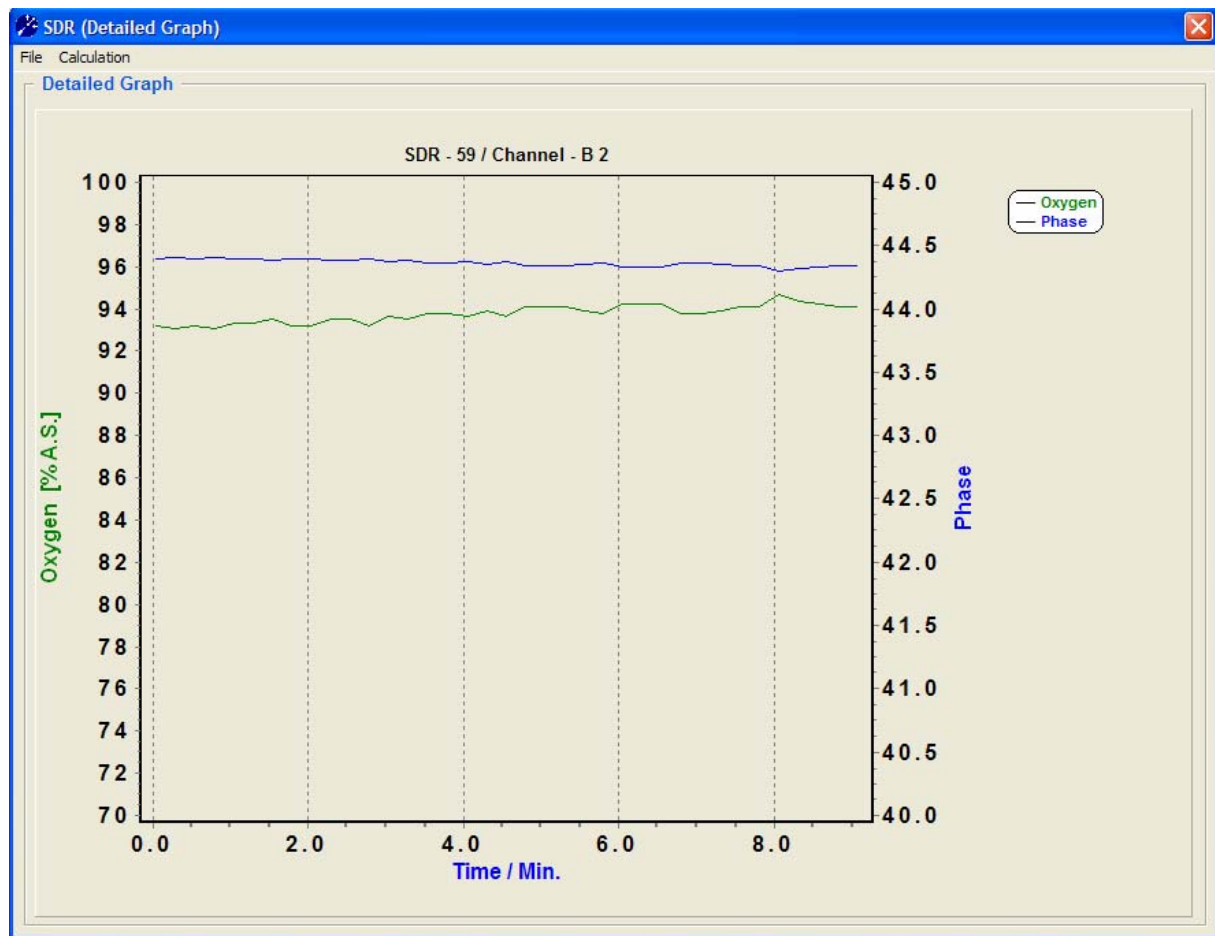
The sensor amplitude is too low.

These messages are also stored in the Excel or ASCII file at exporting the data.

Detailed Graph

(see also chapter 9.1, page 28)

Each Graph can be enlarged by a double click:

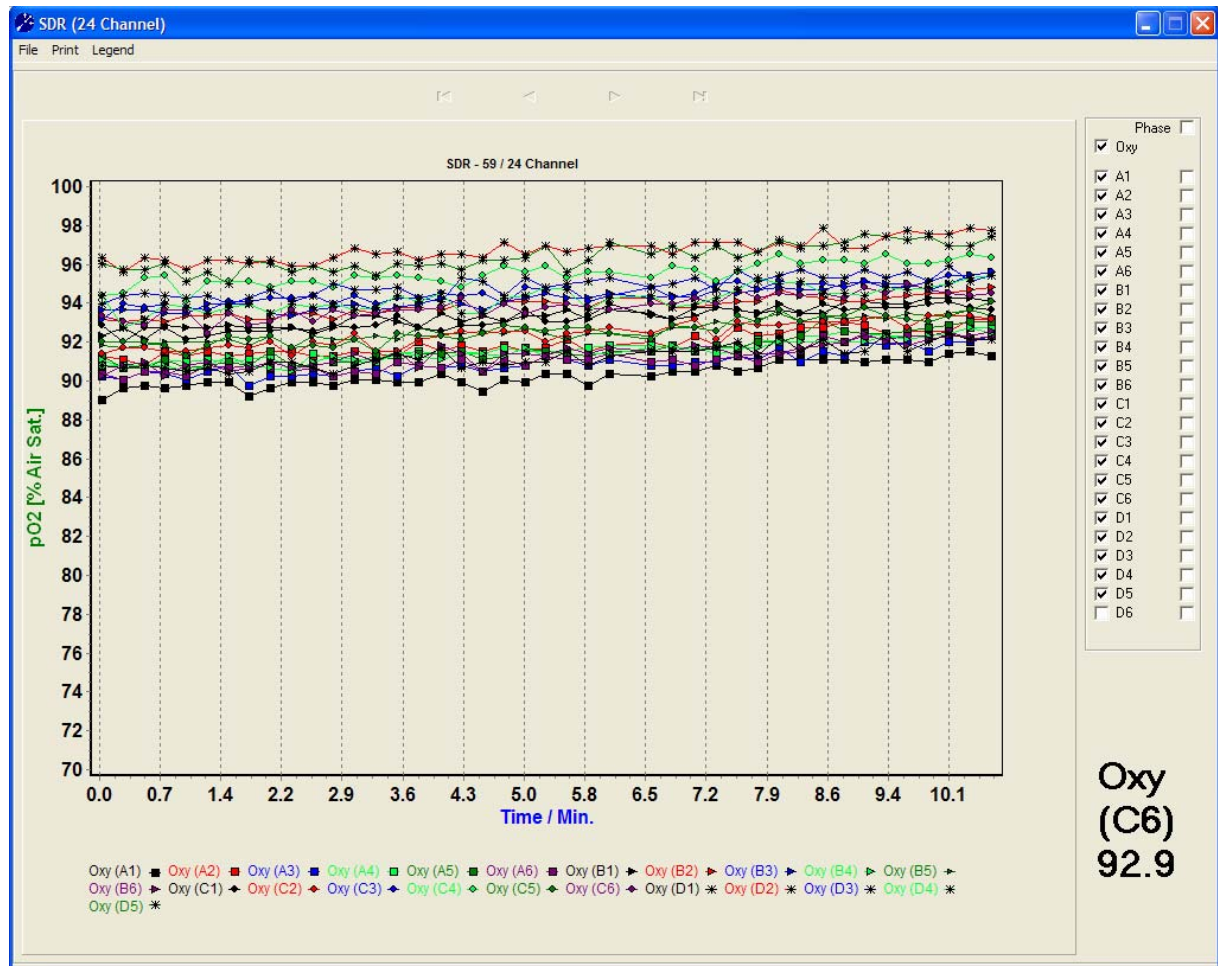


Again, the green (for oxygen) or red (for pH) kinetic displays the respective parameter (pH or oxygen), the blue kinetic the raw value phase (if **Show phase** was activated in the graph settings).

In this window, the trend (slope and intercept) and arithmetical calculations of any pair of graphs can be displayed.

24-channel Graph

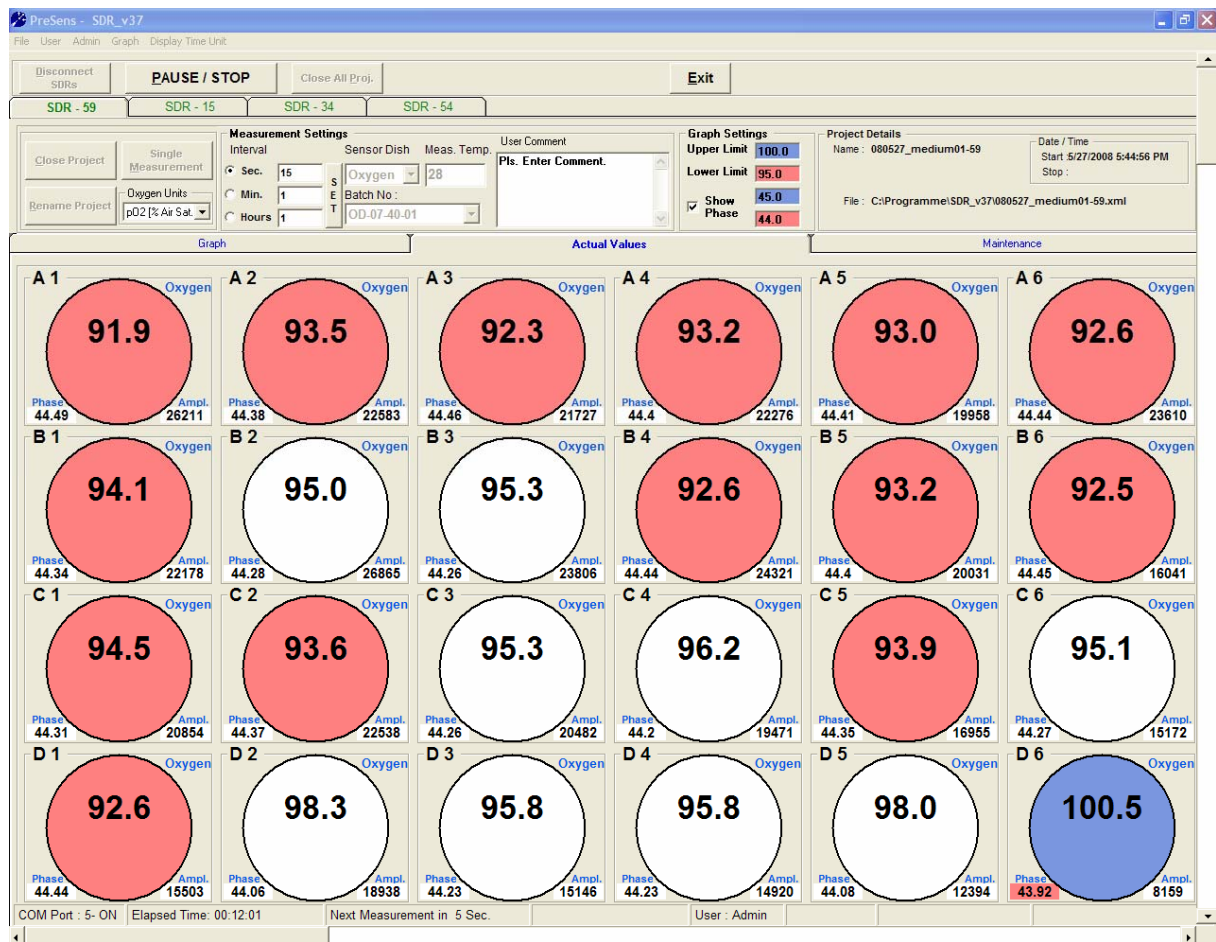
All 24 wells can be displayed in a single graph by choosing **Graph – 24 Channels** in the Menu bar. By placing the pointer on a data point, the parameter (Oxy = oxygen, or pH) value and the respective well are shown in the right lower corner. Individual wells can be chosen by activating or deactivating the respective check boxes. For activating individual phase values (if **Show phase** was not activated before), please activate the phase values for all channels first using the check box next to **Phase**. After that, you can deactivate all phase values again and choose individual ones.



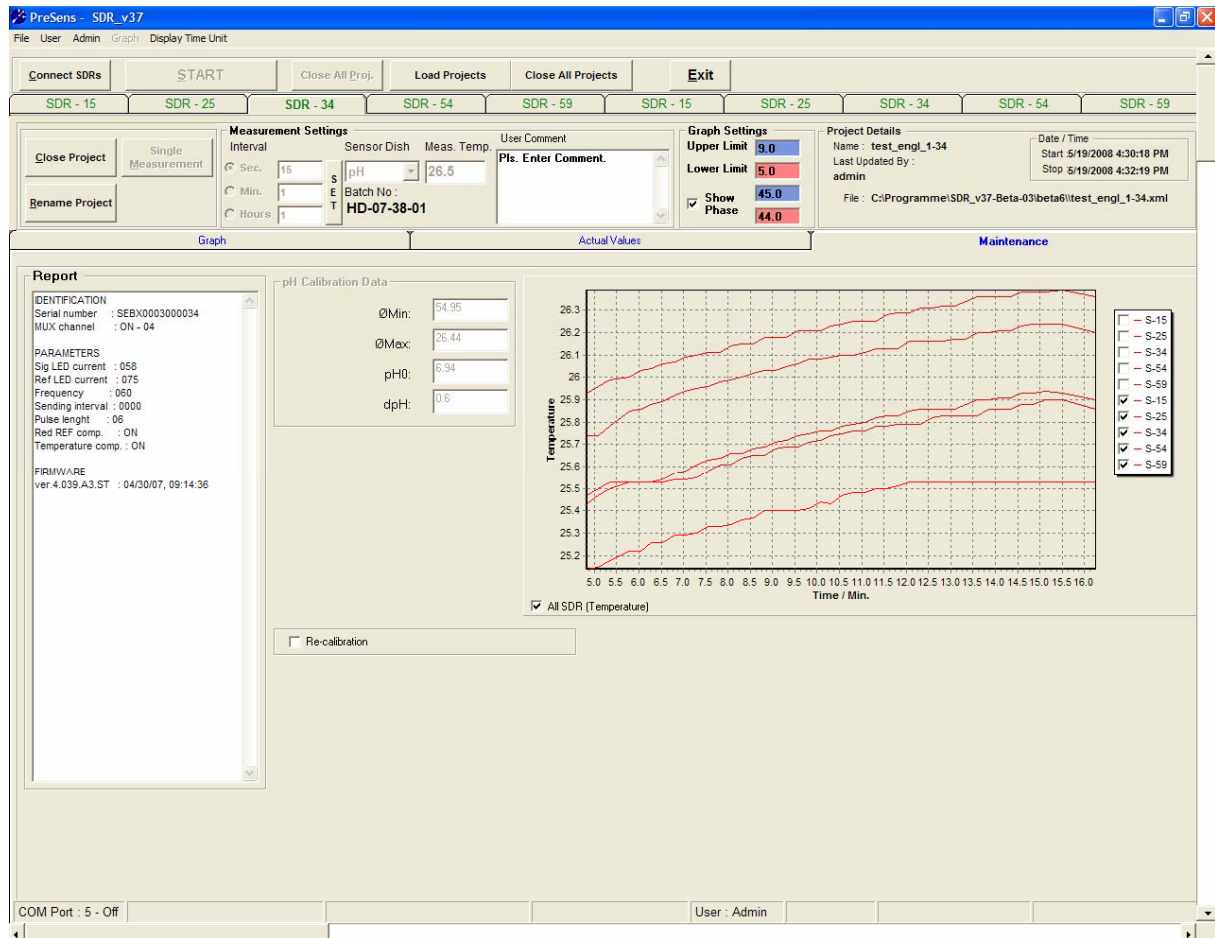
7.5.2 Actual Value

The last measured value of each well is displayed in the **Actual values** window. The background colour of each well is defined by the upper and lower limit of **Graph Settings** in the SensorDish® Reader control bar. The limits can be varied for each SensorDish® Reader individually. Values can be entered manually after clicking into **Upper** or **Lower limit**. This tool helps to recognize a change of the analyte concentration in the sample more easily.

Below the actual value of the calculated parameter, the actual phase value (on the left) and amplitude (on the right) are shown. Again, the background colour of the phase values can be defined in the graph settings. The amplitude indicates how much signal is received by the reader. At amplitudes below 2000, the text **no sensor** is shown instead of the calculated value because the value would be too inaccurate due to the weak signal.



7.5.3 Maintenance Window (Admin only!)



Report: Contains information about internal settings of the respective SensorDish® Reader.

Oxygen Calibration Data / pH Calibration Data:

Depending on the choice of the SensorDish®, the calibration data for the OxoDish® or the HydroDish are displayed. The data cannot be changed in this window but only in the menu bar under **admin -> Calibration (Oxygen/pH)**

Re-calibration (only pH):

Opens a window to make a one-point calibration (see chapter 8.4, page 22).

- ☐ In case of deviations of the start pH point from the measured pH (e.g. due to different ionic strength of the calibration media and the measured media) a one-point calibration is required.

Temperature graph:

The internal temperature of the respective SensorDish® Reader is displayed. Please notice that the absolute value may differ slightly from the temperature of the sample. The SensorDish® Reader is in thermal equilibrium with the environment if the temperature has reached a constant value. At a significant change of this temperature, an external temperature change must be considered (e.g. due to opening the incubator). For information, this temperature is also exported to Excel or ASCII.

- ! For measurements with high measurement rates (below 2 min) a slight temperature increase inside the SensorDish® Reader can occur. Please notice that this will also influence the measurements! For long-term measurements, please choose an interval of more than 2 min.
- ! Please be aware that changes in the temperature change the measured oxygen or pH values. If you see unexpected behaviour of these values, check with the help of the temperature graph if the temperature was constant for this time. Even seemingly small changes like opening the incubator door or taking the plates shortly will be detected both in the temperature graphs as well as in the oxygen or pH graphs.

7.6 Status Bar

The Status Bar contains information about the measurement conditions:

COM Port : 5- ON	Elapsed Time: 00:14:29	Next Measurement in 7 Sec.	User : Admin
↑	↑	↑	↑
Connected Com Port + Status (On/Off)	Time since Project start	Time until next measuring point	Logged- in user

8 Starting a Measurement

This chapter describes each necessary step to start a measurement.

- ! *It is recommended to close all other applications before running the SensorDish® Reader software. Especially internet programs can cause troubles!*
- ! *Too much ambient light (> 300 Lux) will cause an accelerated bleaching rate of the sensor and a change in the calibration data. Do not use the instrument next to windows or even in sunlight. If you do not perform the measurement in an incubator, we recommend covering the SDR!*

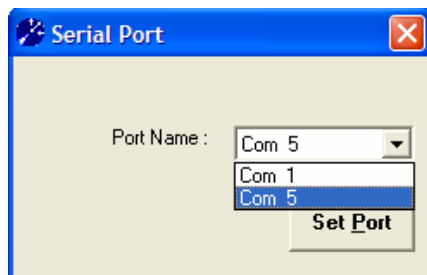
8.1 Set-up

Connect SensorDish® Readers and the Splitter as described in chapter 3:

1. Connect the power adapter to the Splitter.
2. Connect the Splitter via the RS-232 cable to a com port of your PC.
3. Connect the first SensorDish® Reader via the 1.25 m RJ-45 cable to the Splitter.
4. Connect subsequent SensorDish® Readers via the 0.25 m RJ-45 cables to the first SensorDish® Reader.
5. Cover the open connector of the last SensorDish® Reader with the network terminator end cap.
 - ! If the end cap is not attached the last SensorDish® Reader, it is NOT water-proof! This will finally destroy the instrument after some time in a humidified incubator!
6. Ensure that every cable is connected properly. The connectors snap in with a slight click.
7. Ensure that the power control LED of the Splitter is on.

8.2 Connect SensorDish® Readers to the Software

- 1) Start the software SDR_v37.
- 2) Enter **admin** as user name and **admin** as password if the software is opened for the first time. After this, the admin can change his password and generate users with different names and passwords (see chapter 7.1, page 10).
- 3) Select the serial communication port to which the SensorDish® Reader is connected in the menu bar – **User -> Comm Port Setting**: Confirm by clicking **Set Port**.

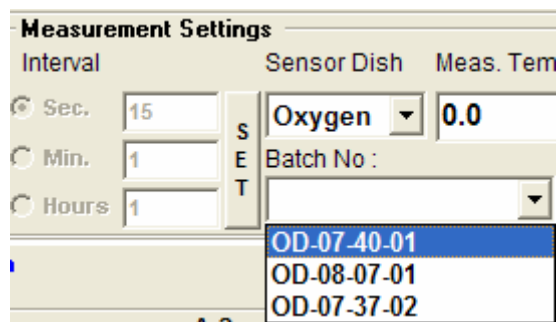


☰ All available communication ports are listed.

- 4) Press the **Connect Port** button in the control bar. Wait until all SensorDish® Readers are configured.
- ☞ Each connected SensorDish® Reader will be listed in the SensorDish® Reader selection according to the last digits of its serial number (e.g. SDR - 49).
 - ! *If you connect further SensorDish® Readers via RJ-45 cables while the existing SensorDish® Readers are still connected to the software, please press **Disconnect SDRs** and **Connect SDRs** again to recognise the newly connected SensorDish® Readers.*

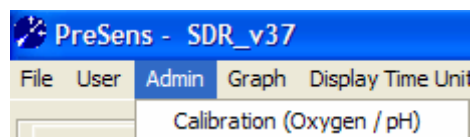
8.3 Choose Calibration Data (Admin only)

Before starting a measurement, calibration data for the HydroDish® or OxoDish® must be entered. This is done by choosing the respective batch no. of your SensorDish® in the measurement settings:



- ! *The batch no. of your OxoDish® or HydroDish® is printed on its silver package and on the Calibration Data Sheet delivered together with the SensorDishes®. Calibration data of one batch are valid for all SensorDishes® of this batch.*

When you retrieve the SensorDish® Reader, the calibration data files for the batches you ordered together with the SensorDish® Reader are delivered on the installation CD in the folder **Batches**. If you order SensorDishes® of a new batch, the respective file containing the calibration data is delivered together with the SensorDishes® on a CD or sent by e-mail. This file has to be uploaded under Admin -> **Calibration (Oxygen / pH)**:



Press **Upload** and choose the respective file containing the calibration data of your SensorDish®.

- ! *Batch numbers for OxoDishes® start with OD, those for HydroDishes® with HD.*
- ! *Please notice that only the Administrator can upload new calibration data. The respective window is deactivated if a user is logged in.*
- ! *If you need special calibration data (e.g. due to doing your own calibration with special media), please contact us!*

To store the uploaded batch, press the **Ok** button. The new batch can now always be found in the drop down menu for batch no. in the measurement settings.

8.4 pH Re-calibration (Admin only)

For pH measurements in samples with an ionic strength not in the physiological range (approx. 140 mM) or with media containing large amounts of fluorescent substances, a one-point calibration can be necessary. Each well is calibrated separately. In this case the pH of the samples at the start of the measurement must be known. Re-calibration can only be performed before a measurement is started, not during or after a measurement.

- 1) Place the HydroDish® filled with your sample of known pH on the SensorDish® Reader.
- 2) Activate **Re-calibration** in the Maintenance window. A window is opened:

pH re-calibration

Calibration temperature : 37

Actual pH and phase values

Click here to enter all pH values.

	1	2	3	4	5	6
A	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5
B	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5
C	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5
D	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5	0.0 6.5

Receive phase value

Calculated pH0

	1	2	3	4	5	6
A	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0
D	0.0	0.0	0.0	0.0	0.0	0.0

Calculate new pH0

Transfer data

- 3) Enter the actual pH value of your sample in the white fields. You can also fill the complete mask with one pH value by pressing **Click here to enter all pH values**, or each row or column by a mouse click on the number of the respective row or column.

! This method only works correctly if the initial pH value is in the range of 6.5 to 8.0!

☰ The calibration temperature is shown as the value given as Measurement Temperature in the Measurement Settings. It is stored with the Recalibration values for information but is not used for calculation of the pH at differing temperatures.

! Ensure that the HydroDish[®] is placed correctly on the respective SensorDish[®] Reader. If the signal is too low, the warning **No Sensor** will appear in the fields of the respective wells, and the measured value will not be taken.

- 4) Click on **Receive phase value**. The SensorDish[®] Reader will read the actual phase value and display it above the pH value entered by the user. The new data for pH0 is calculated automatically for each channel:

pH re-calibration

Calibration temperature : 23

Actual pH and phase values

Click here to enter all pH values.

	1	2	3	4	5	6
A	38.58 7.0	38.08 7.0	38.27 7.0	38.89 7.0	37.87 7.0	37.7 7.0
B	38.24 7.0	38.82 7.0	38.5 7.0	37.7 7.0	37.57 7.0	37.66 7.0
C	38.48 7.0	38.26 7.0	38.76 7.0	38.57 7.0	39.0 7.0	38.56 7.0
D	38.74 7.0	38.0 7.0	38.48 7.0	38.07 7.0	38.24 7.0	38.71 7.0

Receive phase value

Calculated pH0

	1	2	3	4	5	6
A	7.06	7.03	7.05	7.08	7.02	7.01
B	7.04	7.08	7.06	7.01	7.0	7.01
C	7.06	7.04	7.07	7.06	7.09	7.06
D	7.07	7.03	7.06	7.03	7.04	7.07

Calculate new pH0

Transfer data

☰ If you change the entered pH values after receiving the phase values, you can re-calculate the new pH0 values without measuring the phase values again by pressing **Calculate new pH0**.

! Please check your plate and pH input values if any of the calibration results is not between 6.5 and 8.0.

- 5) Press **Transfer data** to use the new calibration data. The Re-calibration mode is now active and the check-box beneath **Re-calibration** is checked:

Re-calibration

To view this new data, press the *right* mouse button in the field **Re-calibration**. To perform a new Re-calibration, disable and enable again the check box **Re-calibration** and repeat the above described procedure.

! Re-calibration data can only be used for one measurement. For new Projects, Re-calibration must be done again if necessary. Re-calibration data of running or uploaded Projects can be seen by pressing the *right* mouse button on the field **Re-calibration**. The new calculated pH0 values are stored and exported to Excel / ASCII for information together with the measurement..

8.5 Choose Measurement Settings

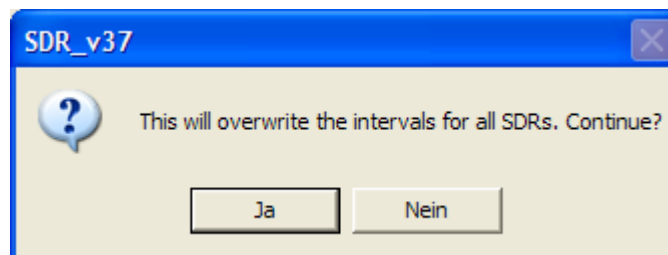
The screenshot shows the 'Measurement Settings' dialog box in the SensorDish software. The 'Interval' section has 'Sec.' selected with a value of 15. The 'Sensor Dish' is set to 'Oxygen' and 'Meas. Temp.' is 37. The 'Batch No.' is 'OD-07-40-01'. The 'User Comment' field is empty. The 'Graph Settings' section shows 'Upper Limit' at 250,0, 'Lower Limit' at 0,0, and 'Show Phase' checked. The 'Oxygen Units' dropdown is set to 'pO2 [% Air Sat.]'. Below the dialog, a table shows 'Actual Values' for channels A 2, A 3, and A 4, all displaying 0,0.

1) Select the measurement **interval**.

The measurement interval is the same for all connected SensorDish® Readers. For fast kinetics an interval of up to 15 sec. is possible.

! For update rates faster than 2 min. a slight warming of the SensorDish® Reader will be observed (e.g. in 30 sec. mode about 0.5°C). For any long-term measurement, please choose a measurement of at least 2 min.

The chosen measurement interval will always be applied to all connected SensorDish® Readers. A message is displayed:



- 2) Choose **SensorDish** type (pH or oxygen): This setting is individual for each SensorDish® Reader.
- 3) Choose the **Batch No.** of your SensorDish®: The batch no. is printed on the silver package of your SensorDish® and on its Calibration Data Sheet (see also page 21).
- 4) Choose **Meas. Temp.** (measurement temperature): The software uses this temperature to calculate the oxygen values and to choose the correct calibration data set for both OxoDish® and HydroDish®.
- 5) **User comment**: You can type a description of your experiment in this window. This is individual for each SensorDish® Reader and can be edited also during measurement. The User comment is also stored in Excel or ASCII if the data are exported.
- 6) **Oxygen units**: For oxygen measurements, the unit in which the oxygen content is displayed and exported to Excel or ASCII has to be defined. The unit can be changed during the measurement if the measurement is paused, and for previous Projects. Oxygen values are exported to Excel or ASCII in the chosen unit.

8.6 Create Project

To start a measurement, a Project to store the data has to be created for each connected SensorDish® Reader. This can be done for all SensorDish® Readers simultaneously by pressing **Create All Proj.** in the control bar. A dialog is opened for storing the Project. A prefix for all file names can be given, which is extended automatically by the serial number of the respective SensorDish® Reader. Alternatively a Project can be created for each SensorDish® Reader using individual file names by pressing **New Project** in the SensorDish® Reader control bar.

The software will create an xml file and a folder with the same name containing the 25 dat files: 24 with data for each channel, and one with the measurement settings. The Project can be recalled later (see chapter 9).

- ! *Do not store a new file inside a folder created by the software. In this case the Project cannot be uploaded later.*
- ! *Do not move the xml file and the associated folder separately. Always maintain the internal storing path! The xml file and the associated folder must be kept in the same folder!*
- 📄 The Project file can be renamed using the Rename button in the software. A Project cannot be renamed manually in the Windows Explorer.
- 📄 Please notice that a Project name must be defined for each connected SensorDish® Reader before taking a measurement!

8.7 Start Measurement

After creating a Project for each SensorDish® Reader, the measurement for all SensorDish® Readers is started simultaneously by clicking **START** in the SensorDish® Reader control bar. In case of a measurement interval of more than 30 sec. you have the possibility to update the values in between two measurement points by pressing **Single measurement** in the SensorDish® Reader control bar. This function is disabled if the next regular measurement point is within the next 30 seconds. The remaining time until the next measurement is displayed in the status bar.

9 Subsequent Data Handling and Visualisation

9.1 Data Visualisation

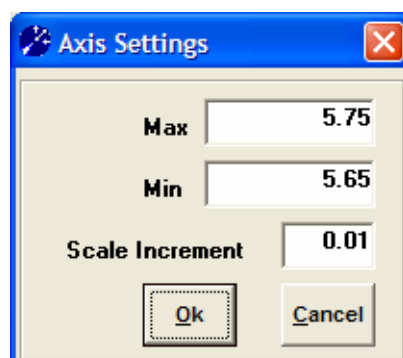
Actual values

The last measured value is displayed in the **Actual values** window. The background colour of each well is defined by the upper and lower limit of “graph settings” in the SensorDish® Reader control bar. The limits can be varied for each SensorDish® Reader individually and are entered manually by the user. This tool helps to recognise an oxygen or pH change in the sample more easily.

Graph window axis settings

Following functions are available in the 24-channel overview as well as in the Detailed Graph window and the 24 Channel Graph windows for data visualisation:

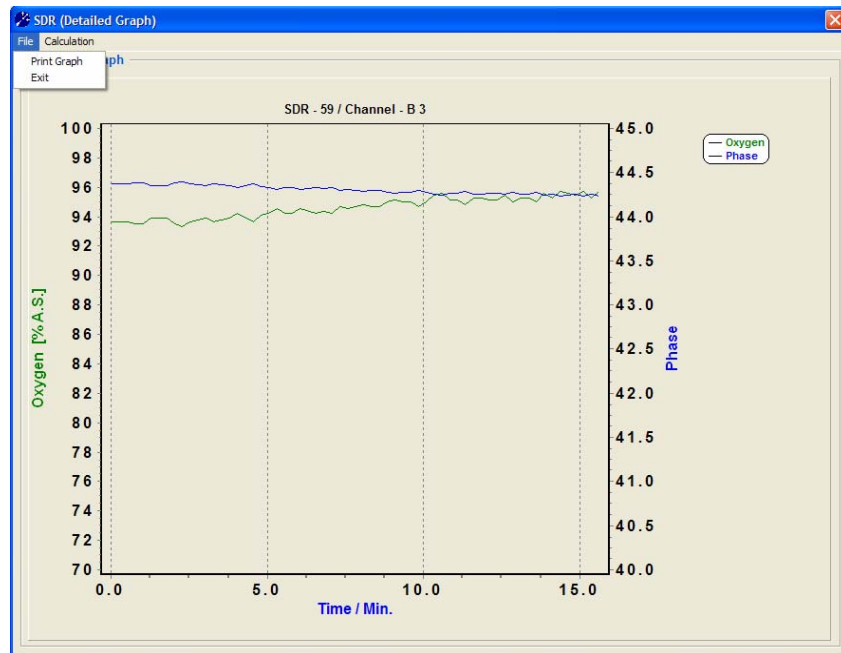
- Zoom** To mark the zoom area, click&hold the left mouse button and move the pointer to the right. To show the zoomed area, release the button. You are still able to observe the kinetics if the zoom area exceeds the right border of the initial graph window.
- Unzoom** Click&hold the left mouse button and move the pointer to the left. To clear the zoom, release the button. To unzoom all 24 graphs simultaneously, choose **Graph -> Unzoom all** in the menu bar.
- Scroll** Use the scroll button of your mouse to scroll the graph window up and down.
- Move** Click&move right mouse button to move the graph in all directions.
- Scaling** Double-click on the y-axis to define the maximum and minimum values as well as the increment manually.



The axis setting of one graph can be applied to the graphs of all other channels using **Graph -> Apply axis settings of XX for all channels** in the menu bar.

Detailed Graph

Each Graph can be enlarged by a double click.



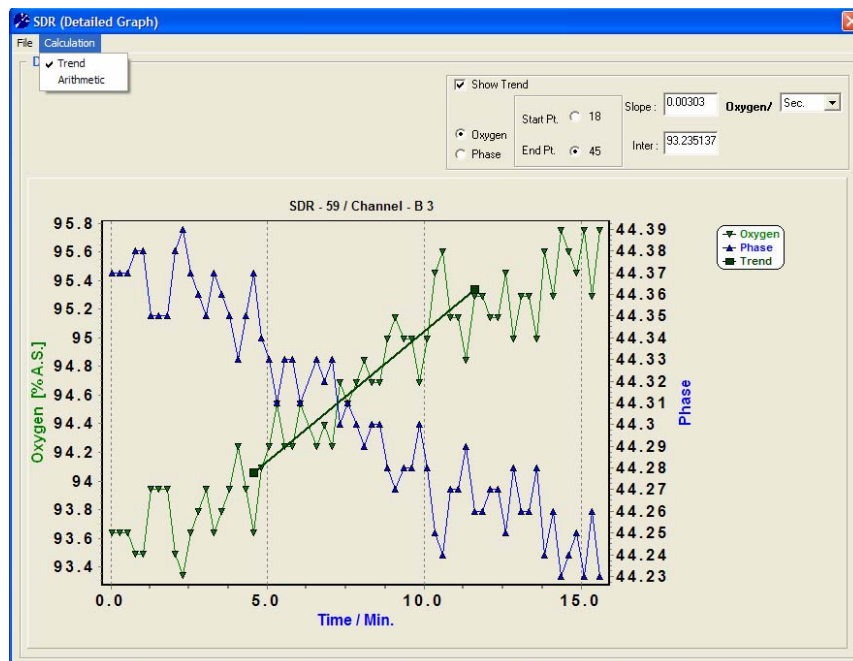
Following functions are available on the enlarged graph:

Print Graph Sends the graph data to a printer.

Exit Closes the detailed graph.

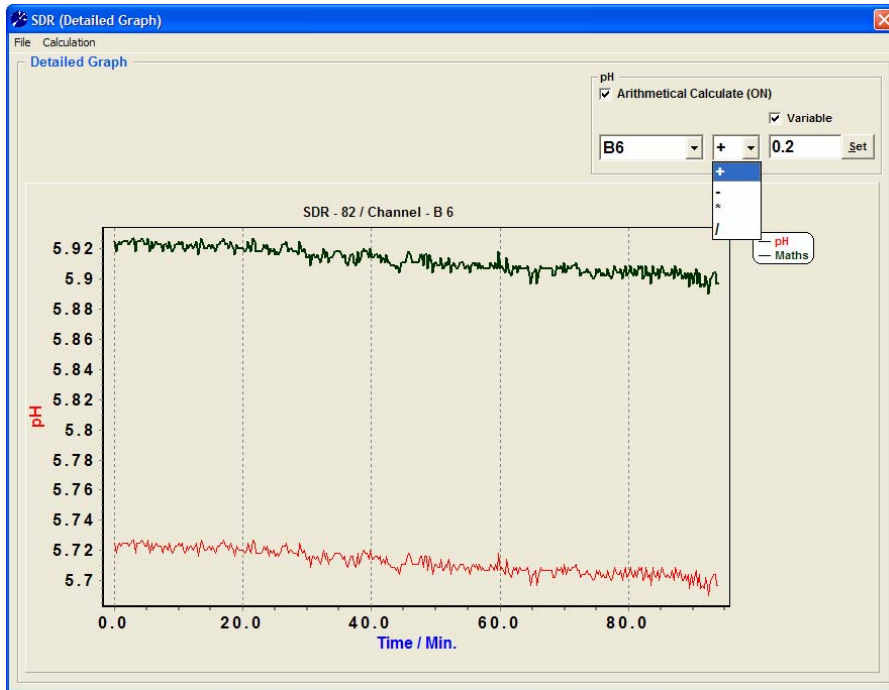
Calculation To calculate the trend (slope and intercept) for selected graph points, please select **Calculation -> Trend**: Select **Start Pt.** and click the required starting point on the graph. Select **End Pt.** and click the required end point on the graph.

The pH or oxygen trend per sec/min/hour is calculated automatically.



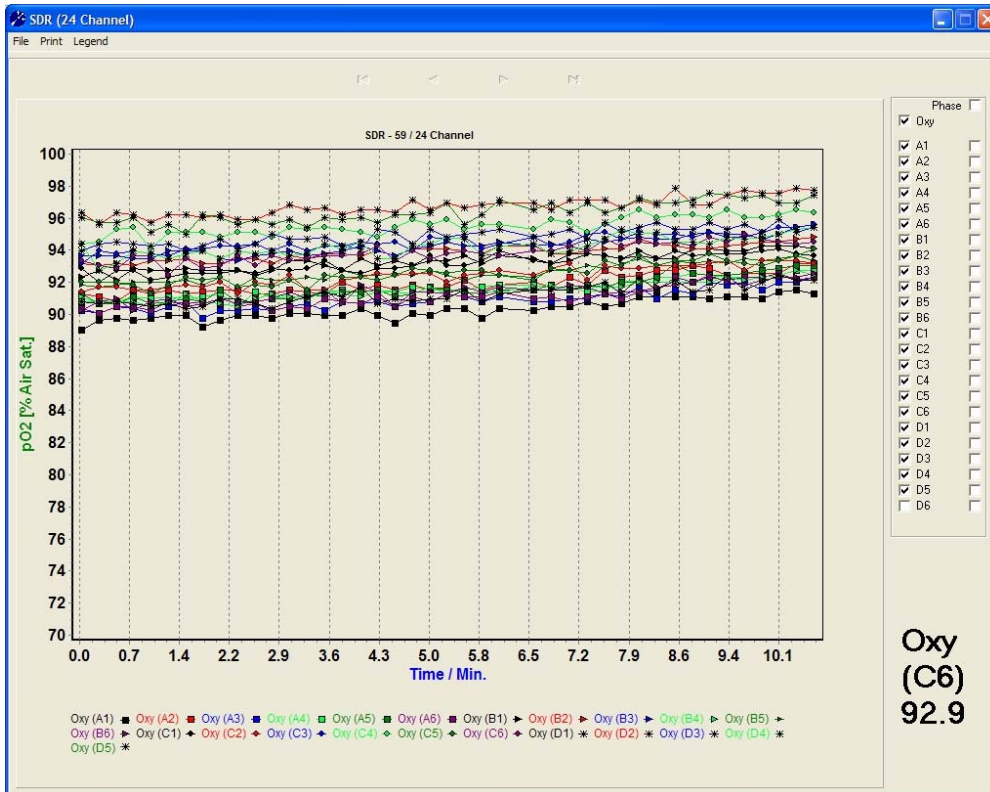
Calculation Calculation (addition, subtraction, multiplication and division) can be either done with

-> **Arithmetic** kinetic values of other wells or using variables by activating the check box **Variable**. This function is useful for comparing kinetics to a reference sample or calculation of oxygen consumption rates.



24-Channel Graph window

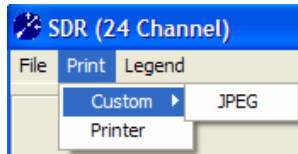
All 24 wells can be displayed in a single graph by choosing **Graph – 24 Channels** in the Menu bar.



The graph of each well can be shown or hidden by activating or deactivating the respective check box. Activating the check box **Oxy** or **pH** shows or hides all graphs. This is also possible for the raw value phase.

Resting the pointer on a measuring point on the 24-channel graph shows the actual value and the corresponding well on the right bottom of the display.

The 24-channel Graph can be printed or exported to jpg format using **Print -> JPEG**:



With **Legend**, the coloured legend below the graph can be deactivated to enlarge the graph area.

9.2 Recall Previous Projects

Previous Projects can only be opened if no SensorDish® Reader is connected. Before uploading previous Projects, **Disconnect SDRs** has to be pressed. The regional settings at loading a previous Project must be the same as for the measurement.

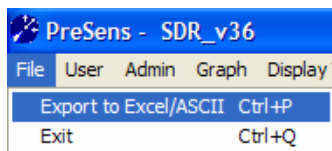
Up to 10 previous measurements can be uploaded successively or simultaneously using the **Load Projects** button in the SensorDish® Reader control bar. For simultaneous upload, the files have to be located in the same folder and marked simultaneously.

To close the Project, press the **Close All Project** button in the Control Bar to close all loaded Projects simultaneously, or the **Close Project** button in the SensorDish® Reader control bar to close only the highlighted Project.

! A Project can only be uploaded if the regional settings of the PC are the same as at the time of the measurement.

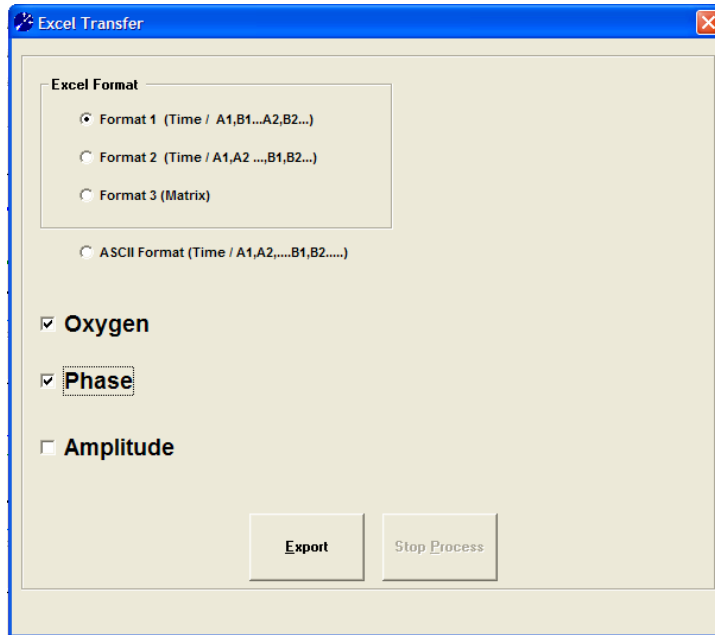
9.3 Export Data to Excel / ASCII

The software stores each Project's information in xml format, which can be uploaded again anytime using the SensorDish® Reader software. For further data processing it is possible to export data to Excel format (generate an xls file, or, for Office 2007, an xlsx file) or ASCII format (generate a txt file). By entering **File->Export to Excel/ASCII** in the Menu Bar, the **Transfer** assistant starts.



! The software was programmed for use with Windows XP and Office 2003. If exporting to Excel does not work on your machine, this may be due to your Excel version. Please export to ASCII format (txt-file) and upload in Excel if this is the case.

For Excel, the user can select between three different export formats. ASCII files are always stored in format 1.



Activate the check box beneath Oxygen or pH, respectively. Activate Phase and/or Amplitude if you also want to export these values to separate files. Pressing **Export** opens a window for choosing the path and the file name. The suffix **_Oxygen**, **_pH**, **_Phase** or **_Ampl**, respectively, is added to the file name automatically.

! Do not store Excel files in the project subfolder created by the software. This may lead to a corrupted data structure. !

The first rows of the Excel sheet contain general information about the SensorDish® Reader and Project settings. The subsequent rows contain the measurement data in the selected format. The time, internal temperature of the SensorDish Reader (only for information, not for calculation) and error message of any error that may occur during the measurement is stored in a separate row after the measurement data. If re-calibration was activated for a pH measurement, the new pH0 values are also stored in the Excel or ASCII file.

Format table

Format	Excel Format											
1	Time/Sec.	A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	
	1	100.84	100.18	100.36	100.36	100.34	100.36	100.55	100	100.54		
	16	100.34	99.82	100	100	100.51	100.36	100.36	100.36	100.9		
	31	100.34	100	100.36	100.18	100.68	100.18	100	100.18	100.36		
2	Time/Sec.	A1	A2	A3	A4	A5	A6	B1	B2	B3		
	1	100.84	100.34	100.54	100.35	100.18	100.18	100.18	100.36	100.36		
	16	100.34	100.51	100.9	100.35	100	100	99.82	100.36	100.36		
	31	100.34	100.68	100.36	100.18	100	100	100	100.18	100.18		
3	Date/Time	26.06.07 17:5		Time / Sec.		1						
		1	2	3	4	5	6					
	A	100.84	100.34	100.54	100.35	100.18	100.18					
	B	100.18	100.18	100.18	100.36	100.54	100.18					
	C	100.54	100.18	100.36	100.18	100.36	100.55					
	D	100.36	100.55	100.36	99.82	99.64	100					
	Date/Time	26.06.07 17:5		Time / Sec.		16						
		1	2	3	4	5	6					
	A	100.34	100.51	100.9	100.35	100	100					
	B	100	100	99.82	100.36	100.36	100.18					
	C	100.36	100.18	100.18	100	100	100.36					
	D	100	100.36	100.36	99.45	99.45	100.18					

10 Trouble Shooting

This table should help you at some error messages which might occur using the software. It is far from being complete. We try to improve it continually. If you discover other items which should be on the list, or if the suggestion "What to do" do not help, please contact us!

Error	What's the reason?	What to do?
At installing the software: Error 1931 (a dll file cannot be updated because it's protected by Windows)	Known Windows bug	Click on OK (ignore the message); installation will be ok despite this message
At opening the software: "Power Status checking software does not exist, please contact administrator!"	The file SDR_v37.exe has been removed from its original place (e.g. by drag & drop).	Copy the file SDR:v37.exe back to the original positions (default: Programs/SDR_v37).
At trying to upload a previous project: "Err no : - 13, Type mismatch cXML.getNodeValue"	The regional settings are not the same as the ones when the measurement was performed.	Switch back to the original regional settings (must be English (US) or German).
At trying to upload a previous project, there are no data in the graphs and actual values.	The xml file cannot find the data files (by default stored in a folder with the same name)	<ol style="list-style-type: none"> 1) Check if the internal path was changed manually (often happens at copying measurements from one place to another): The folder and the xml file must be located in the same folder. 2) Has the Project been renamed manually? Check this by double-clicking on the xml file. You find a line with "FileName", check if it's the same as it is now. If not, rename it back to the original name manually.
At connecting: "SDR not found".	The software is searching for the SDR device and cannot find it. This can have several reasons.	<p>Make sure that</p> <ol style="list-style-type: none"> 1) the SDR is connected to power (left LED on the Splitter should be on) 2) the active ComPort (see lower left corner in the SDR software) is the one connected to the SDR. The middle LED should blink when you press connect. 3) that no other program is running
"No response from device after power on!"	Occurs after "No SDR found."	Click on "Close" sign (cross in upper right corner) and continue.
"No sensor" for actual values	The signal amplitude is too low.	Check if the SensorDish rests in the groove of the SensorDish Reader.
In the Excel file: error code E1 in the column Error, e.g. E1(C1), E1(C2)	Occurs at too much ambient light. C1 and C2 are the channels involved.	<ol style="list-style-type: none"> 1) Make sure no ambient light can get to the SDR 2) If ambient light is not the reason, ignore it as a "false alarm". The values are ok.

11 General Instructions

11.1 Maintenance

The instrument is maintenance-free.

The housing should be cleaned only with a moist cloth. Never use benzene, acetone, or other organic solvents. Cleaning with ethanol (using a cloth) is allowed.

11.2 Service

Balancing, maintenance and repair work may only be carried out by the manufacturer:

PreSens
Precision Sensing GmbH
Josef-Engert-Straße 11
93053 Regensburg
Germany

Phone +49 941 942 72 100

Fax +49 941 942 72 111

Email info@PreSens.de

Internet www.PreSens.de

Please contact our service team in case of any questions. We are looking forward to helping you and are open for any questions and criticism.

12 Technical Data

Required environmental conditions for operating the instrument:

Temperature: +15°C to +45°C,

Relative humidity: IP64 waterproof

Modes	
oxygen	range: 0 - 250 % air saturation resolution: ± 2% air saturation accuracy: ± 5 % air saturation
pH	range: pH 6.0 – 8.5 resolution: ± 0.05 pH accuracy: ± 0.2 pH (for known ionic strength)

Power adapter	
Type:	Mascot 9920
Input:	100-240V AC 50-60Hz max .0,9A
Output:	24V DC 1,6A /40W
Protection category:	IP 20 ! NOT WATERPROOF !
Certification:	CE Category B, EN60950, UL2601-1

Splitter	
Type:	SP1.1 or higher
Input:	18-24V DC 1,5A
Circuit points:	Power adapter, RS-232 interface, SensorDish® Reader
Baud rate:	38400, 8 data bits, no parity, 1 stop bit, no handshake
Protection category:	IP 20 ! NOT WATERPROOF !
Certification:	CE Category B

SensorDish® Reader	
Type:	SDR v3 or higher
Input:	18-24V DC 150mA
Baud rate:	38400 kbit/s
Protection category:	IP 64* ! WATERPROOF !
Certification:	CE Category B

*only with connected RJ-45 cable and end cap

13 Concluding Remarks

Dear customer,

With this manual we hope to have been able to provide you with a preliminary introduction to working with the SensorDish® Reader system.

This manual does not claim to be complete. We are endeavoured to improve and supplement this version.

We are looking forward to your critical review and to any suggestions you may have.

With best regards,

Your PreSens Team