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DatLab 2 Analysis Manual

High-Resolution of Data in the Lab

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Cooperation and Feedback in Science

OROBOROS® **www.oroboros.at** provides basic information, application notes and service notes and information about current developments complementary to the DatLab Manual. Information on updates of DatLab is distributed to all registered users.

If you have any comments on DatLab and the DatLab Manual *High Resolution of Data in the Lab*, we will be pleased to receive them at:

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DatLab 4

For the OROBOROS Oxygraph-2k, DatLab 4 has been developed under Windows®. The MS-DOS version DatLab 2.1 is applied for specific analyses (high time resolution; oxygen kinetics).

DatLab 2 Analysis Manual

Important User Information

Please, read the DatLab Handbook "High Resolution of Data in the Lab" carefully before attempting to install or use the DatLab software.

The software DatLab 2.1 Analysis consists of two independent components designed for full compatibility.

1. Software license

You may and should make one backup copy of the original Setup Disk. You may not make copies of the program or of any file of the Setup Disk for distribution, lease or sale to another party.

2. Copyright

All rights to the program, including the rights to copy, distribute, and translate this software remain with OROBOROS® INSTRUMENTS, Innsbruck, Austria.

3. Limited warranty

If you report, in writing, a significant defect in this software which cannot be corrected within 90 days of the date of the report, you may return the program and be refunded the purchase price. Defective diskettes will be replaced at no charge within 90 days of the date of purchase.

4. Disclaimer

This software is a tool intended to be used by trained professionals only. It is not a substitute for your personal professional judgment. This software has been carefully designed. In a computer program of this elaboration defects cannot be completely ruled out. Under no circumstances may this software be used in tasks involving human health or safety. Persons using this software are responsible for the supervision, management, and control of this software. This responsibility includes, but is not limited to, the establishment of independent procedures for testing the reliability and accuracy of any program output.

5. Limitation of liability

The manufacturer and distributor of this software will not be held liable for damages including loss of data, lost profits, or other special, incidental or consequential or indirect damages arising from the use or inability to use this software.

6. Specifications

Since product development and improvement is a continual process, OROBOROS reserves the right to make changes in the specification without notice.

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A. DatLab 2 Keys, Symbols and Definitions

A1. Hot Keys: Alternate Letters

Alternate letters [Alt-X] generally are used to select a pull-down menu from a list of alternative choices. In cases, the letter alone [X] may yield the same effect.

Aq: DatLab Acquisition
An: DatLab Analysis

Key	Term	Aq	An	Section	
Alt-C	**C**alculate		+		D7
Alt-D	**D**ata sets		+		D8
Alt-F	**F**ile	+	+	C3	D4
Alt-G	**G**raph	+	+	C6	D10
Alt-I	**I**nfo	+	+	C8	D12
Alt-M	**M**arks		+		D9
Alt-O	**O**xygraph	+		C5	
Alt-O	T**o**ols		+		D6
Alt-Q	**Q**uit	+	+		
Alt-T	**T**ext	+	+	C4	D5
Alt-U	**U**ndo		+		D13
Alt-W	**W**indows	+	+	C7	D11

A2. Hot Keys: Control Letters

Control letters [Ctrl-X] generally are used as a shortcut to a specific action, in some cases complementary to function keys.

Aq: DatLab Acquisition
An: DatLab Analysis

Key	Function	Aq	An
Ctrl-**A**	**Autoscale** signal (Aq), all axes (An) of active data	+	+
Shift+Ctrl-**A**	Autoscale **all axes** of all selected data sets		+
Ctrl-**B**	Autoscale *Y* axis of active data set from **baseline**	+	
Ctrl-**C**	**Change** line style between lines and data points		+
Ctrl-**D**	Toggle between marks **deleted**/restored		+
Ctrl-**F**	**Fast** cursor speed		+
Ctrl-**G**	Save HPGL **graphic file**		+
Ctrl-**L**	Toggle between **lines** of the grid on/off		+
Ctrl-**O**	**Other** zoom, toggle between zoom out/in		+
Ctrl-**P**	**Print** hard copy on HP laser printer	+	+
Ctrl-**R**	**Round** cursor to next data point		+
Ctrl-**S**	**Slow** cursor speed		+
Ctrl-**W**	**Switch** marked/unmarked sections		+
Ctrl-**X**	Autoscale ***X*-axis** of active data set		+
Shift+Ctrl-**X**	Autoscale ***X*-axes** of all selected data sets		+
Ctrl-**Y**	Autoscale ***Y*-axis** of active data set		+
Shift+Ctrl-**Y**	Autoscale ***Y*-axes** of all selected data sets		+
Ctrl-**Z**	Switch from {Mark} to {**Zoom**}, and toggle between these modes		+
Shift-**Esc**	Interrupt a macro at pauses		+

A3. DatLab 2 Function Keys

Key	Term	Aq	An
F1	**H**elp	-	-
F2	Open **A**nalyzed file		+
Ctrl-F2	**S**ave DatLab file	+	+
Alt-F2	Open **R**ecorded file		+
F3	**N**otebook information for display and editing	+	+
Ctrl-F3	Edit label of *Y*-axis		+
Shift-F3	Edit label of *X*-axis		+
Alt-F3	Edit title note	-	-
F4	**E**vent and comment	+	+
Ctrl-F4	Mark table with statistics		+
Shift-F4	Event table with comments		+
Alt-F4	Close		+
F5	**P**lay macro		+
Ctrl-F5	**C**alibrate oxygen	+	+
F6	**D**efault axes	+	
Ctrl-F6	**E**dit defaults, signal, flux and time scale	+	
F7	**S**ignal scale, *X* and *Y* scale; define graph window	+	+
Ctrl-F7	**F**lux scale	+	
F8	**A**utoscale signal of active data set	+	+
Ctrl-F8	A**u**toscale flux	+	
F9	Open graph window; **F**ull/Half (open 1 or 2 windows)	+	+
Ctrl-F9	**S**elect data set		+
	or **S**elect/switch chamber	+	
Shift-F9	**S**ize/move input window		+
Alt-F9	**N**ext text window		+
F-10	Menu bar	+	+
Ctrl-F10	**R**ecord macro / Stop recording macro		+

A4. Arrow Keys in the Graph Window

The arrow keys move the axis of the figure, for panning and scrolling, to view various sections of the graph. Alternatively (in DatLab Analysis), arrow keys are used to move the cursor over the screen [Shift-Arrow].

→	Pan **right** on the *X*-axis; time increases
←	Pan **left** on the *X*-axis
PgUp (or: ↑)	Scroll **up** on the *Y*-axis; signal increases
PdDn (or: ↓)	Scroll **down** on the *Y*-axis
Ctrl-→	Zoom **in** on the *X*-axis, reference left; range decreases
Ctrl-←	Zoom **out** on the *X*-axis, reference position left
Ctrl-PgUp	Zoom **in** on the *Y*-axis, reference bottom; range decreases
Ctrl-PgDn	Zoom **out** on the *Y*-axis, reference position bottom
Shift-→	Move the cursor **right**
Shift-←	Move the cursor **left**
Shift-↑	Move the cursor **up**
Shift-↓	Move the cursor **down**

A5. Symbols

A5.1. Safety symbols in the text

⇒ **Information**: Messages appearing after the symbol "Information" specify important information to emphasize specific passages of the text.

☞ **Caution:** Messages appearing after the symbol "Caution" specify instructions which the user should strictly follow to avoid loss of data.

A5.2. Keyboard strokes

Instructions for key strokes on the keyboard are given in the following formats.

[ ] Key: A key on the keyboard of the computer or instrument is specified in the text by putting into brackets the symbol, letter or word representing the key.

{ } Text on the screen: A text or symbol displayed on the screen is specified in the text by putting into braces the corresponding text or symbol.

< > Event label: An event label is indicated in the text by putting into <> the corresponding letter or symbol <*>.

[X] Letter [X].

[Shift-X] [Shift-X]: Hold down the "Shift to upper case" key [⇧] while typing [X].

[Alt-X] [Alt-X]: Hold down the [Alt] key while typing [X].

[Ctrl-X] [Ctrl-X]: Hold down the "Control" key [Ctrl] while typing [X] (German keyboards: [Strg]).

[Shift+Ctrl-X]: Hold down simultaneously [Shift] and [Ctrl] while typing [X].

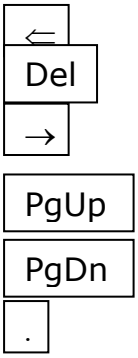
[F1] Function key [F1]; and correspondingly [F2] to [F10].

[Tab] "Tabulator" key [Tab].

[Esc] "Escape" or "Cancel" key [Esc].

[Enter] or "Carriage return" key.

[Ins] "Insert" key [Ins] (German keyboards: [Einfg]).



"Backspace" key.

"Delete" key [Del] (German keyboards: [Entf]).

"Right arrow" or "Cursor" key [→]; and correspondingly [←], [↑], [↓].

"Page Up" key [PgUp] (German keyboards: [Bild ↑]).

"Page Down" key [PgDn] (German keyboards: [Bild ↓]).

Decimal symbol [.]; do not use [,] for the decimal symbol.

A6. Keyboard and Mouse Operations

A6.1. Keyboard

The program can be operated by the use of the keyboard and the mouse. For DatLab Analysis, the use of a mouse facilitates operations in the graph window.

For the presentation of key strokes in this Handbook, see Section A5.

A6.2. Mouse operations

A pull down menu or dialogue option can be selected by moving the pointer into the respective field and pressing the left mouse button once. This may simultaneously activate the operation. More generally, an operation is activated by clicking the left mouse button twice. Pressing the mouse button while the pointer is outside the selection cancels the operation.

Analysis graph window: Moving the mouse along the time axis while pressing the left or right mouse button generates or deletes a marked section. Moving the mouse from one coordinate to another while pressing [Shift] and the left mouse button defines the enlarged window for zooming.

A6.3. Buttons to select program options

Buttons are standard options to be selected, such as {O**k**}, {**Y**es}, {**N**o}, {**C**ancel}, or special options such as {Analysis}.

Tab	Tabulator: Switch to consecutive buttons using this key.
Alt	Alt key: Select a specific button by pressing the Alt key while typing the highlighted letter, e.g. [Alt-F] for {**F**ile} operations.
↵	Enter: Verify and activate a selected and highlighted button. Alternatively, click the mouse on the button once or twice to select and activate the operation.
Esc	Escape: An operation is canceled.

A6.4. Input lines

Input lines are defined lines on the screen for giving answers to specific questions in terms of an input of numbers or text.

⇒ As the decimal symbol type [.]; do not use [,] for the decimal symbol.

For editing the input, you can use the mouse, cursor keys, or [Ins], [Del], [Backspace], [Home] and [End].

Switching between input lines is effected by [Tab].

An arrow {↓} besides the input line indicates that you can scroll through the history of previous inputs by clicking the mouse on the arrow or pressing the down key [↓]. Then a list of previous inputs is displayed. Any of these inputs can be selected using the mouse or the keys [↑] and [↓]. Verify by [Enter].

A7. Definition of Terms

⇒ **The following definitions or explanations of specific terms are useful as a general introduction to DatLab.2**

A7.1. Specific terms in DatLab 2

DL	DatLab Program.
Event	An event is a defined point in time, labeled by a selected letter shown in the graph. A short comment can be entered from the keyboard.
Mark	A mark is a defined period of time, shown by a bar, defining a section of the experiment. Several marks can be set which are characterized by sequential numbers (in Analysis).
Marked section	The data in a section of the experiment combined by a mark. One or several sections of an experiment can be marked (in Analysis).
Notebook	The DatLab notebook allows entering and editing notes from the keyboard during any time of the experiment or analysis. The notebook entries are stored in ASCII format and can be imported into standard word processor programs.

A7.2. General terms

Default settings	Values suggested or used by the program as parameters or variables for various operations.
Function key	Keys [F1] to [F10] on the keyboard associated with specific operations of the program.
Function key bar	Bottom line of the screen which lists selected function keys and hot keys.
Menu bar	Top line on the screen which lists the main groups of program operations which are supported by menus.
Time correction	Correction of measured data for the instrument-specific time resolution, on the basis of calibrated exponential

time constants.

Toggle — To turn something on or off using the same key. Pressing the highlighted key switches between selected or not selected.

A7.3. Data

Active data set — The data set selected from a number of opened or generated sets on which operations are performed.

Data point — A single measured or calculated value associated with a defined point in time.

Data set — Data points equally spaced in time. Data sets in one file may contain data from a single recorded file at various stages of the analysis and data from different recorded files.

DLA — DatLab Analyzed files, containing one or several data sets originating from one or more DLR files.

DLR — DatLab Recorded files, containing one set of raw data transmitted by the OROBOROS Oxygraph (Paar model), and including event labels, experimental parameters and text.

Sampling interval — The constant time interval, Δt [s], between two data points for recording sequential data, i.e. the inverse of the sampling rate.

A7.4. Graph window

Autoscale — Setting of the horizontal or vertical axis to display all available data on the screen.

Pan — Horizontal displacement of the data on the screen.

Plot type — Data are plotted as a function of time, as recorded with time on the *X*-axis. In DatLab Analysis, the plot type can be changed to a *Y*/*X* plot, with a data set (e.g. oxygen flux) on the *Y*-axis plotted as a function of another data set (e.g. oxygen pressure) on the *X*-axis.

Scroll — Vertical displacement of data on the screen.

Signal range	Difference between the highest and lowest value displayed on the signal (vertical) axis.
Zero position	Value of the axis on the origin (lower left corner).
Zoom in	Display a part of the graph, thus enlarging the figure and displaying a smaller range of the axes.
Zoom out	Display more than the visible part of the screen, thus compressing the figure and displaying a larger range of the axes.

A7.5. Oxygraph

Chamber	Chamber A (left, channel 1) or chamber B (right, channel 2) of the Oxygraph, each recorded independently as a separate channel and displayed in a separate window or optionally superimposed as different data sets in one graphic window (Analysis).
Signal	Non-calibrated or calibrated magnitude of the data received from the measuring instrument, e.g. the oxygen signal from the Oxygraph.
Flux	Negative time derivative (slope) of the signal, scaled by a defined flux factor (default is 1000) to convert to convenient units (e.g. from 0.001 nmol·s^{-1}·cm^{-3} to 1.0 pmol·s^{-1}·cm^{-3}), or to calibrate the flux in terms of the amount of sample used in the experiment. Oxygen flux, J_{O_2}.
Flow	Respiratory rate per system. The system must be defined, e.g. the respirometer chamber [pmol·s^{-1}], or the experimental cell [pmol·s^{-1}·10^{-6} cells]. Oxygen flow, I_{O_2}.

B. Introduction

B1. High resolution - the dramatic difference

High-resolution methods, such as Oxygraph High-Resolution Respirometry, critically depend on flexibility of graphical data display and visual magnification of the signal, offered by DatLab. Expanding or compressing the signal and time scales for the display of selected sections of an experiment reveals information not obtained by ordinary equipment.

The flexibility for the display of variable signal and time ranges - on-line and with reference to past events - makes a decisive difference. Dramatically different is the evaluation of a record depending on the display.

An example illustrates the power of high resolution (Figures B1 and B2).

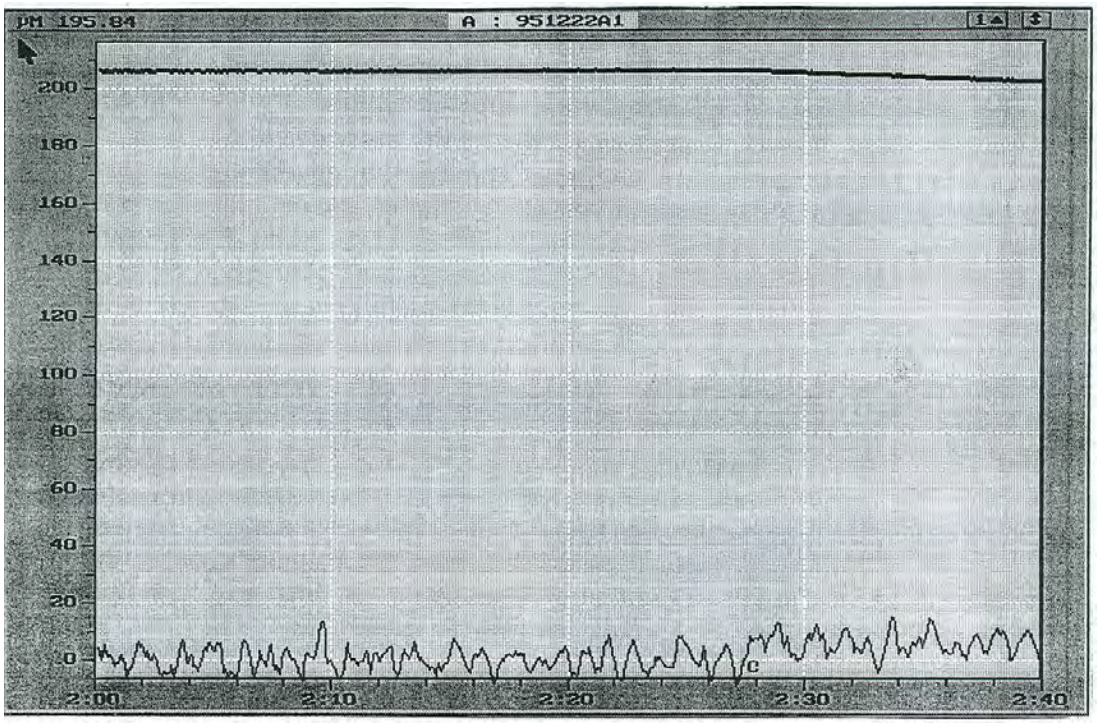


Figure B1. Standard Oxygraph recording showing oxygen concentration [µM] (heavy line, top). No dramatic event is apparent from the oxygen signal. Signal range: 210 µM; Time range: 40 min, from 2 hours to 2 hours and 40 min of the experiment.

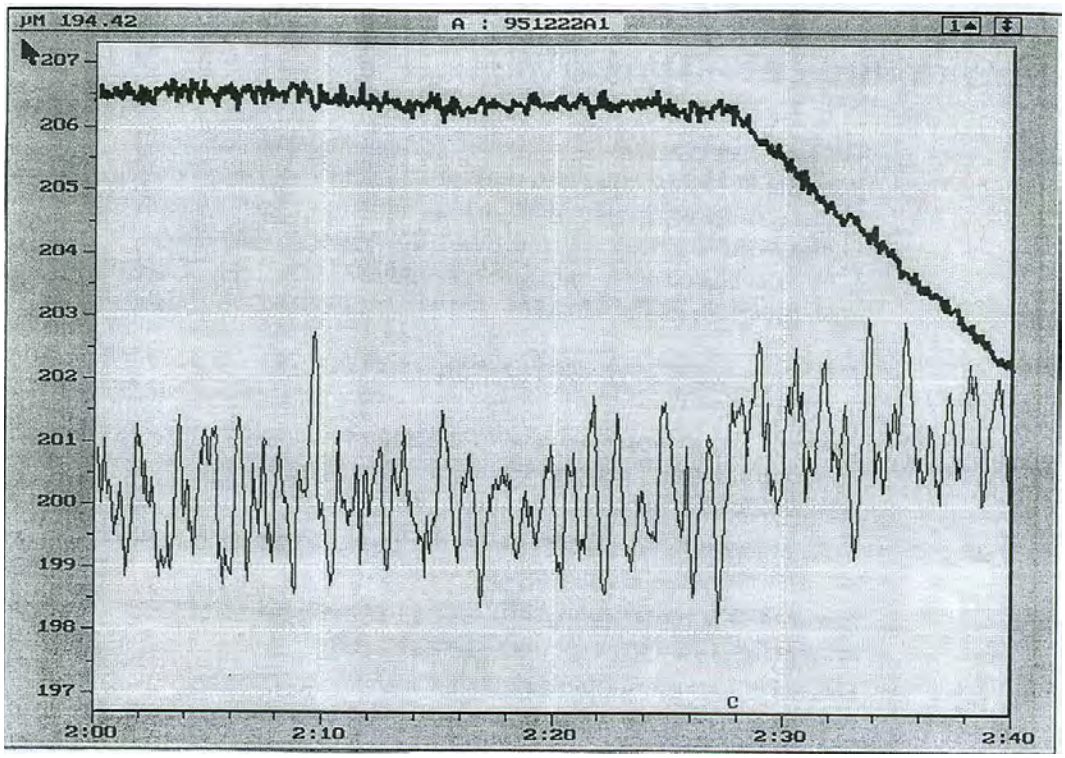


Figure B2. High-resolution display of oxygen concentration [µM] (heavy line, top) and oxygen flux (thin line, bottom). Compare the identical data displayed at low resolution in Figure B-1. The event of closing the chamber at time 2:28 (Event label "C") is now seen to cause a dramatic decrease of oxygen concentration, not apparent at low resolution. Before closing the chamber, a gas phase of air was in equilibrium with the stirred medium for air calibration, with zero flux at steady state. The flux is displayed with a shift of the zero position to a value of 200. Flux increases after closing the chamber to a constant level above 200.

Experiment 951222A1:[1] 25 °C, 94.1 kPa; sucrose medium, 2 cm^3 chamber volume; stirring 350 rpm; sampling interval 2 s.

[1]The negative time derivative is multiplied by 200 (the scale factor for the flux is 200). Therefore, each unit is equivalent to 5 pmol $O_2 \cdot s^{-1} \cdot cm^{-3}$. For these settings, the average flux at a level of 201 was 5 $pmol \cdot s^{-1} \cdot cm^{-3}$ after closing the chamber.

B2. Data in the Lab - DatLab

DatLab was developed especially for data acquisition and analysis in high-resolution respirometry and microcalorimetry. Experimental examples refer to applications of DatLab with the OROBOROS Oxygraph (Anton Paar KG, Austria), and Thermal Activity Monitor TAM (ThermoMetric AB, Sweden).

OROBOROS Oxygraph software DatLab

- DatLab Acquisition and on-line display of oxygen concentration and oxygen flux (time derivative) for 2 independent channels.
- Data sampling interval 200 ms and higher. A sampling interval <1 s is not recommended.
- Menu-driven calibration of the oxygen signal and automatic conversion into oxygen concentration [µM].
- Notes on the PC: Entry and display of notes at any time during data recording and analysis, and event-marker for comments.
- Digital recording of experimental temperature and barometric pressure.
- DatLab Analysis of any data set representing time series, such as the continuous recording of experimental data and A/D conversion with a constant data sampling rate.
- Up to 10000 data points can be handled in one data set, and up to 15 data sets can be displayed and analyzed simultaneously.
- Application examples and guidelines for high-resolution respirometry, automatic analyses with optimized macros.

B3. DatLab Directories and Files

B3.1. Directories

An overview of the DatLab directories and subdirectories is shown in the diagram on the following page.

B3.1.1.DatLab directory for programs

C:\DATLAB	DatLab directory
C:\DATLAB\DL_MACRO	DatLab MACRO subdirectory
C:\DATLAB\DL_PROG	DatLab PROGRAM subdirectory

B3.1.2.DatLab directory for data

C:\DATADLDatLab	DATA directory
C:\DATADL\DL_DEMO	DatLab subdirectory containing data for demonstration and practicing.

The number of data files increases quickly and then requires arrangement into subdirectories. Subdirectories are organized according to experimental groups. Within an experimental group, subdirectories may be generated for each experimental day, using the date as a subdirectory name. It is advisable to keep all DatLab Data subdirectories under the directory DataDL.

For example, an experimental series with human endothelial cell cultures (HUVEC), testing medium B, may be organized in the following way:

C:\DATADL\HUVEC\970101*.*
Experiments on day 1997-01-01 (970101A1.DLR; 970101A1.DLA; etc.).

B3.2. Data files in DATADL

Data files are stored using a file name with maximally eight digits, and an extension of three digits. A careful organization of data files in terms of names and subdirectory placement is essential.

B3.2.1. DatLab Recorded data

*.DLR **D**at**L**ab **R**ecorded files are generated by DatLab Acquisition for DatLab Analysis.

For your convenience a default format of file names is suggested, attaching automatically to each file name four general informations:

1.	970124	The date of recording: Year, Month, Day.
2.	A	The channel or chamber notation: A (left) or B (right).
3.	1.	The sequential number for each date: 1 to 9 and A to Z.
4.	.DLR	The origin of the file: *.DLR for DatLab **R**ecords, *.DLA for DatLab **A**nalyses.

The advantages of this simple naming system are:

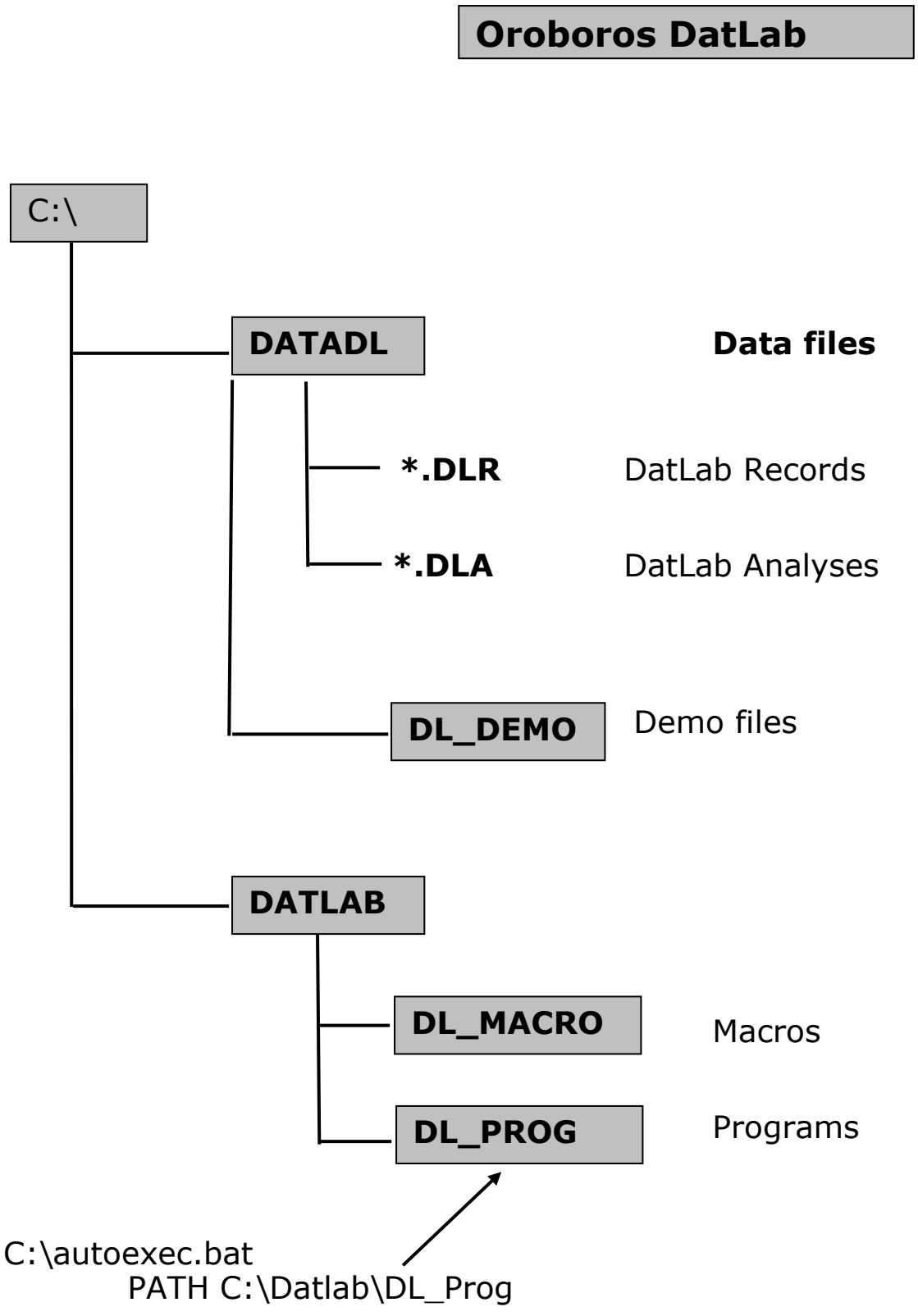
1) Automatic arrangement, retrieval and ordering of files is simplified.

2) The same file name is not likely to be used twice. If you are operating two Oxygraphs in your lab, you may change the notations for left and right chambers (L and R) to an alphabetical sequence (A and B for the first Oxygraph, C and D for the second, etc.).

3) The extension characterizes the nature of the file. When screening through a DataDL subdirectory, you will immediately see if a record (*.DLR file) has already been analyzed and stored as a *.DLA file under the same file name.

B3.2.2.DatLab Analyzed data

*.DLA **D**at**L**ab **A**nalyzed files are generated by DatLab Analysis after processing either recorded files (*.DLR, or ASCII files) or after further analysis of previously stored *.DLA files.


Oroboros DatLab
C:\
DATADL
Data files
*.DLR
DatLab Records
*.DLA
DatLab Analyses
DL_DEMO
Demo files
DATLAB
DL_MACRO
Macros
DL_PROG
Programs
C:\autoexec.bat
PATH C:\Datlab\DL_Prog

D. DatLab Analysis

D1.-D2. Quickstart of DatLab Analysis and overview on menus and function keys.
D3. Operations specific for the graph window.
D4.-D13. Individual menu operations as arranged on the menu bar.

D1. Quick start

DatLab files for analysis should be in a subdirectory in C:\DataDL (Section B3.1 and B3.2). For a quick start, use a demonstration example and DatLab Macros. *(1)* The oxygen signal is calibrated, *(2)* oxygen flux is calculated and displayed on a graph, *(3)* a table of average fluxes is displayed for marked sections of the experiment.

Type [**DL**] to start DatLab. Select {**Analysis**} using the [**Tab**] key. Confirm by [**Enter**] to start DatLab Analysis. The operation {**F**ile}\{Change **D**irectory} is proposed as a default. Select your work directory and confirm by [**F5**]. The subsequent suggestion is to open a recorded DatLab file.

F5

DatLab Macros which provide a highly automatic and interactive approach to standard analyses of Oxygraph experiments. DatLab Macros constitute a programmed series of operations, providing guidelines to various options within program execution. Short instructions appear on the bottom line of the screen. Specific information on DatLab Macros are provided in OROBOROS News. Datlab Software Support.

F1

Within DatLab Macros, short instructions appear on the bottom line of the screen, and **[F1]** is available for a more extensive help menu.

F5

After a pause within macros, proceed by [**F5**].

Press [**Shift-Esc**] to terminate a macro without proceeding to the end of a macro program. Since the

analysis is then interrupted in an undefined state, it is advisable to close the file before proceeding with the program.

☞ If you want to exit the program, type [**Alt-Q**]. Verify exit only if data have been saved or should be erased.

D2. Menus and Function Keys

D2.1. DatLab Analysis menus - F10

Menu bar The top line of the screen is the menu bar, containing a list of menu options.

Mouse Click the **left** mouse button on the menu option in the menu bar and in the sequentially displayed pull-down menus for selection and confirmation of an option. Click the **right** mouse button to cancel.

Keyboard Type the **highlighted letter** (or [Alt] and the highlighted letter), and for selection and confirmation continue to type the highlighted letter in the pull-down menu which appears under the menu option. You may also use the arrow keys to move horizontally and vertically through the menu options. Type [Enter] to confirm the highlighted choice. Press [F10] or [Esc] to cancel and return to other options on the menu bar.

Function key bar Function keys, [F1] to [F10], provide fast access to specific menu options. Selected function keys and hot keys are shown on the function key bar on the bottom of the text screen. Other function keys and specific hot keys are shown in the pull-down menus. Pressing the function key or clicking the mouse on the function key bar is a short-cut to activate a specified operation.

D2.2. Function keys

F1			Help in DATLAB macros.
Shift-F1			Help index (*not installed*).
F2	File	Open Analyzed file	Open a DATLAB Analyzed file (*.DLA).
Ctrl-F2		Save	Save a DATLAB file.
Alt-F2		Open Recorded file	Open a DATLAB Recorded file (*.DLR).
F3	Text	Notebook	Notebook information for display and editing.
Ctrl-F3		Graph	Edit label of *Y*-axis.
Shift-F3		Graph	Edit label of *t*-axis.
Alt-F3		Graph	Edit title note.
F4		Graph window	Set event.
Ctrl-F4		Mark statistics	Table with statistics on data in marks.
Shift-F4		Event table	Table with events and comments.
Alt-F4	Windows	Close	Close the active text window.
F5	Tools	Play macro	Execute the series of operations programmed in a selected macro.
Ctrl-F5		Calibrate oxygen	Calibrate the *Oxygraph* signal in units of oxygen concentration [μM].

F7	Graph	Axes scale	The signal and time axes are scaled on the basis of defined ranges and zero positions.
F8		Autoscale *Y*-axis	Autoscale the *Y*-axis of the active data set.
F9	Windows	Graph window	Open graph window.
Ctrl-F9	Data sets	Select	Select active data set and data sets for display.
Shift-F9		Text window	Change size of text window by Shift-arrow key, and move by arrow-key.
Alt-F9	Windows	Next	Select next text window.
F10	Menu bar		Display the menu bar for selecting an operation.
Ctrl-F10	Tools	Record macro	Start and stop record (programming) a macro, or interrupt playing a macro.

D3. Graph Window

F9 Open the graph window by pressing [F9].

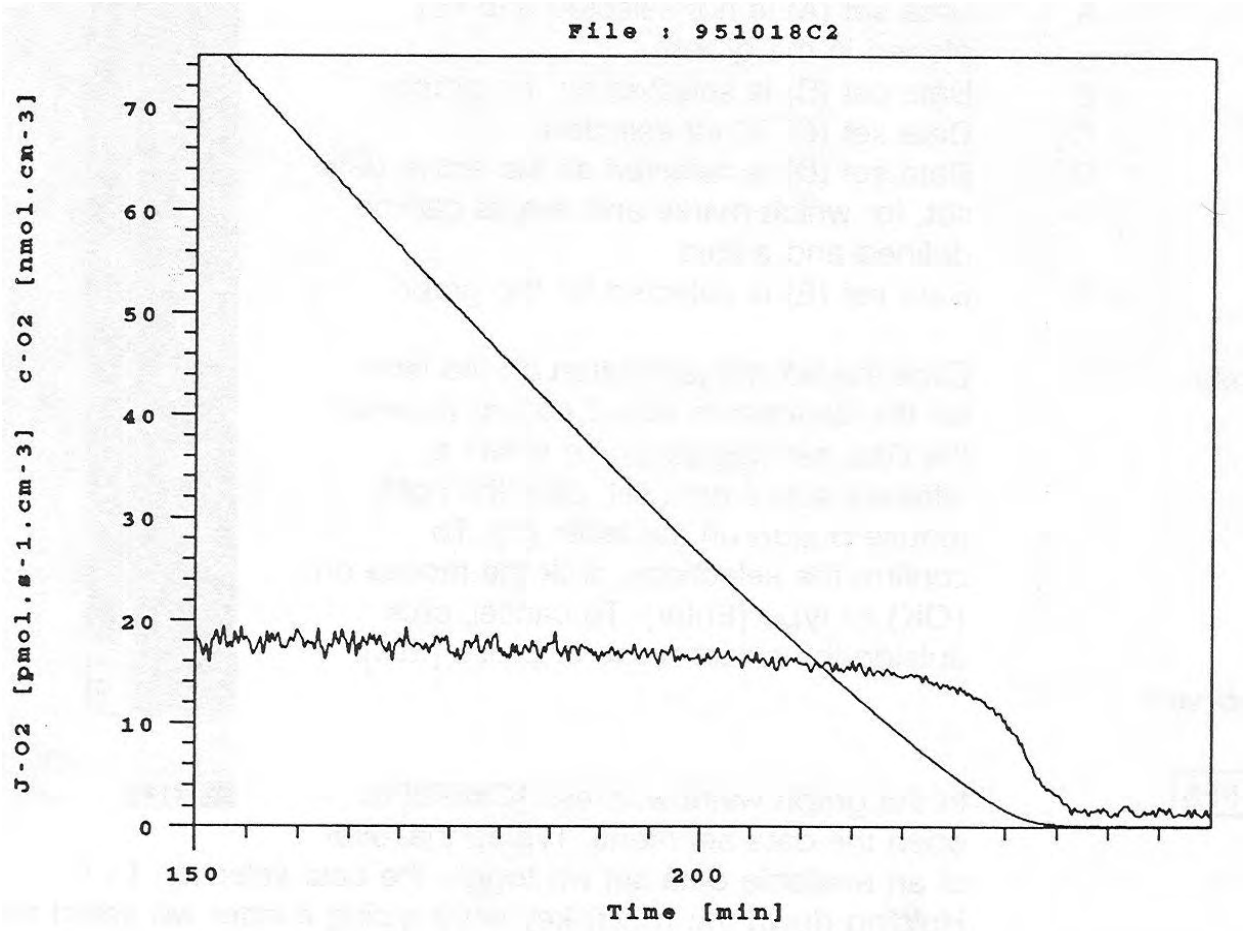


Figure D3.1. DatLab figure printed on a HP laser printer, after pressing [Ctrl-P] in the graph window. The time scale was converted to minutes, after calculating flux, JO_2. Oxygen concentration, cO_2, is displayed in the range up to 75 µM (8 kPa). Steady-state respiration of endothelial cells, 37 °C, and aerobic-anoxic transition.

Ctr-L Toggle between a display of **Lines** to form a grid and removal of the lines by pressing [Ctrl-L].

F10 or Menu To return to the menu bar in the text window, press [F10], or click on {Menu}.

For merely closing the graph window, press [Esc].

D3.1.Select data sets

A data file contains one or several data sets. For example, the vertical box on the right displays all available data sets (A to E).

A	Data set (A) is not selected and not plotted in the graph.
+B	Data set (B) is selected for the graph.
C	Data set (C) is not selected.
*D	Data set (D) is selected as the active data set, for which marks and events can be defined and edited.
+E	Data set (E) is selected for the graph.

Mouse

Click the left mouse button on the letter for the data set to select {+} or deselect the data set (toggling). To select a different active data set, click the right mouse button on the letter {*}. To confirm the selections, click the mouse on {OK} or type [Enter]. To cancel, click outside the select menu or press [Esc].

Keyboard

Ctrl-F9

In the graph window, press [Ctrl-F9] to open the data set menu. Typing the letter of an available data set will toggle the data selection {+}. Holding down the [Shift] key while typing a letter will select the active data set {*}.

[+] and [-]

Type [+] to select all available data sets, type [-] to deselect all data sets except for the active data set. Confirm with [Enter] or cancel by [Esc].

D3.2.Autoscale

Ctrl-A	**Autoscale all axes** for the active data set {*}.
Shift-Ctrl-A	**Autoscale all axes** for all selected data sets {*, +}.
Ctrl-B	Autoscale from **Baseline** the signal of the active data set {*}.
Shift-Ctrl-B	Autoscale from **Baseline** the signal of all selected data {*, +}.
Ctrl-Y	Autoscale the signal or ***Y*-axis** for the active data set {*}.

Shift-Ctrl-Y	Autoscale the ***Y*-axes** for all selected data sets {*, +}.
Ctrl-X	Autoscale the ***X*-axis** for the active data set {*}.
Shift-Ctrl-X	Autoscale the ***X*-axes** for all selected data sets {*, +}.

D3.3.Zoom

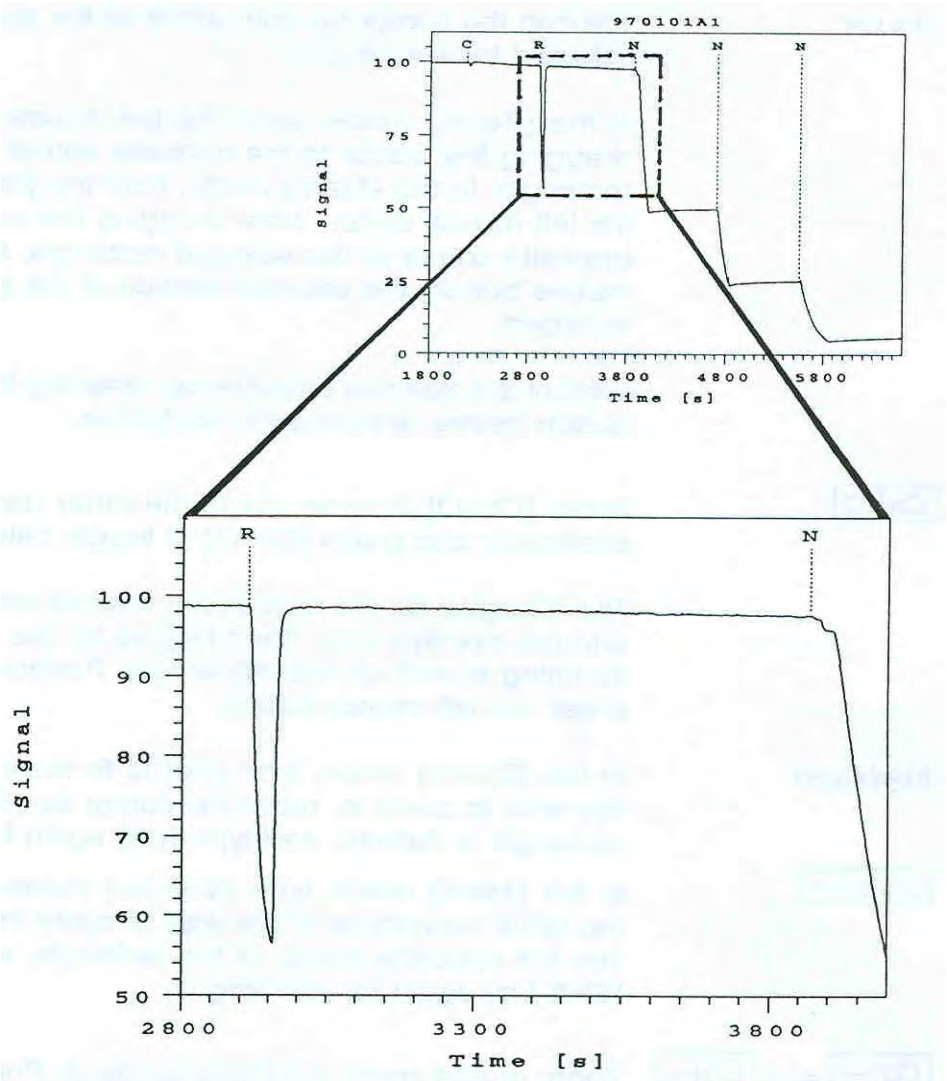


Figure D3.2. To zoom in for magnification of a selected data range, define a rectangle with the cursor in the graph (top) which will then be amplified in the new display (bottom).

Zoom	Clicking on the {Mark} button with the mouse, or pressing [Alt-Z] switches from {Mark} to {Zoom} mode.
Shift	Holding the [Shift] key temporarily changes between {Mark} and {Zoom} mode.

Mouse

Position the cursor on one corner of the squared section selected for zooming in.

In the {Zoom} mode, press the left mouse button while dragging the cursor to the opposite corner of the selected rectangle. In the {Mark} mode, hold the [Shift] key and press the left mouse button while dragging the cursor to the opposite corner of the selected rectangle. After releasing the mouse button, the selected section of the graph is displayed enlarged.

Cancel the zoom-in selection by pressing the right mouse button before releasing the left button.

Ctrl-O

Press [Ctrl-O] to zoom out to the **other** display shown previously and press [Ctrl-O] to toggle between zoom in/out.

The triangles on the right of the *X*-scroll bar are for zooming in and out the time axis. The triangles on the *Y*-scroll bar are for zooming in and out the signal axis. Position the cursor and press the left mouse button.

Keyboard

In the {Zoom} mode, type [Ins] to fix the initial coordinate of the area to zoom in, move the cursor by [Shift-Arrow] until a rectangle is defined, and type [Ins] again for zooming in.

Shift-Ins

In the {Mark} mode, type [Shift-Ins] instead of [Ins] to define the initial coordinate of the area to zoom in, move the cursor into the opposite corner of the rectangle, and type [Ins] or [Shift-Ins] again for zooming in.

Ctrl→ and Ctrl←

Zoom in and zoom out the time axis *X*. Press [Ctrl-→] for magnifying the time resolution on the screen (decreasing the time range) and [Ctrl-←] for covering a larger time range on the screen. [Ctrl-→] expands the data, half the original time range is displayed. [Ctrl-←] compresses the data display, twice the original time range is shown. The reference time point is fixed on the origin (left).

Ctr-PgUp and Ctr-PgDn

Zoom in and zoom out *Y*. Press [Ctrl-PgUp] for magnifying the signal (decreasing the signal range) and [Ctrl-PgDn] for covering a larger range on the screen

for overview. [Ctrl-PgUp] compresses the data display, while [Ctrl-PgDn] expands the data display: twice or half the signal range is displayed. The reference point is fixed on the bottom.

Ctr-O

Other zoom: Press [Ctrl-O] to zoom out and toggle between the last zoom-out and zoom-in selections.

Press {Shift+Ctrl-A} to autoscale all selected data sets.

D3.4. Scroll *Y* and pan *X*

Mouse

The triangles on the left of the *X*-scroll bar are for padding left and right the time axis. Pressing the mouse button on any position of the dotted scroll bars centers the graphic display on the respective *X* or *Y* position.

Keyboard

→ and ←

Press the arrow keys [→] or [←] for panning right or left the time axis, shifting the time axis by 50% each time.

↑ and ↓

Press the arrow keys [↑] and [↓] or the keys [PgUp] and [PgDn] for scrolling up and down the *Y* axis, with a shift of 50% each time.

D3.5.Cursor in the graph window

The cursor (mouse pointer) is a cross visible in the graph. It moves when the mouse is moved. At each position of the cursor, the *X* and *Y* coordinates are displayed on top of the graph. When the cursor is moved out of the graph, it changes its appearance into an arrow.

Mouse

Change the position of the cursor by moving the mouse.

Keyboard

Shft-Arrow

Press [Shift-Arrow] for moving the cursor into the direction of the arrow.

Ctrl-F & Ctrl-S Press [Ctrl-F] to increase the cursor speed to **fast**, decreasing the step size of the cursor. Press [Ctrl-S] to decrease the cursor speed to **slow**, increasing the step size of the cursor.

D3.6.Mark

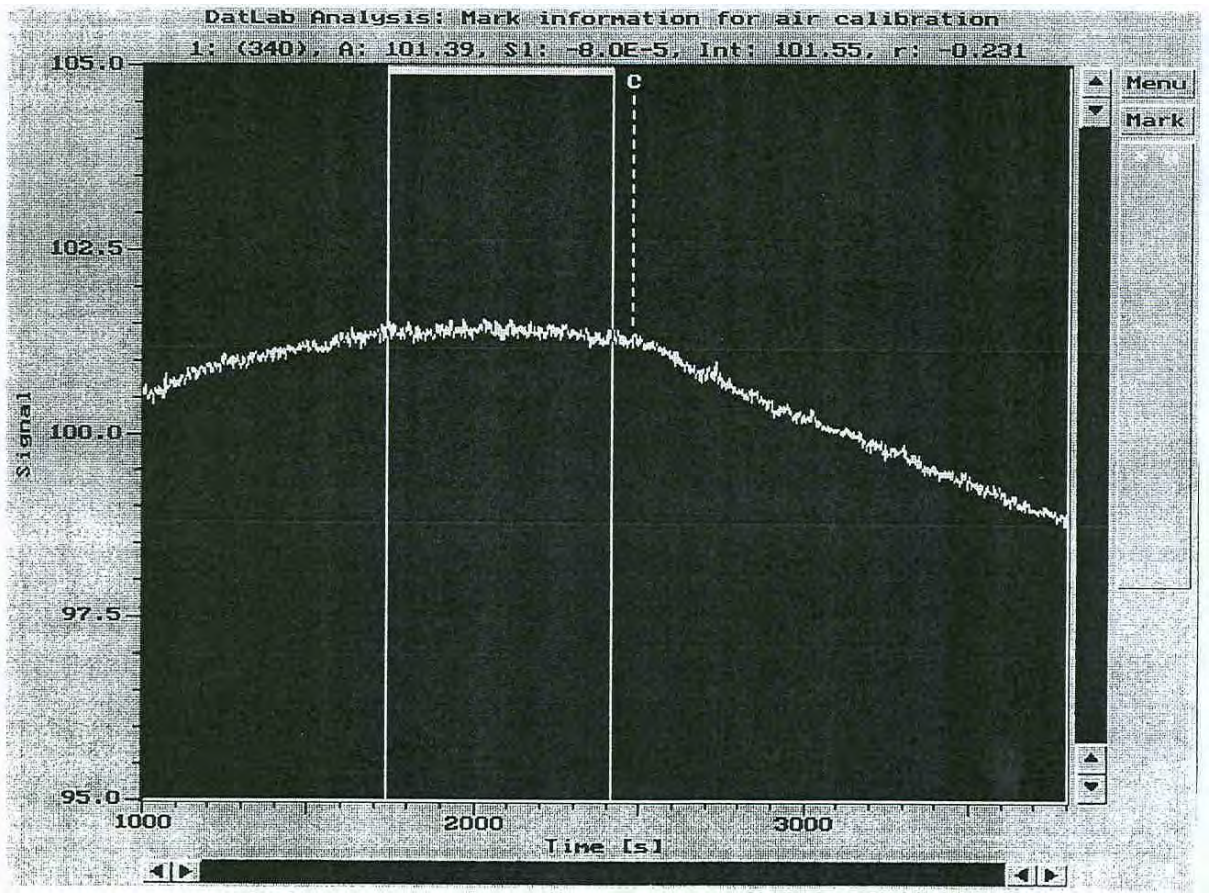


Figure D3.3. A mark is shown as a bar on the upper *Y*-axis, for the active data set *A. The lower and upper time limits of marks are indicated by vertical lines. Statistics for the mark is displayed in the graph window above the bar when the cursor is moved into the bar. 1: = Consecutive number of the mark; (340) = Number of data points in the mark; A: 101.39 = Average of data points in the mark; Sl: -8.0E-5 = Slope; Int: 101.55 = *Y*-Intercept of linear interpolation; *r*: -0.231 = correlation coefficient.

Marks are used for the display of statistical information on a selected section of the data (Section D5.6 and D5.7), and for performing many operations by DatLab Analysis selectively on the marked sections (Section D7 and D9). A mark on the active data set is displayed in the graph window as a bar on the upper *Y*-axis delimited by vertical lines at the beginning and end of the mark.

Fast information is obtained on mark statistics by moving the cursor into the mark bar on top of the graph window.

Ctrl-F4

An overview of statistical information of data for all marks is displayed in the mark statistics table after pressing [Ctrl-F4] (Section D5.6)

Integrals for the marks are displayed in the integral table. Select {**T**ext}\{Mark **I**ntegrals} (Section D5.7).

Zoom

Clicking on the {Zoom} button with the mouse, or pressing [Alt-Z] switches from {Zoom} to {Mark} mode.

Shift

Holding the [Shift] key temporarily changes between {Zoom} and {Mark} mode.

Mouse

Mark

Select the active data set. In the {Mark} mode, moving the mouse along the time axis while holding down the left button produces or enlarges a mark. Moving the mouse while holding down the right button deletes or reduces a mark.

Shift

Holding the [Shift] key temporarily changes between {Zoom} and {Mark} mode when moving the mouse with a pressed button.

Keyboard

Home

Move the cursor to the top of the graph. This is particularly useful when moving the cursor anywhere between the vertical lines of the mark and typing [Home], to position the cursor on the mark bar and display the mark statistics.

Ctrl-D

Delete marks and toggle between delete/restore of all marks by pressing [Ctrl-D].

Ctrl-W

Switch all marked sections to unmarked and *vice versa* by pressing [Ctrl-W].

Ins

Type [Ins] before moving the cursor by [Shift-Arrow], for setting a mark in the {Mark} mode, and type [Ins] again after moving the cursor to the final position of the mark.

D3.7.Events

Events are displayed as defined during the experiment with DatLab Acquisition (Section C5.2). The comments can be displayed in a text window (Section D5.3) and saved on an ASCII file (Section D4.5).

X — New event labels can be set by setting the cursor to a selected position on the time axis, and typing any letter, lower or upper case.

F4 — A comment can be added to a new event by typing [F4] immediately after entering the letter. To edit the comment of an event, position the cursor exactly on the corresponding vertical line and type [F4]. An input line opens at the bottom of the screen. Type the new text and confirm by [Enter].

Ctrl-F4 — Edit the comment of an existing event by zooming in the time axis for expanded display of the time around the event, position the cursor exactly on the time axis on the event, and press [Ctrl-F4]. Then edit the text corresponding to this event, confirm by [Enter].

⇐ — Delete an event label and comment by positioning the cursor exactly on the time axis on the event, and type [⇐] (Backspace). If this is not successful, zoom in on the time axis and position the cursor more exactly before typing [Backspace].

Ctrl-R — Round cursor to the next data point.

D3.8.Axis labels and title note

Mouse — Click the mouse on the title or an axis label to edit.

Keyboard

Ctrl-F3 — Edit label of *Y*-axis.

Shift-F3 — Edit label of *t*-axis.

Alt-F3 — Edit title note.

When editing, delete individual characters of the title or axis label to the left by typing [←] or [⇐] (Backspace) and type new text. [Ctrl-⇐] deletes the entire text. Confirm the edited text by [Enter]. Cancel and restore the original text by [Esc].

D3.9.Print and save graph

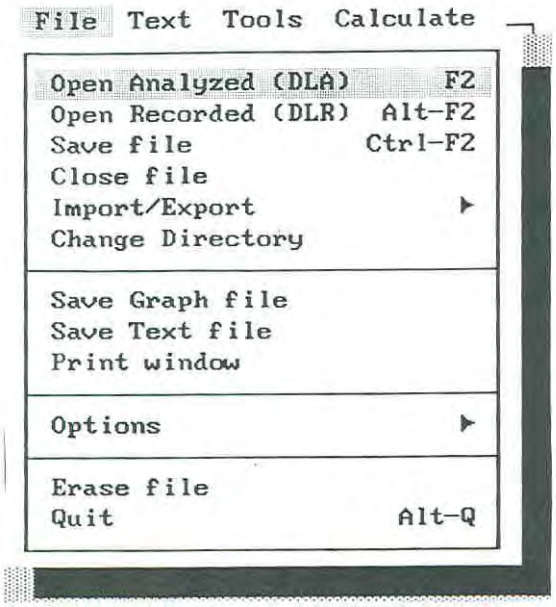
Ctrl-P

Print the figure on a HP LaserJet. Make sure that a HP laser printer is connected to your PC. Open the graph window and edit the graph. Press [Ctrl-P] and verify by [Enter] to produce a hard copy.

Ctrl-G

Save a **Graph** on a HPGL file after defining the file name. To do so, press [F10] and select {**F**ile}\{Save **G**raph file} to open an input window for editing the graphics options (Section D4.7). Return to the graph window [F9] and press [Ctrl-G].

D4. File



The menu options under {**F**ile}: Operations to open and save files, change directory, print graph and text windows, options for program default values, delete files on disk, and quit the program. An ASCII format for opening and saving files assures compatibility with a wide range of other software systems.

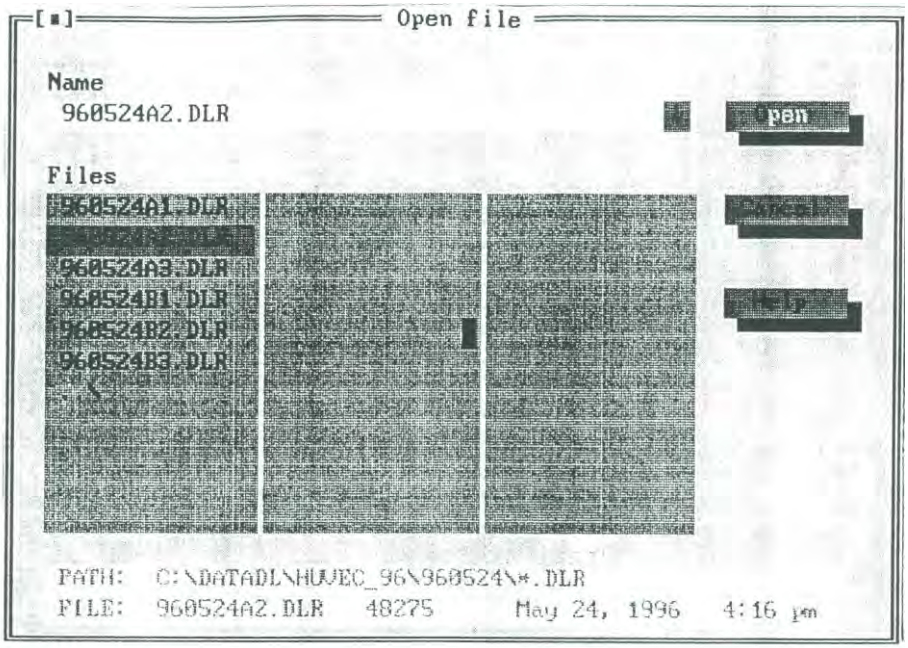
D4.1. A Open Analyzed (DLA) - F2

Open a DatLab Analyzed (*.DLA) file. DLA files are files in binary format created when saving data in DatLab Analysis. DLA files can be opened for display, for further analysis and combination with other files.

For details see Section D4.2.

D4.2. R Open Recorded (DLR) - Alt-F2

Open a DatLab Recorded (*.DLR) file, containing data recorded by DatLab Acquisition. The DatLab Recorded file contains data as transmitted by the Oxygraph and stored as a single data series (A). In addition, a DLR file contains notebook information and events with comments.



Standard dialogue window for selecting a file. The default input field is {**F**iles}. Information on the path and selected file is displayed below the input field. 48275 is the size of the file [byte]. The default mask (*.DLR) in the {**N**ame} input field is determined by the selection of open file formats, **A**nalyzed or **R**ecorded. The present example: **R**ecorded (DLR).

Mouse

Click on the selected file name with the left mouse button once to select a file, click twice to open.

Keyboard

Use the keys [↓] or [↑] to select a highlighted file. Press [→] to jump to the line {..\}. Upon [Enter] on this line, the parent directory is displayed. Press [←] to jump to the first file name of the input field. Type [Enter] to activate the operation with the selected file.

Type [Tab] or [Alt-N] to change to the {**N**ame} input field, to type in a file name or edit the mask for file selection, e.g. *.* to display all files. After typing [Alt-N] and the key [↓], previous selections are displayed. One of these lines can be selected by [↓] or [↑]. Confirm by [Enter] to display the names of files matching the mask in the {**F**iles} window.

Notebook information is displayed before importing the file. If your strategy changes on the basis of this notebook information, select {Cancel} and continue by opening a different file.

If the data set contains more data points than the limit set by the system memory (maximum is 10.000 data), the data can be either compressed, or sections of the data can be selected and stored sequentially in different data sets.

Data compression is similar to recording data with a larger sampling interval. With a compression factor of 2, every second data point is included, equivalent to doubling the sampling interval. At a compression factor of 3, only every third data point is retained. The smallest compression factor compatible with file length and system memory is given as the default. Confirm the compression factor by [Enter]. Compare Section D8.6.

If data compression is not wanted, press [Esc] instead of confirming the compression factor. In the following input line, you are asked to enter the number of data points to be skipped at the *beginning* of the recording. The data after the skipped ones are imported as recorded up to the maximum number of data compatible with system memory (10.000). To import other sections of the same experiment, open the same file as before, proceed to the input line for **N**umber of data points to skip, and enter the number suggested in a previous window (10.000 if this number of data points was read the first time). If the second part of the file is listed in data set (B), this data is either associated with the original time axis of data set (A), or with the new time axis associated with data set (B).

D4.3. S Save file - Ctrl-F2

☞ It is important to note that data sets are not saved to disk unless this is explicitly done intermittently or at the end of a DatLab Analysis session. During analysis, data are saved only in the random access memory (RAM). If you quit the program without saving or the computer is turned off without saving, then the modified data sets are lost. The original file on disk is not affected. The original recorded data (*.DLR files) are not modified. Files on the hard disk or floppy disk are not overwritten unless an overwrite operation is explicitly chosen.

DatLab Analyzed files are saved on disk as *.DLA files in binary format. Before the final step, notebook

information may be added or edited. Binary format is chosen as the fastest way of saving and loading data.

D4.4. C Close file

All data sets are deleted. A message to save modified data appears if any data set has been changed.

D4.5. I Import/Export

D4.5.1. O **O**pen

Files of various formats can be opened in DatLab Analysis. The file format must be known.

A **A**SCII

Many programs have the option to store files in ASCII format, which can be opened in DatLab. The ASCII files may contain several columns separated by white spaces. Columns are read as data sets, and rows are the consecutive data points.

T ASCII with **T**ime axis

Numbers in the first column are assumed to be the time corresponding to the data points in the following columns, with a constant sampling interval.

D **D**atGraf 2.0 (DGR)

Open files which have been generated by the discontinued program DatGraf. The default extension is ***.DGR**, searching for files which have been analyzed previously and saved as a DatGraf file.

Files with extension ***.RAW** can be imported, changing the search mask to *.RAW. To do this, type [Alt-N] to access the input line {**N**ame}, replace *.DGR by *.RAW, and type [Enter] to display all files matching this mask under {**F**iles}.

D4.5.2. S **S**ave

A **A**SCII

Save a file in ASCII format without saving the time axis as the first column. The ASCII file consists of lines with floating point numbers in ASCII representation (text) separated by white spaces. Notebook information, events and marks are not saved in an ASCII file. A missing data point is indicated by "NaN" (not a number). This representation can be changed in the configuration file.

T ASCII with **T**ime axis

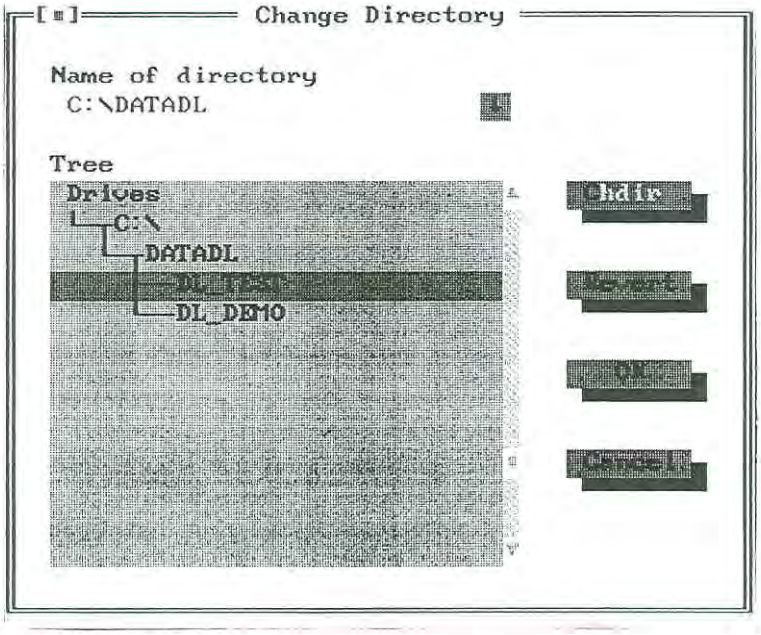
Save in ASCII format with the time axis as the first column.

D4.6. D Change Directory

The default directory is selected when starting DatLab Analysis. In the start-up macro, a message appears:

Select work directory. CONFIRM with [Enter]. CONTINUE with [F5].

For changing the directory again, use the operation {Change **D**irectory}.



Dialogue window for {**C**hange dir}. The default input field is {**T**ree}.

Mouse Position the cursor and click the mouse button twice to select a subdirectory. Confirm by clicking on {O**K**}. Alternatively, click on the input field {**N**ame of directory}, type and edit the path name and directory

name from the keyboard, and confirm by clicking on {O**K**}. Click on {**R**evert} to return to the original default directory.

Keyboard Use the arrow keys to move to a different subdirectory, and type [Enter] or [Alt-C] to select it. Confirm the selected default directory by pressing [K] or [Alt-K] for {O**K**}. Alternatively, press [Alt-N] and type the path name and directory name into the input field {**N**ame of directory}. This is particularly useful when changing from the drive c: to the floppy drive a:. Press [R] or [Alt-R] for {**R**evert} to return to the original default directory.

D4.7. G Save Graph file - Ctrl-G

Save the a current figure as it appears in the graph window to file. The path name, file name and plot options are defined in an input window. The actual saving is initiated in the graph window when pressing [Ctrl-H]. If [Ctrl-H] is pressed again without a prior change of the plot file name, the old file is replaced by the new figure. Marks and scroll bars are not printed. The file is saved in HPGL format.

Colors and line styles on the screen and on the HPGL plot are not necessarily the same. Dotted and dashed lines (styles 1 and 3; Section D10.8) are not available for HPGL format.

The Hewlett Packard Graphics Language (HPGL) is a widely used standard for plotters and plot files. HPGL files can be directly incorporated into many standard word processing and desk-top publishing programs.

D4.8. T Save Text file

The top (active) text window is written to a file as a table in ASCII format. If the file exists already, the new window can be appended to the existing data.

D4.9. P Print window - Ctrl-P

To print a hard copy, open a text window or graph window [F9], and press [Ctrl-P]. Make sure that a HP

laser printer is connected and ready for printing. Marks and scroll bars of the graph window are not printed.

D4.10. O Options

D4.10.1. L Load options

A configuration file can be loaded with information on display settings and other default parameters stored in an *.INI file. These files are written in ASCII format and can thus be edited with any text editor.

D4.10.2. S Save options

The current configuration can be saved on a configuration file (*.INI).

D4.11. E Erase file

A file can be erased on disk after selecting a file name and confirmation. Notebook information may clarify that a file is of no use. Then erasing the file can be done immediately. A rigid management of files is essential for saving time and disk space.

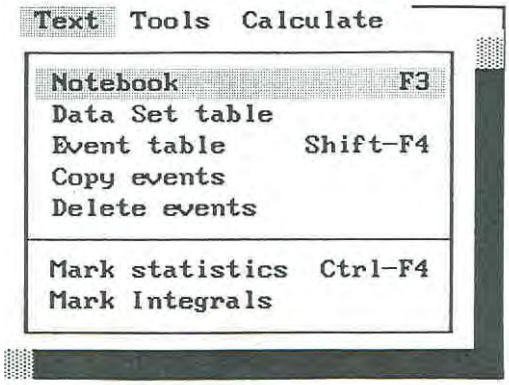
☞ {**U**ndo} is **not** available for this operation.

D4.12. Q Quit - Alt-Q

[Alt-Q] terminates a work session and exits the program DatLab Analysis. All data sets and corresponding information is deleted.

☞ Data are **not** automatically saved. Save before any quit.

D5. Text



The menu options under {**T**ext}: Text information from the notebook, events, data sets, mark statistics and integrals.

D5.1 N Notebook - F3

The top line of the notebook shows the file name, the data and time of the experiment, and the sampling interval. This information and text is retrieved from the notebook generated in DatLab Acquisition (Section C5.1). The text field in the notebook can be entered and edited at any time during the analysis. Press [F3] to edit text. Press [Tab] to jump to the next input filed {O**K**} for confirmation. Press [Shift-Tab] to jump back to the previous input field. Press [Esc] to cancel all previous changes and exit the notebook. Notebook information is saved with the current file.

For editing text, the following keys can be used.

←	Move left.
→	Move right.
Ctrl-←	Jump word left.
Ctrl-→J	ump word right.
↑	Move line up.
↓	Move line down.
Home	Jump to the beginning of a line.
End	Jump to the end of a line.
Shift-←	Block left.
Shift-→	Block right.
Shift-↑	Block line up.
Shift-↓	Block line down.

D5.2. S Data Set table

The data set table is automatically displayed after a file is opened. Empty data points are indicated by NaN (Not a Number). The table can be re-opened by {Data **S**et table}. Close the window by [Alt-F4].

D5.3. E Event table - Shift-F4

A list of events and corresponding comments can be opened for display in the event window. See Section D3.7 for events in the graph window.

The following information is displayed in the event window:

#	Sequential number of the event.
L	Letter assigned to label the event.
T	Time of the experiment at which the event was set, *X*-value.
Y	*Y*-value of the data point in the data set at the time of the event.
Comment	A comment as added to the event in DatLab Acquisition or edited in the graph window (Section D3.7).

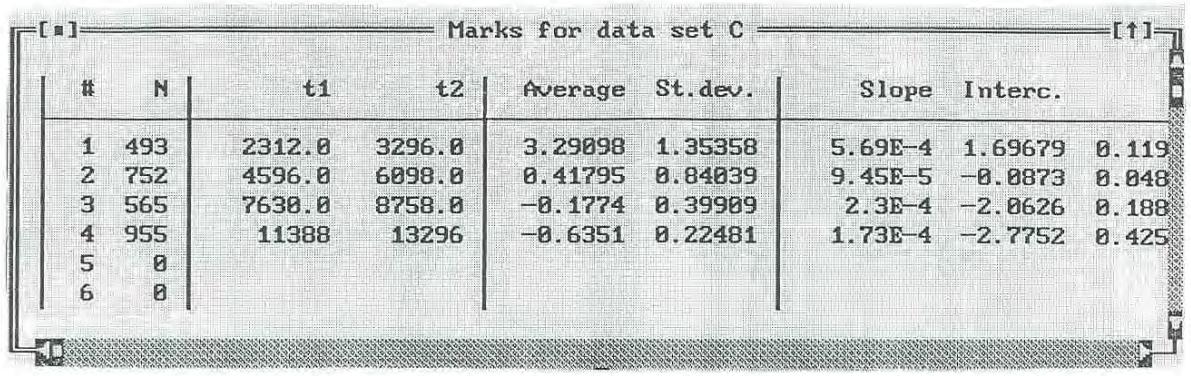
D5.4. C Copy events

Copy events with comments from a data set to other data sets.

D5.5. D Delete events

Delete all events with their comments in a selected data set.

D5.6.Mark statistics - Ctrl-F4



Marks for data set C

#	N	t1	t2	Average	St.dev.	Slope	Interc.	
1	493	2312.0	3296.0	3.29098	1.35358	5.69E-4	1.69679	0.119
2	752	4596.0	6098.0	0.41795	0.84039	9.45E-5	-0.0873	0.048
3	565	7630.0	8758.0	-0.1774	0.39909	2.3E-4	-2.0626	0.188
4	955	11388	13296	-0.6351	0.22481	1.73E-4	-2.7752	0.425
5	0							
6	0							

Figure D5.1. Mark statistics for a selected data set is given for each mark, #, giving the number of data points, *N*, the initial and final time of the mark, t_1 and t_2, and standard statistical information. The slope is given in units of [signal units/time units].

See Section D3.6 for editing marks in the graph window, and Section D9 for operations on marks.

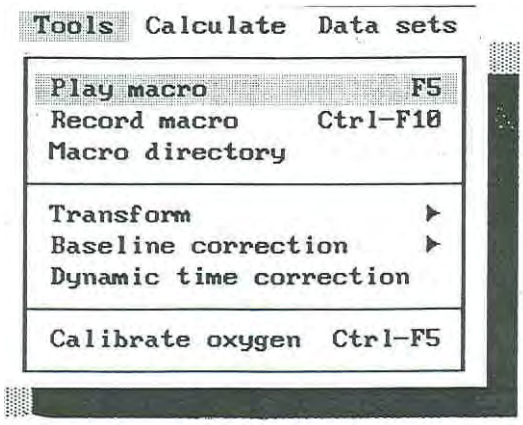
D5.7. I Mark Integrals

Integrals (areas) are calculated over the marked sections with several options on the reference line. The following reference lines can be selected:

0) Null at 0: Zero line
1) Null at x1: Horizontal line from the first point of the marked section.
2) Null at x2: Horizontal line from the last point of the marked section.
3) Proportional: A linear line drawn from the first to last point in the mark.

The integral is displayed in units of [time unit · signal unit].

D6. Tools



The menu options under {**T**ools}: Tools include the option to play and record macros, transform of time and signal, baseline correction, dynamic time correction, and calibration of the oxygen signal.

D6.1. P Play macro - F5

Select a macro for performing a programmed sequence of operations. First, check carefully the initial conditions, such as the data set opened for analysis.

F5

DatLab Macros provide an automatic approach to standard data analyses. They provide guidelines to various options within program execution. Specific information to DatLab Macros are provided in OROBOROS News: DatLab Software Support.

F1

Within DatLab Macros, short instructions appear on the bottom line of the screen, and [**F1**] is available for opening a more extensive help menu.

F1

After a pause within macros, proceed by [**F5**].

☞

If you are not sure about the individual operations of a macro and about the required initial conditions, save your data on file before starting a macro. This avoids the chance of inadvertent loss of data.

Shift-Esc

Macro execution can be interrupted at the stage of various messages or pauses by pressing [Shift-Esc].

☞ Proceed by closing all data sets, {**F**ile}\{**C**lose file}, since the macro interruption may render the data in an indeterminate state.

A step-by-step listing of DatLab Macros is available from OROBOROS® upon request.

D6.2. R Record macro - Ctrl-F10

After defining the file name of the macro to be generated, all the following keystrokes and mouse actions will be written to this file. Recording is stopped by pressing [Ctrl-F10] again in the text window. The successful end of recording a macro is indicated by a beep.

After programming of a macro is started, [F5] will provide the option for inserting a **M**essage, **P**ause, or **I**nput value. At this stage, [F1] allows the programming of help information. Macros are saved in ASCII format and can be edited.

D6.3. M Macro directory

Function in preparation.

D6.4. T Transform

D6.4.1. **S** **S**ignal transform
Linear transformation of the data, by a multiplication factor {**S**cale} and an additive factor {**O**ffset}.

D6.4.2. **N** **N**ormalize data
A linear transformation of the data points is made. All new data, Y_{new}, are in the range between Min_{new} = 0.0 and Max_{new} = 1.0.

$$Y_{new} = (Y_{old} - Min_{old}) / (Max_{old} - Min_{old})$$

D6.4.3. **T** **T**ime axis transform
A linear transformation of the time axis is made for all data sets. In DatLab Macros, time transformations are accompanied by changing the units of the time axis.

D6.4.4. **A** **A**lter time axis

Reset the sampling interval for all data sets. Discrete data indices are converted into a time reading by multiplication with a factor {**S**cale}. The scaling factor is the sampling interval [s].

D6.5. B Baseline correction

Marked sections of the data set are used to align this data set to a baseline contained in a reference data set.

D6.5.1. A

Add
The data are aligned to the baseline by addition.

D6.5.2. M

Mult
The data are aligned to the baseline by multiplication (proportional baseline correction).

D6.5.3. S

Scale
The baseline is used to scale the data points.

D6.6. D Dynamic time correction

Function in preparation.
Use DatLab Macros for general applications.

D6.7. C Calibrate oxygen - Ctrl-F5

The oxygen sensors are calibrated by a two-point calibration. The exact signal output at zero oxygen and air saturation, R_0 and R_1, is the basis of a final calibration in DatLab Analysis for high-resolution respirometry.

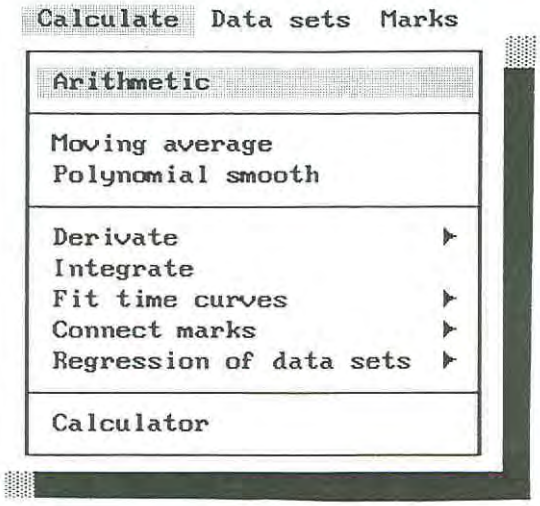
Open a *.DLR file in data set (A), and press [Ctrl-F5]. Calibration is incorporated in DatLab Macros.

Air and zero calibrations are recorded on a single file or on two different files which may be opened as two data sets. Mark a section which defines the 100% air calibration recording for calculating an average value for R_1. Move the curser into the bar of the section mark for quick reading of the section mark statistics. In the same way an average value of R_0 is performed.

In the calibration window edit the values which were previously entered during data recording. Enter the new values of R_1 and R_0 obtained from an air calibration

mark and zero calibration mark. Check if the O_2 saturation factor of the medium is correct. Experimental temperature and barometric pressure are the signals from the Oxygraph, and can be edited if necessary. Confirm by [Enter]. Then information on derived calibration variables is displayed. [Enter] confirms the calibration of the oxygen signal in units of concentration [µM = nmol·cm^{-3}].

D7. Calculate



The menu options under {**C**alculate}: Arithmetic operations on data sets, smoothing, derivation, and integration of data, and linear, polynomial or exponential fitting.

Calculus operations are performed on an entire data set or exclusively on its marked sections.

D7.1. A Arithmetic

Data sets can be transformed by arithmetic equations, and data sets can be combined in equations. Examples:

A=	A-0.15	Offset by an additive term (zero correction).
A=	A*1.97	Multiplication by a (calibration) constant.
C=	-C	Sign conversion; the original data are not conserved.
D=	C-(B*0.025 - 1.5)	Example for background correction of flux, data set (C) is the uncorrected flux, data set (B) is oxygen concentration. The uncorrected data set (C) is conserved for comparison with the new data set (D).

D7.2. M Moving average

Each data point is replaced by the average value of a selected number, *N*, of data points to the left and right of the point. This smoothing has a strong leveling effect with high *N* and time resolution is lost with increasing *N*.

Noise

Prolonged continuous measurements yield accurate information on oxygen flux after strong smoothing, even if noise is high.

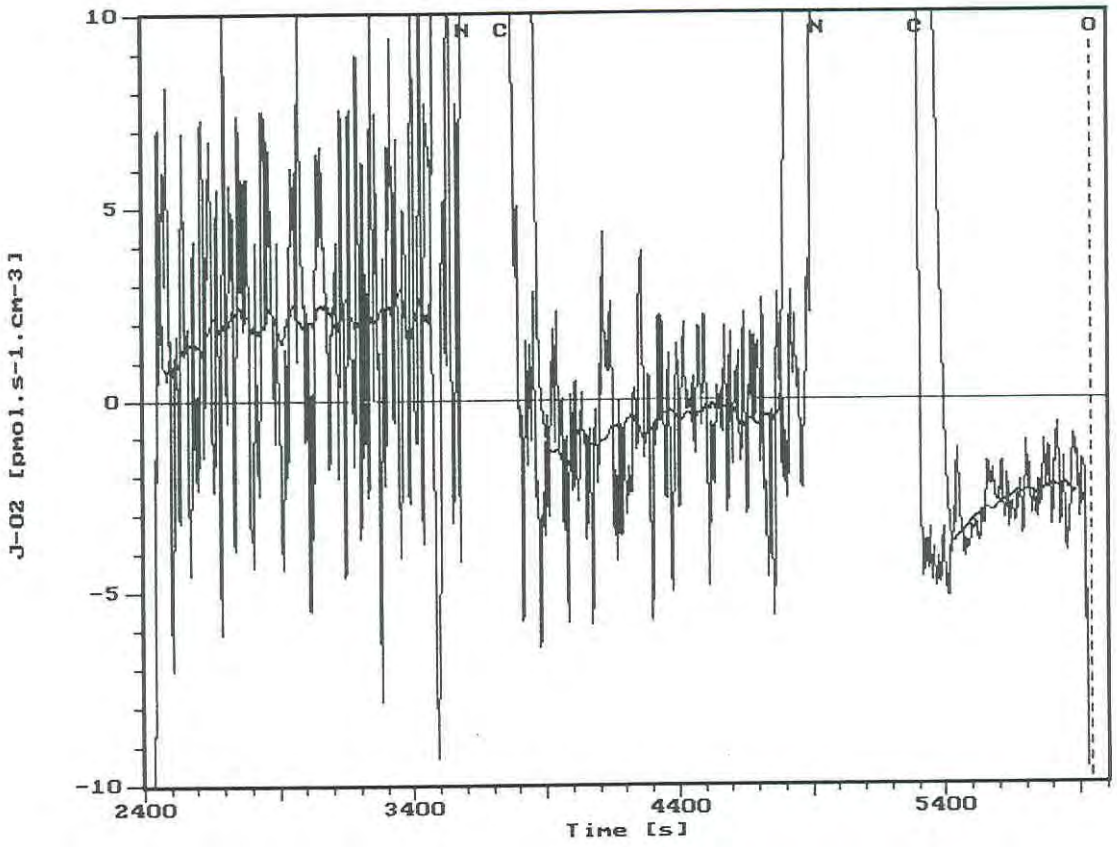


Figure D7.1. Effect of strong smoothing on the display of oxygen flux, J_{O_2} [pmol·s^{-1}·cm^{-3}]. The noisy data set (C) is identical to the flux shown in Figure D1.4 (bottom line), after zooming in for amplification. Data set (D) is the smoothed flux, generated by a moving average over 120 data points. Events <C> indicate the time of closing the chamber. After a short equilibration time, flux is constant. Note how the smoothed curve lags behind the original flux after events <C>.

D7.3. S Polynomial smooth

Each data point is replaced by the value of an interpolation polynomial calculated through a selected

number (*N* = 1 to 8) of data points to the left and right of the point. This smoothing retains a high time resolution but does not produce a very smooth curve of strongly noisy data.

D7.4. D Derivate

The first derivative is the slope of a curve, calculated to obtain the flux (negative time derivative) or for calculating time-corrected data using an exponential time constant. The units of the time derivative are [signal unit / time unit]. Frequently smoothing the original data is necessary to reduce noise of the calculated derivative.

D7.4.1. D

Derivate symmetric
The first order derivative at a point is calculated from a selected number (*N* = 1 to 5) of points to the left and right of the point.

D7.4.2. R

Right
Simply the difference between the values of the point and the next point is calculated and divided by the sampling interval.

D7.4.3. L

Left
As above, but using the difference between the point and the preceding point.

D7.4.4. S

Second order
The second order derivative is calculated using an interpolation polynomial.

D7.5. I Integrate

The integral function of a curve is calculated, with units [signal unit · time unit].

D7.6. F Fit time curves

The time-sequence of one data set is fitted to a mathematical equation. If you want to keep the original data, copy the data set first.

D7.6.1. L **L**inear fit

The marked section of the selected data set is converted to a fitted line. If there is more than one mark, the sequential mark number can entered to selectively choose a single mark. By entering [0], data in all marks are replaced by a linear fit.

D7.6.2. E **E**xponential fit

Mark the section of a data set which is to be fitted by an exponential function. Only the marked data are considered for fitting the equation,

$Y_t = a + b \cdot \exp(-t/\tau)$

τ is the exponential time constant, that is the time by which the signal reaches 63% of the full response. The resulting parameters are displayed and saved in memory and can be used for later arithmetic calculations. Use the underscore character [_] as a prefix to refer to these constants, [_a], [_b], and [_T] for a, b and τ in the equation shown above. The exponential fit is a fast and reliable way to obtain the time constant of the polarographic oxygen sensor for time correction of the signal.

D7.7. O Connect marks

Several marks must be defined on the selected data set. The entire data set is converted to a fitted time-curve which involves intrapolation and extrapolation. If you want to keep the original data, copy the data set first.

D7.7.1. L **L**inear

The average value of Y and X (time) is calculated for each mark, and these averages of the marks are linearly connected by straight lines.

D7.7.2. **P** **P**olynomial

A cubic interpolation is calculated for the data in each mark. The average value in *Y* and *X* direction of each mark is connected with a cubic polynomial to the next so that the slopes at the connecting point are equal to the average slope in the marked part. This yields a smooth curve.

D7.8. R Regression of data sets

A regression is calculated for one or more marked sections in a *X*/*Y*-plot of two data sets. The statistics of the regression is displayed.

D7.8.1 **L** **L**inear regression

All marks of the data set selected for *X* are copied to a second data set selected for *Y*, and a linear regression is calculated over all marked data points.

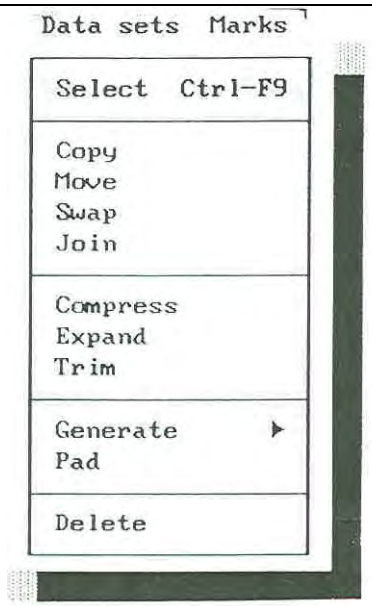
D7.8.2. **H** **H**yperbolic fit

Marks of the data set selected for *X* are copied to a second data set selected for *Y*, and a linear regression is calculated over the data points in the first mark only.

D7.9. C Calculator

Use your PC as a desk top calculator. Enter the formula, and type [Enter] or {**O**k} to perform the calculation. Type [Esc] or {**C**ancel} to exit the calculator.

D8. Data sets

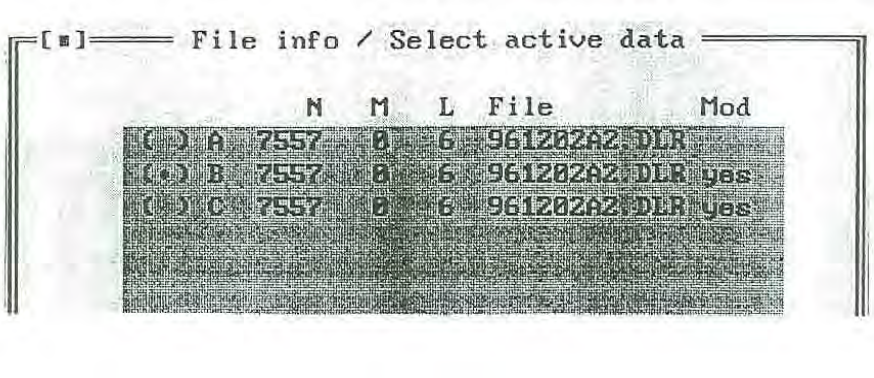


The menu options under {**D**ata sets}: Operations on data sets, including selection of the active data set and other data for display, copying and joining data sets, data compression, and generation of data for modeling.

See Section D3.1 for selecting data sets and defining the active data set. The following sections describe operations which are performed on entire data sets.

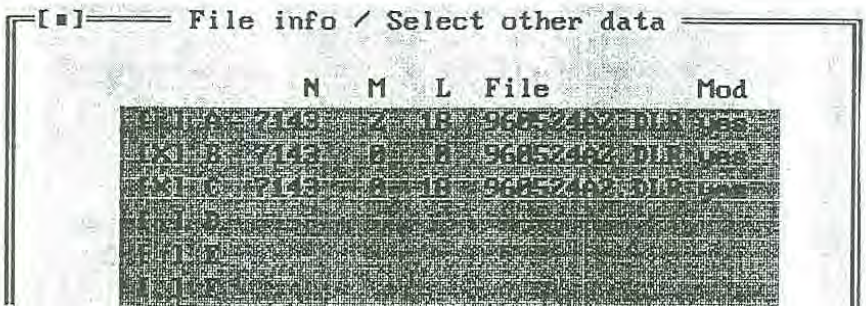
D8.1. S Select - Ctr-F9

Various operations require selection of one active data set and optionally several other data sets. See also selection of data sets in the graph window ([Ctrl-F9]; Section D3.1).



Selection of a single data set (D). The dot **(·)** indicates the selected data set. Click the left mouse button after moving the cursor to the chosen set and to the {OK} button, or type the letter and confirm by [Enter]. Information is displayed on each data set.

N Number of data points, *N*, in the data set.
M Number of marks, *M*, in the data set.
E Number of events, *E*, in the data set.
File File name of the file from which the data set originates, either directly or derived by modification.
Mod Modified data sets are indicated by "yes" under the column Mod. A modification information (Mod yes) is removed after a modified data set has been saved under a file name, either replacing the old file or under a new name.



Selection of multiple data sets [B] and [C]. A selected data set is indicated by **[X]**. Click the left mouse button after moving the cursor to the chosen sets. Click the {OK} button to confirm. Or type the letters to toggle between selected and deselected. Confirm by [Enter]. Type [+] to select all data sets; type [-] to deselect all data sets. Empty data sets are shown without information.

D8.2. C Copy

Selection of a single data set for the source and the destination.

D8.3. M Move data

Same as copy, but the source data set is deleted.

D8.4. w Swap

Exchange the contents of two data sets.

D8.5. J Join data

Data from several data sets can be joined (appended) into one data set. To terminate the selection of data sets to be joined in series, press [Esc]. Then you are asked for the destination of the new data set. If the number of data points in the new data set exceed the capacity (maximum 10000), a compression factor can be selected to adjust the effective sampling interval.

Joining data allows the combination of sections of an experiment, which was saved intermittently at various times, into one data set and one file. First the files are opened sequentially and put into consecutive data sets, then the data sets are joined.

D8.6. o Compress

Compress a data set by averaging over an optional number of data points. The resulting data set has less points than the original, equivalent of reducing the sampling rate (expanding the sampling interval). Compressing data can be used to smooth data since the averaging will remove data noise. Plot operations are faster if there are less data points.
Compressing or expanding data results in a new time scale since the effective sampling interval changes.

D8.7. E Expand

Expand a data set by a factor, leaving gaps. The resulting data set has more points. The gaps may be filled.

D8.8. T Trim

Remove empty points (NaN) at the end of a data set.

D8.9. G Generate

Data sets can be generated with a defined number of data points, {**U**ser defined number of points}, or identical number of data points to that of another data set, {**S**ynchronous to existing data}.

D8.9.1. **C** **C**onstant All points have the same defined value.

Example For graphical display of the scatter of data points around the zero line, a straight line can be generated, synchronous to one of the experimental data sets (see Figure D7.1).

D8.9.2. **R** **R**amp The data points are on a linear line with a defined slope and intercept.

D8.9.3. **E** **E**mpty Generate a data set with empty points (NaN).

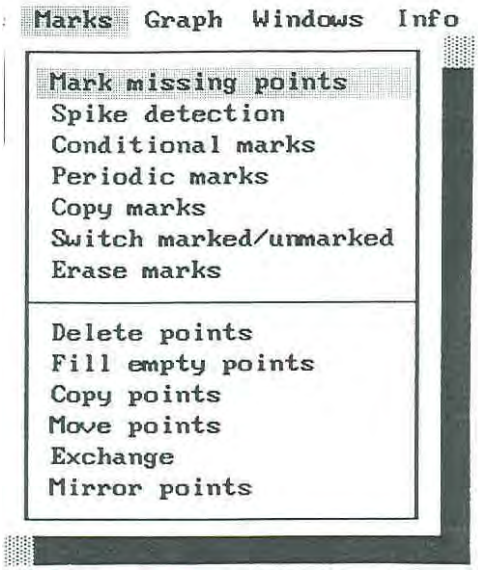
D8.10. P Pad

Fill up a data set with empty points (NaN).

D8.11. D Delete

Selection of multiple data sets.

D9. Marks



The menu options under {**M**arks}: Mark missing data points, spike detection, generate conditional marks, and operations on marked sections of a data set, including deletion, filling, moving and producing mirror images. Mark operations are one of the keys to the high flexibility of DatLab Analysis.

Table D9.1. Overview on operations involving marks

Section	Operation with marks
D3.6.	Generate, delete and use marks in the graph window.
D5.6.	Display the table of mark statistics.
D5.7.	Display the table of mark integrals.
D7.	Calculations can be optionally restricted to marks.
D7.7.	Connect marks by linear or polynomial interpolation.
D9.a.	Generate or erase marks according to defined conditions.
D9.b.	Perform specific operations on marks.

D9.a.

Marks are selectively generated in the operations of this section. Subsequently, all marks can be edited in the graph window (see Section D3.6). Marked points or

marked empty spaces can be edited by operations in Section D9.b.

D9.1. M Mark missing points

Marks are set on missing data points (NaN) of a selected data set. The old marks on this data set are lost.

Missing points may occur during data acquisition. Individual missing points may not be apparent on a screen with many data points. If undetected, such missing points disturb several calculations. For instance, a noisy appearance results in the calculated flux (time derivative) of a data set with missing points. A routine screening for missing points is recommended, followed by {**F**ill}.

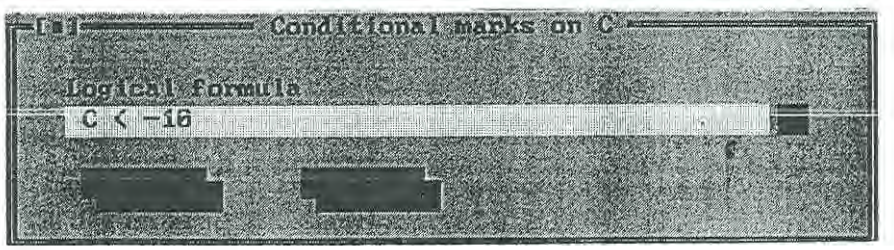
D9.2. S Spike detection

Spikes are errors in the data caused by short disturbances of an instrument or data acquisition. These disturbances may be caused by external influences or by the measuring system. Spikes are apparent as narrow (usually only a few points wide) peaks or valleys in the recorded data. DatLab Analysis provides an automatic spike recognition function. Marks are set on detected spikes and can be edited in the graph window (Section D3.6). Previous marks are lost. The parameters for spike detection can be optimized for specific applications. Usually, marks on detected spikes are edited by {**F**ill}.

{**A**bsolute change in data value}
{**N**umber of points in spike}

D9.3. o Conditional marks

All data points in the selected data set are marked if they fulfill the condition defined in a logical equation. Previous marks on the data set are lost, but the marked data remain unchanged.



Logical equation for setting conditional marks on data set C. All data which have a lower value than -10 are marked.

In the logical equation data sets are represented by letters (e.g. C), the time axis by (T).

Further examples for logical equations are:

ABS(C) > 5.0
T < 300
C < F
(C > -20) | (C > 250)
2*C - 0.5 > SQRT(D) + LN(ABS(E))

D9.4. P Periodic marks

Periodic marks are generated on a selected data set. The old marks are lost. The periodic mark setting is defined in terms of {**N**umber of points in mark} and {**N**umber of points to next mark}.

D9.5. C Copy marks

Copy marks from a data set to other data sets.

D9.6. w Switch marked/unmarked

S**w**itch all marked sections to unmarked and *vice versa* (identical to pressing [Ctrl-W] in the graph window.

D9.7. E Erase marks

Delete all marks attached to a data set (compare [Ctrl-D] in the graph window).

D9.b. All operations in this section are performed selectively on one or all marked sections of the data set. Type [0] into the input line if the operation applies to **all marks**. Type the sequential mark number into the input line for restricting the operation to a selected mark.

D9.8. D Delete points

The data points in the mark are deleted and replaced by empty spaces (NaN). Optionally, the resulting gaps can be filled.

D9.9. F Fill empty points

Gaps in marked sections are filled by linear interpolation.

D9.10. y Copy points

Marked data of one data set are copied to another data set or within one data set. You can enter a new position on the time axis.

D9.11. v Move points

Marked data of one data set are moved to another position within the data set or to a selected data set. You can enter a new position on the time axis.

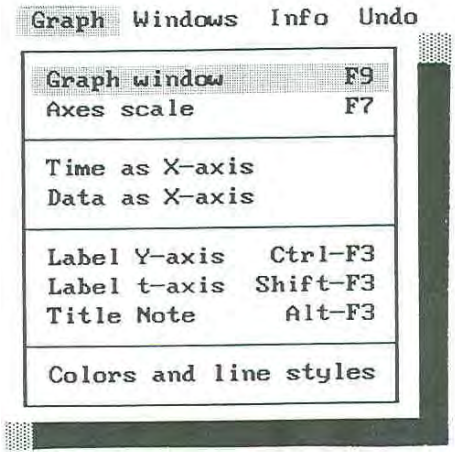
D9.12. x Exchange points

Select two data sets. The marked data of the first data set and the corresponding section of the second data set are exchanged.

D9.13. i Mirror points

Data in the mark are time reversed (mirrored). This is useful for the study of time-symmetrical functions.

D10. G Graph

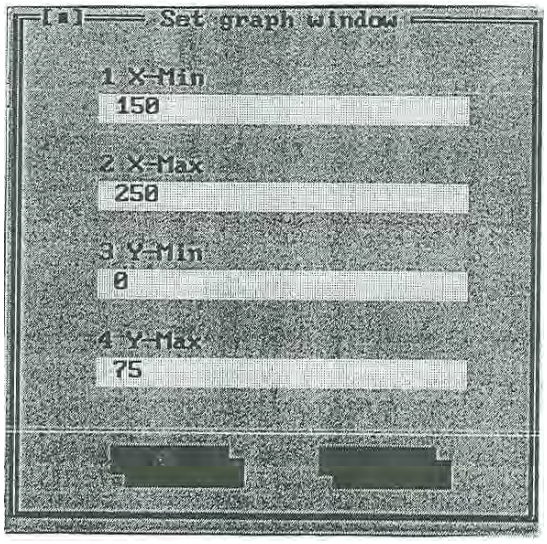


The menu options under {**G**raph}: Set axes default scale, define limits, select plot types with time or data as *X*-axis, and define colors and line styles for graphic display (see Section D3 for operations in the graph window).

D10.1. G Graph window - F9

Open graph window by pressing [F9].

D10.2. A Axes scale - F7



Define the *X*- and *Y*-axes, with minimum and maximum values. Type in the number (or an equation) from the keyboard, change to the next input field by [Tab], and

confirm all numbers displayed by [Enter]. The default values are the values from the actual figure displayed in the graph window. For visual comparison and for hard copies of figures, numerically defined axes are particularly useful. Press [F9] to display the new figure.

D10.3. T Time as X-axis

The standard plot type equivalent to the recorded data uses time as the *X*-axis.

D10.4. D Data as *X*-axis

Change your figure to an *X*/*Y*-plot by selecting one data set for the *X*-axis, and selecting one or more related data sets as the *Y*-axis.

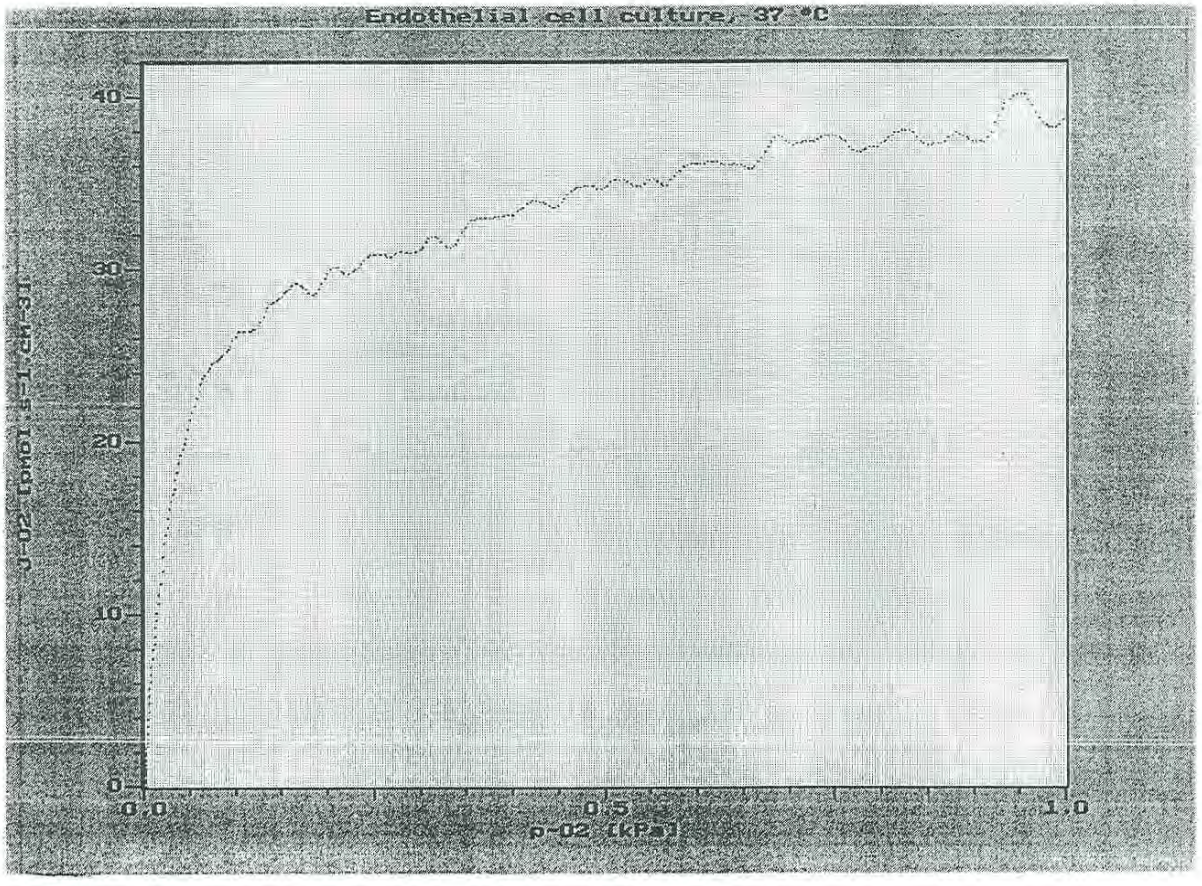


Figure D10.1. Oxygen flux, JO_2, as a function of oxygen pressure, pO_2, in cultured endothelial cells. Line style 4 is selected to plot individual data points.

An important example for an *X*/*Y*-plot is the display of Oxygraph Records as an oxygen flux/pressure plot for evaluation of the oxygen affinity (Figure D10.1).

Oxygen concentration was converted to oxygen pressure and this data set is chosen for the *X*-axis.

No marks or events can be set in an *X*/*Y*-plot.

D10.5. Y Label Y-axis - Ctrl-F3

Edit the label of the *Y*-axis for a selected data set. Axis labels are stored with any saved data set. If a data set is selected as the *X*-axis in an *X*/*Y*-plot, the label is correspondingly transferred to the new *X*-axis.

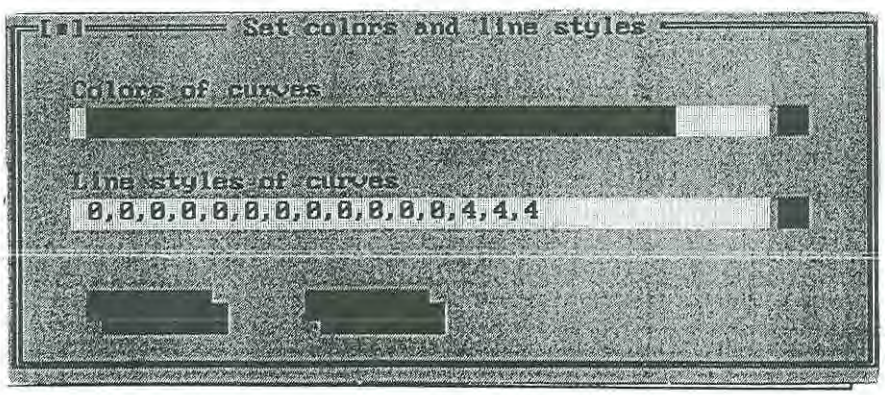
D10.6. x Label t-axis - Shift-F3

Edit the label of the time axis, when transforming to a different time unit.

D10.7 N Title Note - Alt-F3

The file name is given as a default for the title note. Additional information may be added, and the file name may be deleted.

D10.8 C Colors and line styles



Colors and line styles of curves for the consecutive data sets (A) to (O) are defined as numbers, separated by a comma. Write [DEFAULT] instead of the numbers to return to the default settings (see Section E2). Writing an asterisk [*] before a number assigns the corresponding color or line style to all following data sets.

Change line style of active data set between lines and data points. When closing the graph window, the line style is reset to line automatically.

⇒ The exact colors on the screen depend on your hardware. Editing the colors exerts an effect on the appearance of the data sets on a screen dump. Data sets can become invisible if colors are not properly chosen. A careful selection of line styles may clarify a figure.

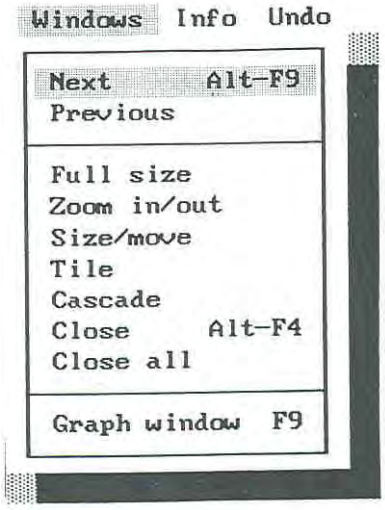
Colors

0	Black	8	Dark gray
1	Blue	9	Light blue
2	Green	10	Light green
3	Cyan	11	Light cyan
4	Red	12	Light red
5	Magenta	13	Light magenta
6	Brown	14	Yellow
7	Light gray	15	White

Line styles

0	Solid line	5	Circles
1	Dotted line	6	Triangles
2	Center line	7	Squares
3	Dashed line	8	Crosses
4	Data points		

D11. Windows



The menu options under {**W**indows}: Arrangement of text windows.

D11.1. N Next - Alt-F9

Select next window for active (top) position. Text within the active window can be moved by arrow keys and [PgUp] or [PgDn].

D11.2. P Previous

Select previous window as the active window.

D11.3. F Full size

Select a standard position of the active text window, covering the entire screen.

D11.4. Z Zoom in/out

Zoom in or out the active window.

D11.5. S Size/move Shift-F9

Move the active window by arrow keys and [PgUp] or [PgDn]. Pressing [Shift-] and arrow keys changes the size of the window. Adding the Ctrl-key increases the step size of the above operations.

The key [Shift-F9] can also be used for input windows and dialogue boxes.

Press [Enter] to exit the Size/move operation. When the Size/move operation is selected, it is not possible to perform any other operations.

Arrow keys and [PgUp], [PgDn] move the text within a window when the Size/move operation is not active. The text can be moved to the beginning or end when pressing [Ctrl-] in combination with these keys.

D11.6. T Tile

Tile windows (see Figure D2.1).

D11.7. a Cascade

Cascade windows.

D11.8. C Close - Alt-F4

Close the top (active) window, without deleting the data set.

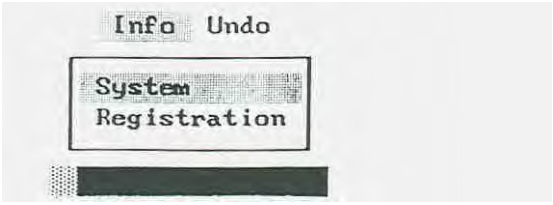
D11.9. C Close all

Close all text windows, without deleting the data sets.

D11.10. G Graph window - F9

Open the graph window.

D12. Info



The menu options under {**I**nfo}.

D12.1. S System

Information on your computer shows the number of available data sets, the number of data points per data set, and the free memory available. If a mouse is connected to your PC, but a message appears "No mouse found", exit the program, check if the mouse is properly connected and the mouse driver is installed. Then restart DatLab and check information again.

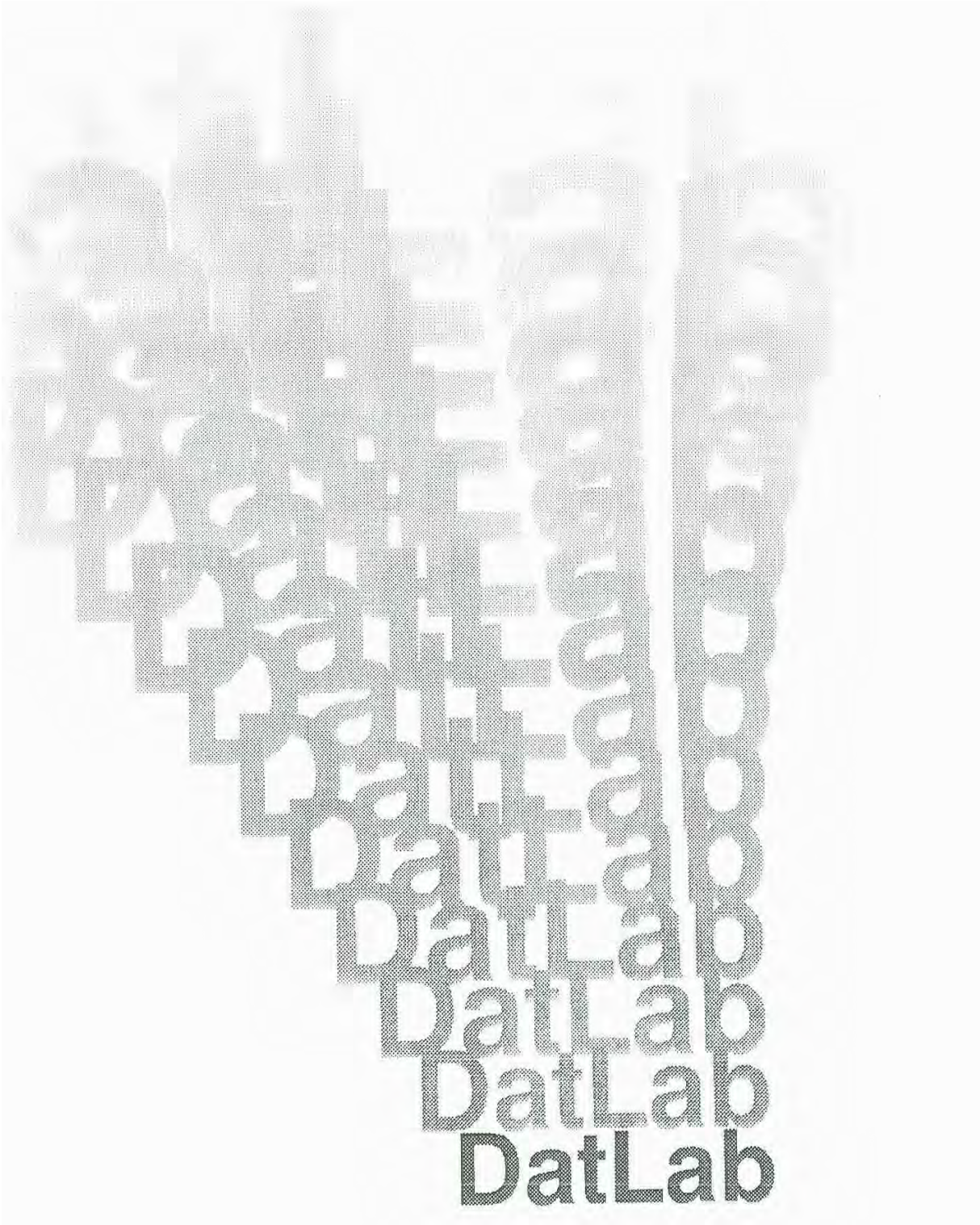
☞ Check for sufficient free memory. Insufficient free memory may cause loss of data.

D12.2. R Registration

Personal identification of the registered software.

D13. Undo

Reversibility with {**U**ndo}: The last change can be undone, and the previous information is then retrieved


DatLab
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