



# **Dissolved Oxygen Analyser**

## **User Manual**

Rev. 1.03

SiS Sensoren Instrumente Systeme GmbH  
Mühlenkoppel 12  
D-24222 Schwentinental  
Germany

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## **Chapter 1**

### **Introduction**

This manual is part of the Dissolved Oxygen Analyser documentation. It will give the user a detailed description of the titrator and program operation. For hardware and software installation and a general introduction to the system, see the tutorial.

Please read the files WHATSNEW.DOC and README.DOC in your DOA directory for up-to-date information on revisions and corrections to this manual.

## **Chapter 2**

### **Functional Description**

#### **2.1 Photometer**

The first version of the SiS titrator has a single-beam photometer with blue light at the absorption wavelength of iodine. By use of a high resolution analog-to-digital converter the decreasing of the absorption during the titration is recorded with very high precision. The new photometer, in addition to the blue beam, has a red one which is little attenuated by the iodine. This beam is used to estimate the transmission endpoint after titration. The transparency of the sample in the blue is then nearly identical to the almost unchanged one in the red. The light sources are solid state devices (light emitting diodes) with low power consumption. To prevent errors from daylight or illumination effects they are modulated.

#### **2.2 Algorithms**

This section will give you some information about the titration process, the endpoint calculation, and the quality of titrations. To understand the descriptions you need some mathematical basics about polynomial approximation, linear regression, and differential calculus.

##### **2.2.1 Titration Process**

Every titration will be done in three steps:

###### **1. Fast titration phase**

During this phase the system dispenses decreasing amounts of titer until a specific transmission is reached. Between every step the system will wait some time to ensure that the dispensed titer has reacted mainly. This wait time is called "Fast Delay" and can be changed by the user. The default value is two seconds; proper delay times are between two and five seconds. The fast titration phase ends when the transmission reaches the estimated endpoint multiplied with the "Fast Factor". The default value is 0.92; proper factors are in the range from 0.85 to 0.95.

For the 1-channel systems the "Fast Factor" does not exist. In this case the fast phase ends when the entered transmission value is reached or the primary shot volume has been dispensed.

## 2. Wait time between fast and slow titration phase

After the fast titration phase, the system has to wait some time to ensure that all the dispensed titer has reacted. The default value for this "Wait Time" is ten seconds.

## 3. Slow titration phase

During this phase the system dispenses constant amounts of titer. These amounts are defined by the "Step Size". Every step corresponds to 1/10000 of the burette volume. The default value is five; proper step sizes are in the range from two to ten. Like in the fast titration phase, there is a delay time in the slow phase. The default value for the "Slow Delay" is also two seconds. The slow titration phase ends, when the transmission is nearly constant. To get the value of the constant transmission and the accuracy of the measuring (e.g. noise from air bubbles), the system has to dispense some more titer.

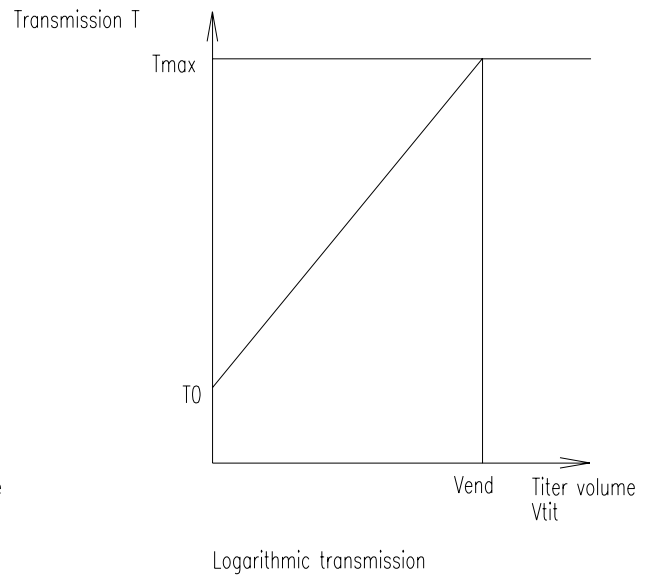
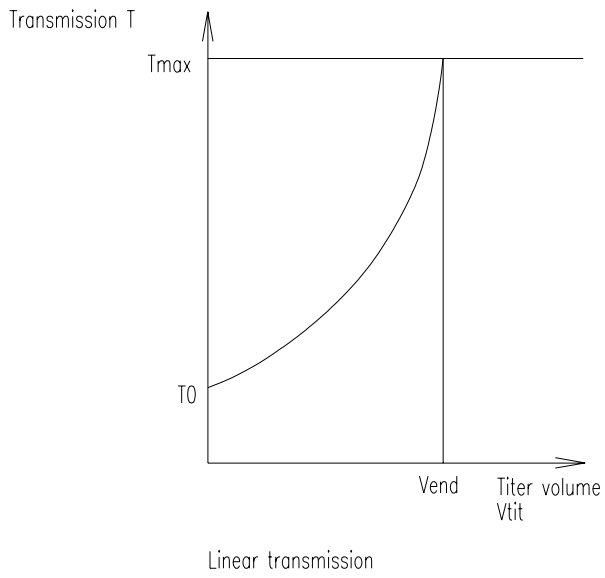
During the slow titration the measured transmission values are checked for spurious points from air bubbles or particles in the sample to eliminate these points.

### 2.2.2 Titration Curves

The graph of transmission as a function of titer volume is based on de Beer's law. Theoretically the function is:

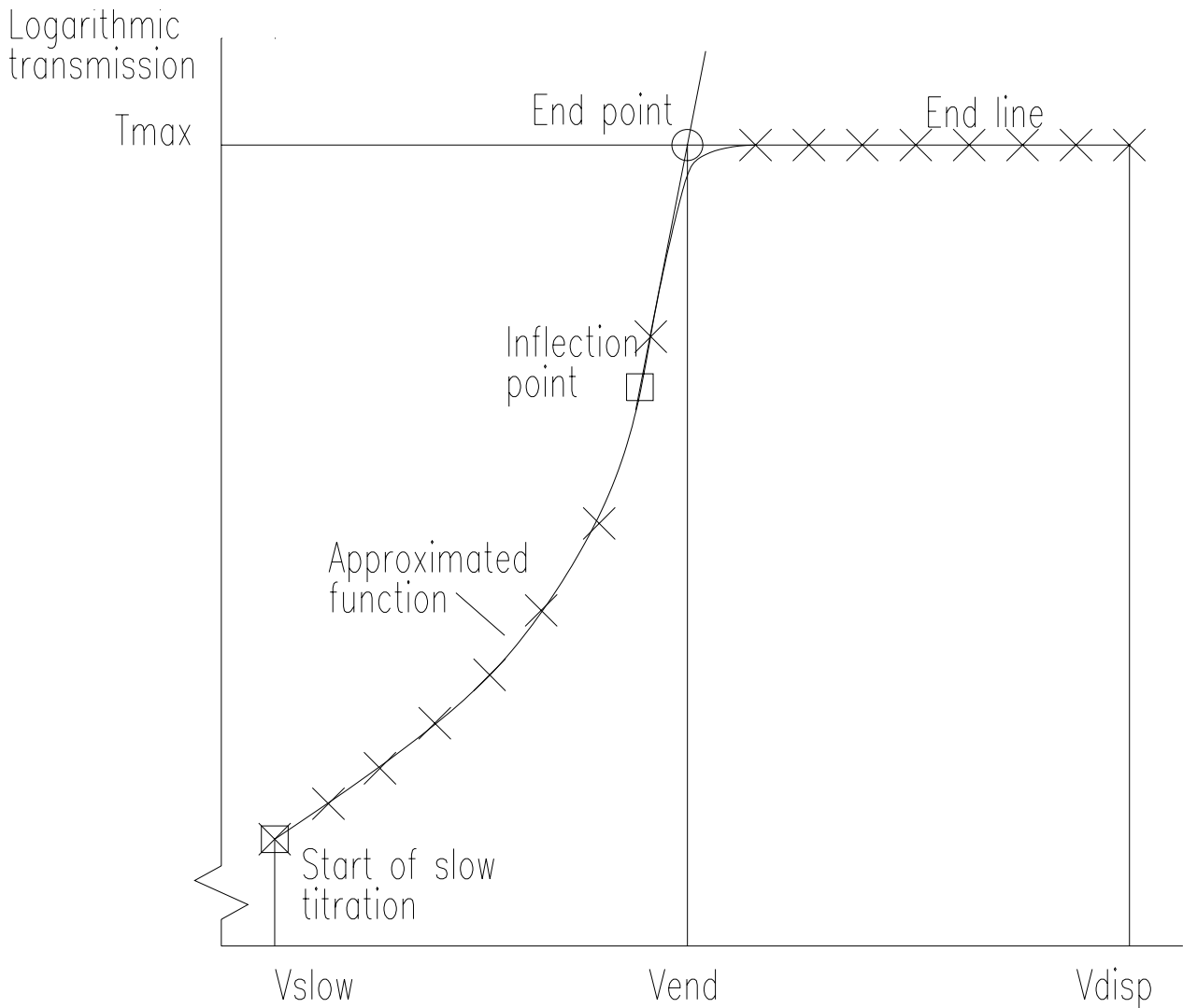
$$T = T_0 * e^{c*V_{tit}}, \text{ for } 0 \leq V_{tit} \leq V_{end}$$
$$T = T_{max}, \text{ for } V_{tit} > V_{end}$$

with T = transmission,  
T<sub>0</sub> = transmission at the start of titration,  
T<sub>max</sub> = transmission at the end of titration  
c = a constant factor,  
V<sub>tit</sub> = titer volume, and  
V<sub>end</sub> = titer volume equivalent to dissolved oxygen.



**Figure 2.1 Theoretical Titration Curves**

In practical operation the detected curves will differ from the theoretical function.



**Figure 2.2 Practical Titration Curve**

This figure shows a typical titration curve with the approximated function, the end line and the interesting function points.

### 2.2.3 Titration End Condition

The titration will stop if the slope of the line calculated by linear regression from the last ten valid transmission values is zero or negative, that is reaching the transmission maximum. The average of these values is taken as the end transmission (or end line), which is used for the endpoint calculation. In addition the point of maximal slope, detected during the slow phase, is stored for later use.



## 2.2.4 Endpoint Calculation

The endpoint calculation is done by a third order polynomial approximation of the logarithmic transmission values in the range from the beginning of the slow titration up to the constant end transmission. To optimize the polynomial, the approximation is done iteratively, eliminating the values outside three sigma for every iteration pass. Then the inflection point of the polynomial is calculated by double derivation. The endpoint is the point of intersection from the transmission end line and the line which is determined by the inflection point and the slope of the polynomial at that inflection point (Remember that we are using logarithmic transmission values; therefore, it is an e-function in reality).

This method guarantees that all valid measuring points are used for the endpoint calculation instead of a subset. If the approximation fails (e.g. no inflection point inside the valid range, the inflection point is a saddle point, or there are not enough measuring values during the slow titration), the endpoint will still be calculated by intersection point determination, but by using the point of maximal slope, detected during slow titration, by linear regression. In these cases you will get a warning message. To assess the quality of the endpoint calculation, observe the titration curve obtained by the Graph command. Particularly when the inflection point is a saddle point, the titration may have a very high accuracy when the approximated function is nearly a straight line (This occurs sometimes in the demonstration program, but not very often in real titrations).

## 2.2.5 Accuracy of Endpoint Determination

The accuracy is calculated from the variation of the end line and the approximated polynomial (or the data calculated during titration, if the approximation fails). By using small titer amounts during slow titration (1/2000 of burette volume) and optimization of the curves, the calculated errors are often very small (0.05 . . . 0.001% relative to burette volume). Therefore, the accuracy of the system generally is based on the error of the motor burette (absolute error  $\leq$  0.3 %, reproducibility error  $\leq$  0.1 %).

## 2.3 Titration Procedures

The next part will give you some brief information to the preparation of samples and titration procedures. The software supports the WOCE and ISO standards for whole bottle titrations. All additional features mentioned in the WOCE standard but not in the ISO standard are also available in ISO mode. For more information, see the WOCE manual (1991) or Carpenter (1965) and the ISO specifications.

### 2.3.1 Standardization

WOCE: Standards should be determined in pure water, according to the WOCE recommendations. It is the procedure described by Carpenter (1965) with the extension of adding manganous chloride to the standards.

To make a standardization, pipette your standard solution (10 ml of 0.01 N potassium iodate ( $\text{KIO}_3$ )) into a bottle, nearly fill with distilled water, add the same volumes of reagents as for titrations (sulphuric acid ( $\text{H}_2\text{SO}_4$ ), sodium

iodide-sodium hydroxide (NaI/NaOH) and manganous chloride ( $\text{MnCl}_2$ ), and start the standard determination.

ISO: Dissolve approximately 0.5 g potassium iodide or sodium iodide (KI or NaI) in 100 to 150 ml pure water and add 5 ml sulphuric acid ( $\text{H}_2\text{SO}_4$ ). Mix the solution and add exactly 20 ml standard solution ( $\text{KIO}_3$ , 10 mmol/l). Then fill up to 200 ml with pure water and start the standard determination.

### 2.3.2 Blank Determination

WOCE: Blanks should be determined in pure water, according to the WOCE recommendations and Carpenter (1965). To determine the blank value pipette 1 ml of your standard solution into a bottle, nearly fill with pure water, add the same amount of reagents as for titrations, and start the first blank titration. Then add another ml of standard solution into the solution and titrate the liberated iodine. If you want to get a more precise result, repeat the last step one or more times. The blank value is calculated by subtraction of the average of all additional titer volumes from the first one.

ISO: Blank determinations are not mentioned in the ISO standard, but the software allows blank determinations even in ISO mode. They are handled in the same way as for the WOCE standard.

### 2.3.3 Sample Titration

WOCE: Fill and overflow the flask with at least three bottle volumes, add the reagents ( $\text{MnCl}_2$  and NaOH/NaI; e.g. 1 ml of each) and stopper the flask. Shake the bottle and allow the precipitate to settle. After settling, add the sulphuric acid, place a magnetic stirring bar in the flask, place the bottle in the photometer and start the titration. Take care to avoid the introduction of air bubbles.

ISO: The software supports only whole bottle titrations. Fill the flask, add the reagents (1 ml  $\text{MnCl}_2$  and 2 ml NaOH/NaI) and stopper the flask. Shake the bottle and allow the precipitate to settle. Before titration, add 1.5 ml sulphuric acid.

### 2.3.4 Duplicate Samples

WOCE: The WOCE recommendations insist on the titration of duplicate samples to provide a reliable estimate of analytical precision. They should be taken for at least 10% of all samples from a data set. To make a duplicate sample, prepare two flasks from one sample, enable the duplicate sample switch in the titration menu (duplicate samples must be enabled in the configuration menu), and start the titration. The reproducibility, calculated from all duplicates in a data set, is stored in the data file together with other statistics.

ISO: Procedures for duplicate samples are not described, but mentioned in the ISO standard. The software handles duplicates in ISO mode in the same way as in WOCE mode.

### 2.3.5 Titer Concentration

The concentration of the thiosulphate titer should be strong enough, to titrate nearly all samples with a titer volume less than one burette volume. If the titer is not strong enough, the burette has to be refilled during titration, producing less accurate results. Especially for standardization the titer volume must be less than one burette volume, because an inexact result will affect all following titration results. On the other hand the titer should not be too concentrated, as this will lead to less accurate results and could, in the worst case, cause failure of the titration.

### 2.4 Calculations

This chapter lists all equations, used by the program to calculate oxygen concentrations. All calculations will match the WOCE (World Ocean Circulation Experiment) and the ISO (International Standardization Organization) recommendations.

Titer concentration in mmol/l (ISO, 1983):

The original ISO equation is:

$$c = \frac{6 * 20 * 1.6}{V_{std}}$$

for 20 ml of 10 mmol/l iodate standard.

The used equation is:

$$c = \frac{V_{IO_3} * N_{IO_3}}{V_{std}}$$

- $V_{std}$  = thiosulphate titer of standard (ml)
- $V_{IO_3}$  = volume of iodate standard (ml)
- $N_{IO_3}$  = normality of iodate standard (mmol/l)

Oxygen mass concentrations in mg/l (ISO, 1983):

The original ISO equation for whole bottle titrations is:

$$O_2 = \frac{M_r * V_x * c * f_l}{4 * V_{bot}}$$

with

$$f_1 = \frac{V_{bot}}{V_{bot} - V_{reg}}$$

- $M_r$  = relative molar mass of oxygen (32)
- $V_x$  = thiosulphate titer of sample (ml)
- $c$  = titer concentration (mmol/l)
- $V_{bot}$  = volume of sample bottle (ml)
- $V_{reg}$  = volume of sample displaced by reagents (ml)

The used equation is:

$$O_2 = \frac{((V_x - V_{blk,dw}) * c * \frac{M_r}{4}) - (DO_{reg} * 1000 * \frac{8}{5.598})}{V_{bot} - V_{reg}}$$

- $V_x$  = thiosulphate titer of sample (ml)
- $V_{blk,dw}$  = thiosulphate titer of pure water blank (ml)
- $V_{bot}$  = volume of sample bottle at the pickling temperature (ml)
- $V_{reg}$  = volume of sample displaced by reagents (ml)
- $DO_{reg}$  = absolute amount of oxygen added with reagents (ml)

To match the original equation use the default values:

- $V_{blk,dw} = 0$  ml
- $DO_{reg} = 0$  ml

Oxygen volume concentrations in ml/l (WOCE, 1991):

$$O_2 = \frac{(V_x - V_{blk,dw}) * V_{IO3} * N_{IO3} * 5598}{(V_{std} - V_{blk,dw})} - 1000 * DO_{reg}$$

$$(V_{bot} - V_{reg})$$

- $V_x$  = thiosulphate titer of sample (ml)
- $V_{blk,dw}$  = thiosulphate titer of pure water blank (ml)
- $V_{std}$  = thiosulphate titer of standard (ml)
- $V_{bot}$  = volume of sample bottle at the pickling temperature (ml)
- $V_{reg}$  = volume of sample displaced by reagents (ml)
- $V_{IO3}$  = volume of iodate standard at temperature of standardization (ml)
- $N_{IO3}$  = normality of iodate standard at temperature of standardization
- $DO_{reg}$  = absolute amount of oxygen added with reagents (ml)

Oxygen weight concentrations in  $\mu\text{M}/\text{kg}_{sw}$  (WOCE, 1991):

$$O_2(\mu M/ kg_{sw}) = \frac{44.660 * O_2(ml/l)}{\rho_{sw}}$$

44.660 = 1000/molar volume of oxygen gas at STP (Weiss, 1981)  
 $O_2(ml/l)$  =  $O_2$  volume concentration (ml/l)  
 $\rho_{sw}$  = density of seawater at the sample temperature ( $g/cm^3$ )

Percentage  $O_2$  saturation (Weiss, 1970):

$$O_{2sat} = \frac{100(\%) * O_2(ml/l)}{e^C}$$

C =  $-173.4292 + 249.6339 * (100 / T) + 143.3483 * \ln(T / 100) - 21.8492 * (T / 100) + S * (-0.033096 + 0.014259 * (T / 100) - 0.0017 * T^2 / 10000)$   
T = sample temperature (Kelvin)  
S = salinity (psu)

Density of pure water in  $g/cm^3$  (Bigg, 1967):

$$\rho_w = 0.999842594 + 6.793952 * 10^{-5} * T - 9.095290 * 10^{-6} * T^2 + 1.001685 * 10^{-7} * T^3 - 1.120083 * 10^{-9} * T^4 + 6.536332 * 10^{-12} * T^5$$

T = temperature ( $^{\circ}C$ ); range 0 - 40  $^{\circ}C$

Density of seawater in  $g/cm^3$  (Millero and Poisson, 1981):

$$\rho_{sw} = \rho_w + A * S + B * S^{1.5} + C * S^2$$

$\rho_w$  = density of pure water ( $g/cm^3$ )  
S = salinity (psu); range 0.5 - 43 psu  
T = temperature ( $^{\circ}C$ ); range 0 - 40  $^{\circ}C$   
A =  $8.24493 * 10^{-4} - 4.0899 * 10^{-6} * T + 7.6438 * 10^{-8} * T^2 - 8.2467 * 10^{-10} * T^3 + 5.3875 * 10^{-12} * T^4$   
B =  $-5.72466 * 10^{-6} + 1.0227 * 10^{-7} * T - 1.6546 * 10^{-9} * T^2$   
C =  $4.8314 * 10^{-7}$

Volume corrections (WOCE, 1991) for bottles and pipettes:

$$V = V_{(20)} * (1 + \alpha * (T - 20))$$

$V_{(20)}$  = volume at 20  $^{\circ}C$   
 $\alpha$  = cubical coefficient of thermal expansion ( $1/^{\circ}C$ )  
T = actual temperature ( $^{\circ}C$ )

Standard normality correction (WOCE, 1991):

$$N_{IO_3} = N_{IO_3(20)} * \frac{\rho_{w(T)}}{\rho_{w(20)}}$$

$N_{IO_3(20)}$  = normality of iodate standard at 20 °C  
 $\rho_{w(T)}$  = density of pure water at temperature T (g/cm<sup>3</sup>)  
 $\rho_{w(20)}$  = density of pure water at 20 °C (g/cm<sup>3</sup>)  
T = temperature (°C)

Titer volume correction:

$$V_x = V_{x(T_{tit})} * \frac{\rho_{dw(T_{std})}}{\rho_{dw(T_{tit})}}$$

$V_{x(T_{tit})}$  = titer volume at current temperature  $T_{tit}$   
 $\rho_{w(T_{std})}$  = density of pure water at standardization temperature  $T_{std}$  (g/cm<sup>3</sup>)  
 $\rho_{w(T_{tit})}$  = density of pure water at current temperature  $T_{tit}$  (g/cm<sup>3</sup>)

## Chapter 3

### The DO Analyser Software

#### 3.1 Convert Bottle File

The software includes a file named CONVBOT.EXE. It is used to convert bottle files created with older software versions to the 3.x format. To convert old bottle files select the drive and directory containing the old file and type "CONVBOT <Enter>". The program will create a version 3.x binary file (DOA.BOT) from the old text files (BOTTLE.TXT or FLASCHEN.TXT), without deleting them.

#### 3.2 Calibration Program

The software package includes a calibration program DOACAL.EXE for the 2-channel system. For a detailed description of the calibration procedure see the Technical Reference Manual. Note that the system is calibrated by the factory and that a new calibration should only be done by qualified technical personnel if it is really necessary.

#### 3.3 Hercules Graphic Utility

To use the Graph command with Hercules graphic cards, you must install the terminate-and-stay-resident program MSHERC.COM before starting the DOA program.

#### 3.4 Command Line Syntax

Usage: DOA [/{MCL}] [/{ED}] [/X] [/Zname] [/Fname] [/{H?}]  
DOADEMO [/{MCL}] [/{ED}] [/X] [/Zname] [/Fname] [/1] [/{H?}]

Command line parameters:

M	Monochrome display mode (default is auto detection)
C	Colour display mode (default is auto detection)
L	LCD display mode (not yet implemented; use colour table)
E	English language (default setting)
D	German language
X	Write all titration data to log file (default is off)
Z<name>	Set log file name to 'name' (default name is DOA.LOG)
F<name>	Use configuration file 'name' (default is DOA.CFG)
1	Demo for one channel system (only for DOADEMO.EXE; default is two channels)
H, ?	Display help screen with command line parameters

The options are selected by typing a switching character ('/' [slash] or '-' [minus]) followed by the option character (upper-case or lower-case). Each option must be separated from another by a white-space character (e.g. space or tab).

All options will overwrite the current settings (from the configuration file DOA.CFG or the default settings if no configuration file is found). The options 'M', 'C', 'L', 'E' and 'D' are saved in the configuration file. Thus the settings will be valid until they are overwritten by other settings.

The options 'X', 'Z' and '1' (for DOADEMO.EXE) are only valid for the current program execution. The default settings (no configuration file found) are English language and auto-detection for the display mode (monochrome or colour, depending on video card).

If you select the X-option the titration steps (transmission values and dispensed titer) of every titration will be written to an ASCII log file. This may be of interest to you, if you want to create your own graph of the titration curve. Even if the X-option is not specified you can save the data after each titration with the Log command.

The F-option is useful if you have more than one exchange unit with different titer concentrations. So the program must only be restarted when changing the unit instead of starting new standard and blank determinations. The distribution disk includes an example batch file for the use of different configuration files.

### 3.5 Demo Program

The demo program DOADEMO.EXE works like the program DOA.EXE. However, the results of titrations, standardizations and blank determinations may sometimes be rather improbable because they are produced by a random number generator. In particular, the curves will fit the theoretical curves of light absorptions. In addition to the full version you can select a demonstration mode for the old 1-channel hardware by the command line option '/1'.

### 3.6 File Formats

All files created by the software are stored in binary format, so you cannot read them with an editor or word processor. To produce readable text files use the Print to File option in the Print Menu. The Print Menu is available at many points inside the menu system. Text files contain only ASCII characters including the IBM PC graphics and national characters (codes 128 - 255). All system and data files contain an identification string, to ensure that only valid files will be used. The system uses four types of data files with identical file format, but with differences in the mode (WOCE or ISO) and replication data (duplicates enabled or disabled). The standard extension for data files is "DAT", but other extensions may be used.

Besides the data files, the software uses some system files with reserved names:

- DOA.CFG: The configuration file, holding all configuration data, the data of the last titration, standardization and blank determination, the file name of the last used data file etc.

At the start, the program first tries to load this file from the drive and path of the program, and if this fails to load the configuration file from the current drive and directory. If no configuration file is found, the program will ask if the file should be created with the default data.

- DOA.BOT: The bottle file, holding all bottle data. If the configuration file exists, this file is loaded from or created in the drive and path of the configuration file, otherwise the current drive and directory will be used.

- DOA\_\*.HLP: The help text files. The program tries first to locate these files in the program path. If this fails, the program searches for the files in the



current directory. Note that no error or warning message is produced, if no file is found.

- DOA\_\*.NDX: The help index files.
- DOA\_\*.MSG: The message text files.
- DOA\_\*.STM: The status message files.

Please do not modify the data or system files, because this could produce unpredictable results.

# Chapter 4

## The Menu System

### 4.1 Help System

To call up Help, press <F1>. The Help window details the functions of the item on which you're currently positioned. To get to the Help Index press <F1> again once you're in the Help system. Inside the index list you can choose your desired help index to get the attached help text. For more information about the help system see section 4.3.30, Help Menu.

### 4.2 Status Line

The Status Line at the bottom of the screen contains some short information about the current item you're on.

### 4.3 Menu Commands

For use of the keyboard and the mouse inside the menu system, see the tutorial.

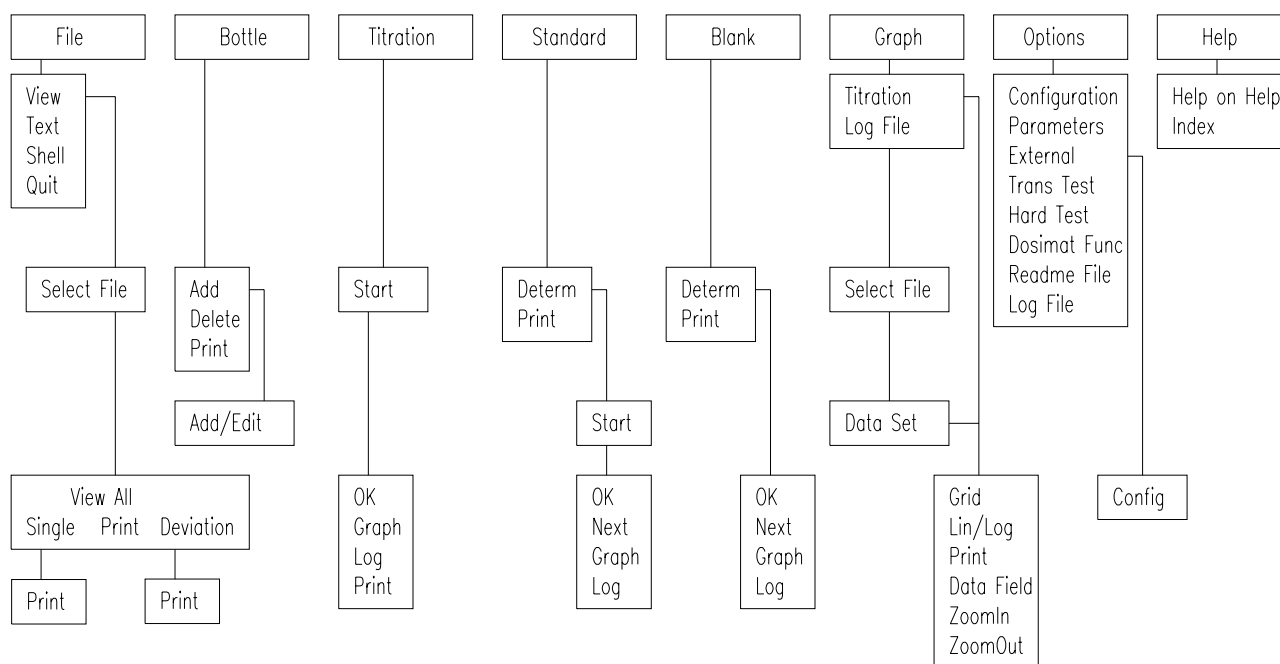
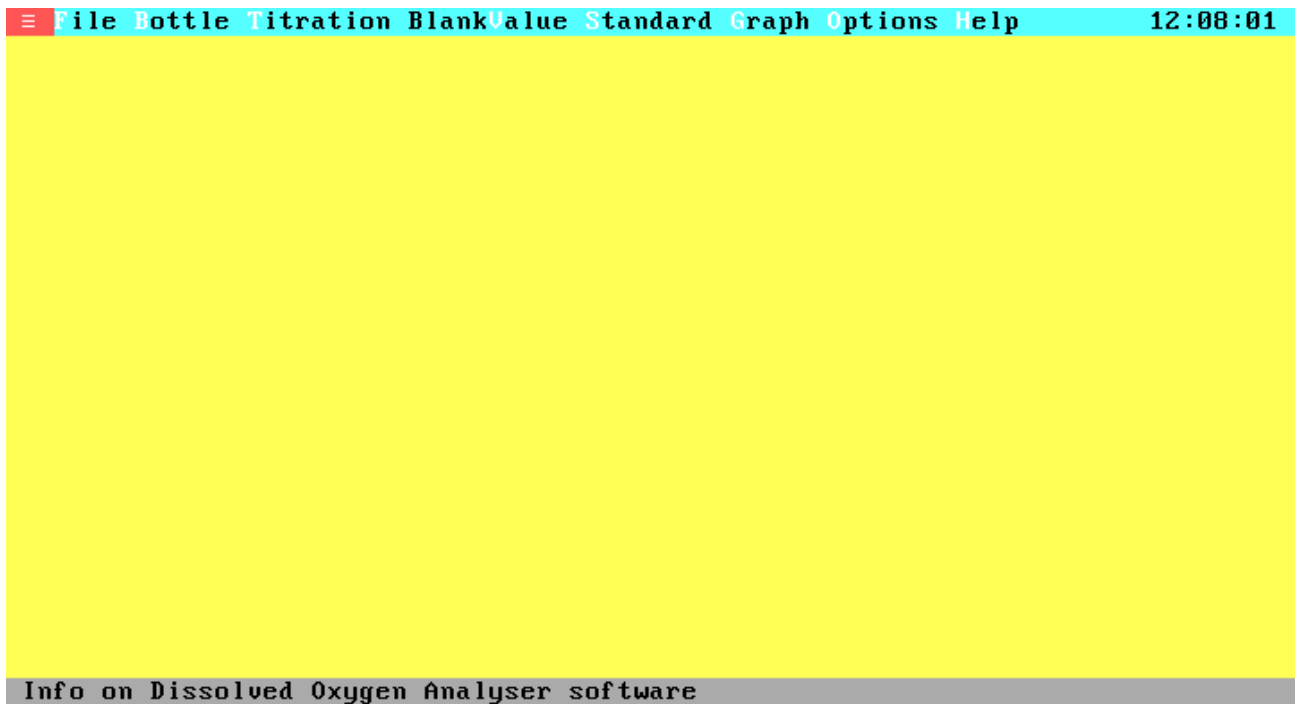


Figure 4.1 Menu Tree

### 4.3.1 Main Menu

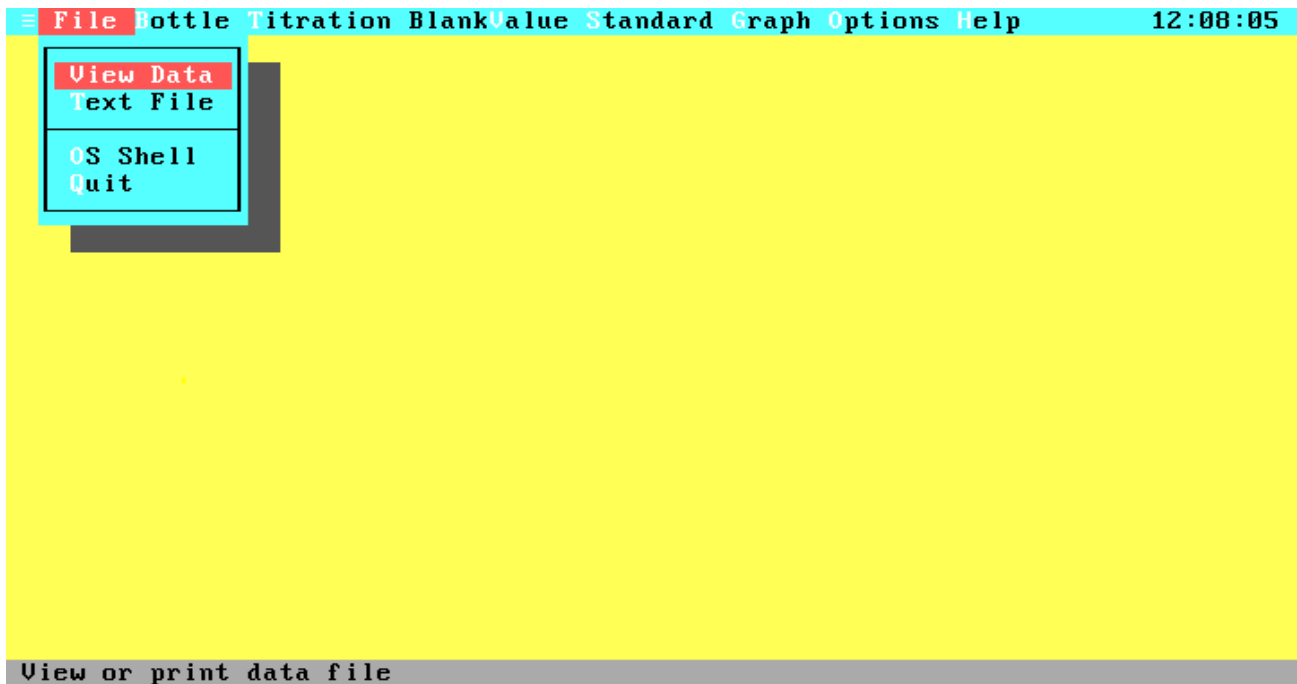


**Figure 4.2 Main Menu**

At the top of the main screen is the main menu bar, offering nine selections and displaying the current time at the right:

≡ (About)	Displays the product version information.
File	Handles files, invokes DOS and quitting the program.
Bottle	Handles bottles (viewing, adding, deleting, printing).
Titration	Determination of the dissolved oxygen from a sample.
BlankValue	Blank Value (view or print current value, determination of blank value).
Standard	Standardization (view or print current data, determination of new data).
Graph	Display the graph of the last titration.
Options	Allows you to configure your system and lets you check the hardware.
Help	Invoke the help system (Help On Help, Help Index)

### 4.3.2 File Menu

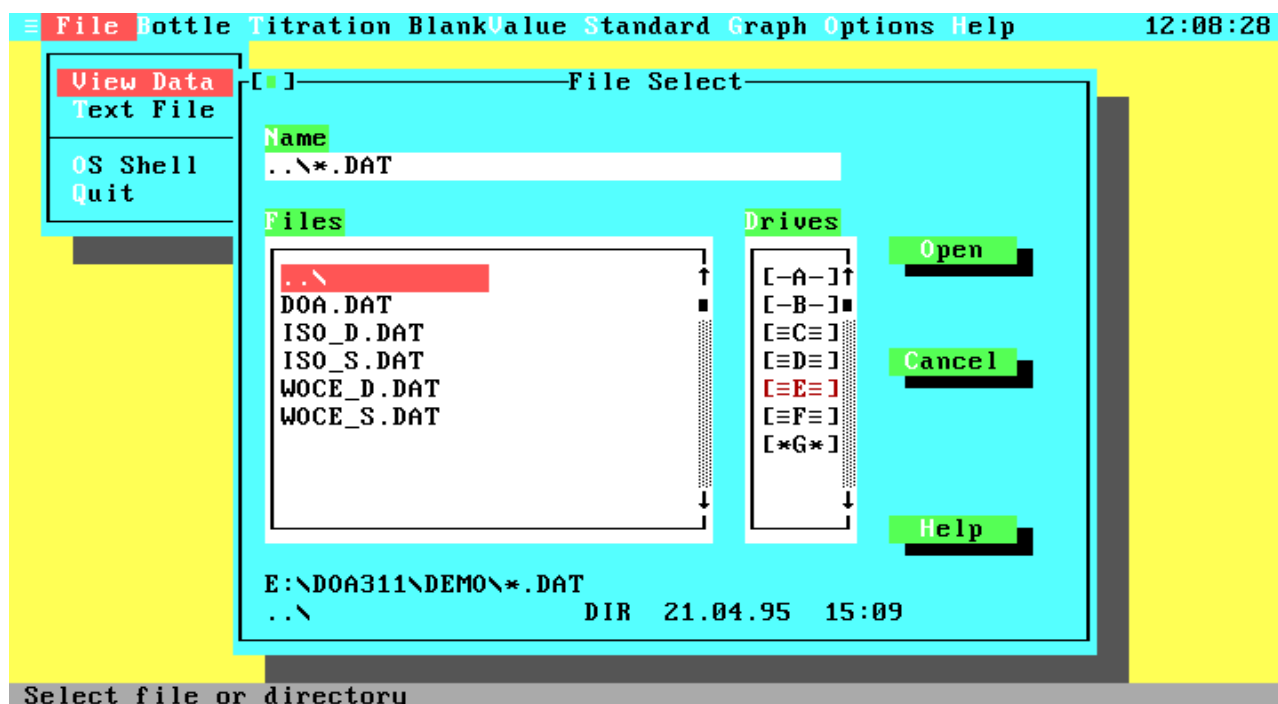


**Figure 4.3 File Menu**

The File pull-down menu allows you to view and print existing data files, view and edit text files, temporarily go to the DOS shell, or exit the program.

- |           |  |
|-----------|--|
| View Data | Allows you to view and print existing data files. After activation of View Data the File Select window will pop up, prompting for input of a file name.  |
| Text File | Lets you load an ASCII file vor viewing and editing. This command is only available if an external editor is installed with the External item in the Options menu.                             |
| OS Shell  | Leaves the program temporarily and takes you to the DOS prompt. To return to the program, type "EXIT <Enter>". This is useful when you want to run a DOS command without quitting the program. |
| Quit      | Quits the program and returns you to the DOS prompt. There is no verifying to exit from the program, because all important data are saved automatically before the program terminates.         |

### 4.3.3 File Selection



**Figure 4.4 File Selection**

From this window you can select a file for viewing, printing or data output.

- |        |   |
|--------|---|
| Name   | The name of your data file, a directory specification, or a search mask.  |
| Files  | Select an existing data file to load, or a directory to change to from this list by using the cursor keys or the mouse (activation with double click). When you move through the list, the name of the current file or directory is copied to the Name field. |
| Drives | Select a new drive.   |
| Open   | Opens the file from the Name Field or changes to the directory specified in the Name Field.   |
| Cancel | Leaves the File Selection Window without changing the current file name.  |
| Help   | Displays the help screen about the File Selection Window.   |

The file list contains only directories and files of the currently required types. At the bottom of the window the current drive, path and search mask and the file size, date and time of the currently selected file or directory are displayed.

### 4.3.4 Data Overview

Date	Time	Station	Depth	Bo#	BotVol	BVol20	Botα	Tsw	Tpick	Tt
01.02.93	13:24	SiS	0	63	59.71	59.71	1.0E-5	14.30	14.70	19
01.02.93	13:27	SiS	0	64	59.53	59.54	1.0E-5	3.20	4.10	19
01.02.93	13:31	SiS	0	65	59.49	59.50	1.0E-5	-0.40	1.20	19
01.02.93	13:34	SiS	0	77	59.56	59.56	1.0E-5	17.30	17.45	19
01.02.93	13:37	SiS	0	79	58.99	58.99	1.0E-5	23.40	23.35	19
01.02.93	13:41	SiS	0	80	59.92	59.92	1.0E-5	17.30	17.30	19
01.02.93	13:44	SiS	0	93	59.08	59.09	1.0E-5	6.70	7.10	19
01.02.93	13:47	SiS	0	98	59.79	59.79	1.0E-5	18.30	18.30	19
01.02.93	13:50	SiS	0	99	59.71	59.71	1.0E-5	12.10	12.40	19
01.02.93	13:53	SiS	0	63	59.70	59.71	1.0E-5	4.50	4.90	19
01.02.93	13:55	SiS	0	64	59.54	59.54	1.0E-5	17.20	17.25	19
01.02.93	13:59	SiS	0*	65	59.50	59.50	1.0E-5	15.60	16.10	19
01.02.93	13:59	SiS	0*	77	59.56	59.56	1.0E-5	15.60	16.10	19
01.02.93	14:06	SiS	0	79	58.99	58.99	1.0E-5	13.20	13.40	19
01.02.93	14:10	SiS	0	80	59.92	59.92	1.0E-5	23.90	23.80	19

Buttons: Single, Print, Deviation, Cancel

Status bar: Display selected single data set

**Figure 4.5 Data Overview**

This window gives you a total overview on all data sets in the selected data file. On the top border of the window the name of the data file, together with the drive where it is stored and the determination method are displayed. Note that an asterisk behind the depth field marks the data sets as parts of duplicate samples.

Move through the data file by using the mouse and the scroll bar or by using the following keys:

- <Up>: Previous data set
- <Down>: Next data set
- <Left>: Column left
- <Right>: Column right
- <Home>: First data field of data set
- <End>: Last data field of data set
- <PgUp>: Previous page
- <PgDn>: Next page
- <Ctrl-Left>: Data field left
- <Ctrl-Right>: Data field right
- <Ctrl-Home>: First data set on screen
- <Ctrl-End>: Last data set on screen
- <Ctrl-PgUp>: First data set in file
- <Ctrl-PgDn>: Last data set in file

**Single** Opens the Single Data Set Window, displays the currently selected data set in a wide format, and lets you print the single data set to the line printer or a text file.

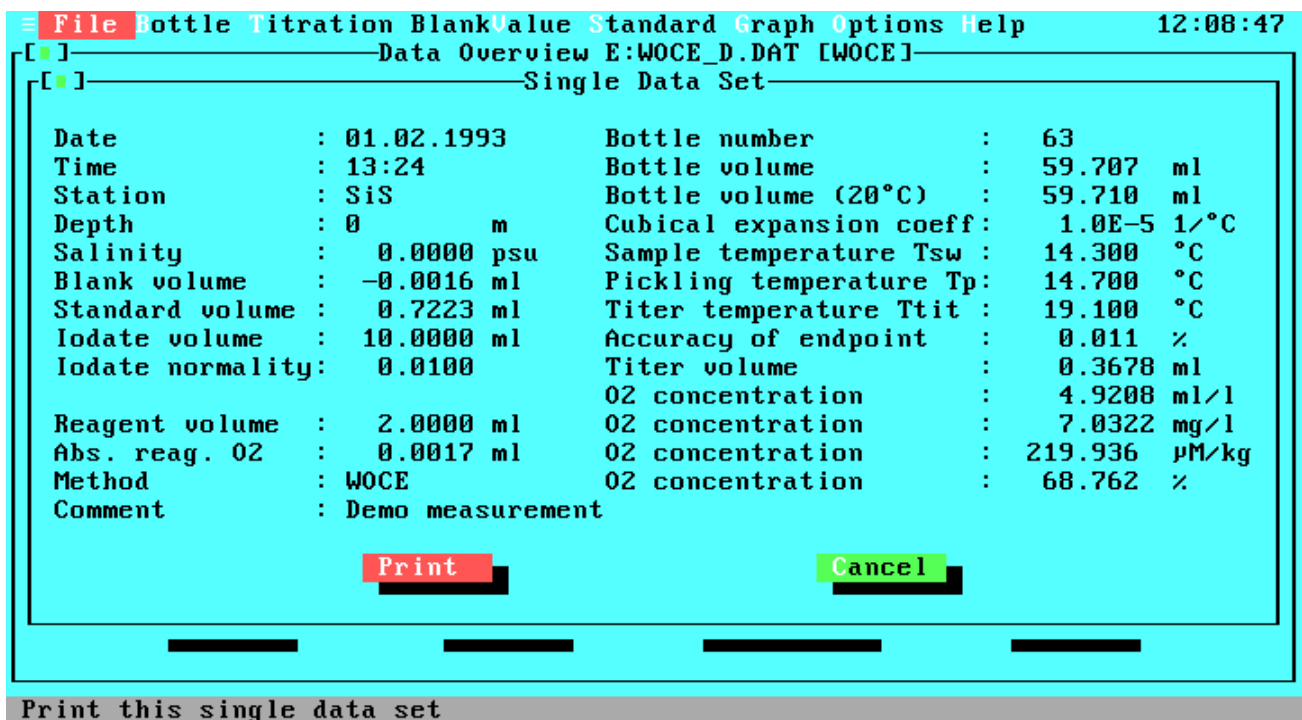
**Print** Prints all data sets from the data file to the line printer or a text file. If you only have a standard printer, the width of one data set line will exceed the printing

width of your printer. To get a readable output you can select the Split Printing option in the Configuration window (see Options Menu).

**Deviation** Displays statistics (precision, reproducibility) about the titration data from the current data file. This option is only available if the data file contains duplicate samples (see Duplicate Sample Control in the Options Menu / Configuration Window).

**Cancel** Leaves the Data Overview Window and returns you to the Files Menu.

### 4.3.5 View Single Data Set



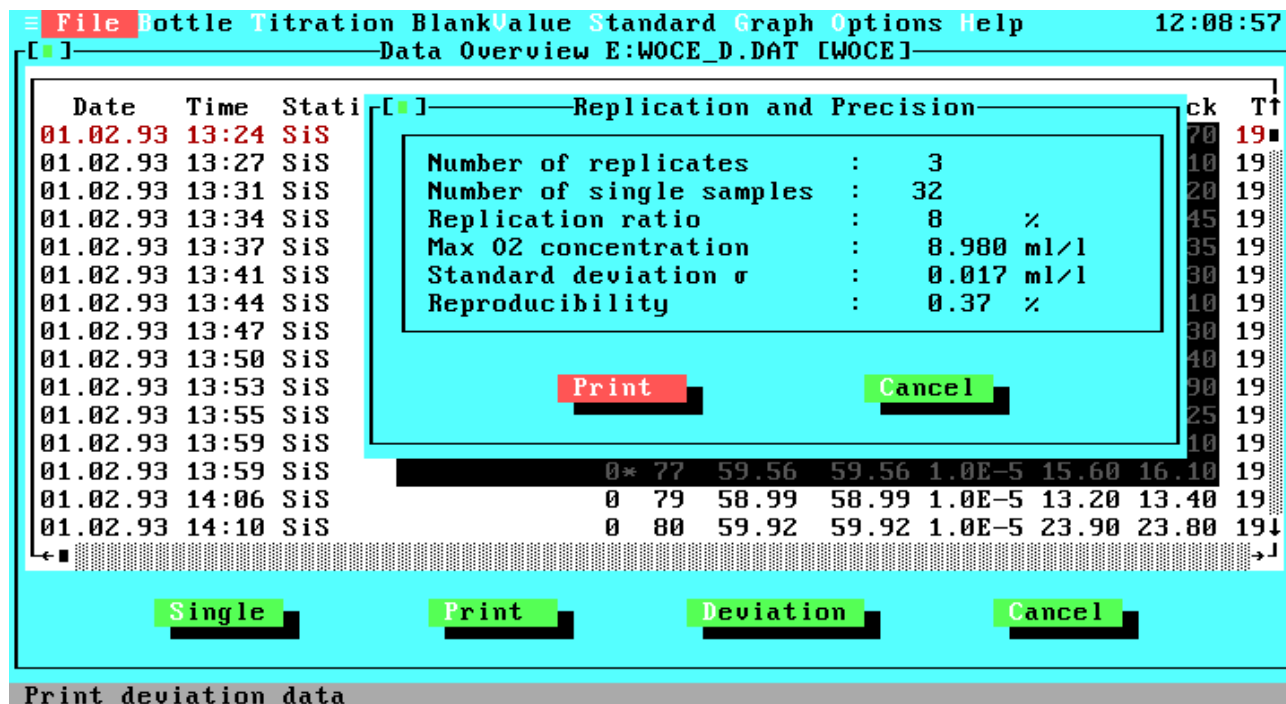
**Figure 4.6 View Single Data Set**

Displays a single data set in a wide, screen filling format.

**Print** Prints the single data set to line printer or text file.

**Cancel** Leaves the Single Data Set Window and returns you to the Data Overview Window.

### 4.3.6 View Replication And Precision



**Figure 4.7 View Replication and Precision**

Displays statistics about the titration data from the selected data file.

Description of the statistic data:

- Number of replicates: The total number of duplicate samples in the data file.
- Number of single samples: The total number of single samples in the data file.
- Replication ratio: The percentage ratio of the number of duplicates to the sum of the number of duplicates and the number of single samples.
- Max O2 concentration: The maximal measured O<sub>2</sub> concentration from this data file.
- Standard deviation: Standard deviation of differences from all duplicate samples.
- Reproducibility: Percentage reproducibility ( $2\sigma$ ) of all duplicates relative to the maximal O<sub>2</sub> concentration.

**Print** Prints the statistics to line printer or text file.

**Cancel** Leaves the Replication And Precision Window and returns you to the Data Overview Window.



### 4.3.7 Print Menu

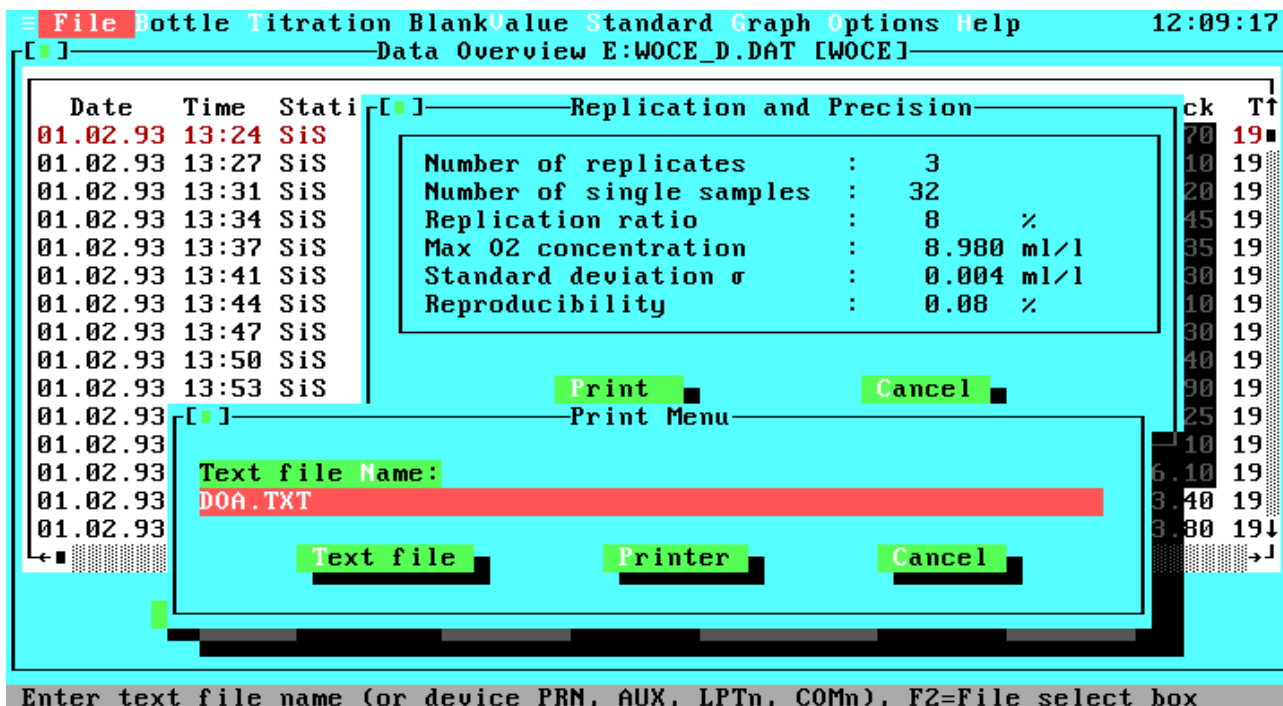


Figure 4.8 Print Menu

The Print Menu can be activated by many program items to print the currently selected and/or displayed data to your line printer or to a text file.

**Text File Name**      The name and optional drive and/or path of the file, to which the output should be written. If the output file exists already, you will get a warning message, giving you the choice of overwriting the existing file, appending the data to the file or leaving the Print Menu. Note that also the DOS device names PRN, AUX, LPTn and COMn are valid names and that the output will be directed to the specified DOS device instead of a file. By pressing the function key <F2> you may open the File Select window to choose an existing file or to change the drive or directory.

**Text File**              Prints the data to the file or device specified in the Text File Name field. The output will be done without any control characters except the carriage return and line feed sequences.

**Printer**                 Prints the data to the selected parallel printer. For parallel printer selection, open the Configuration Window in the Options Menu.

**Cancel**                 Leaves the Print Menu and returns you to the previous menu or window.

### 4.3.8 Bottle Management

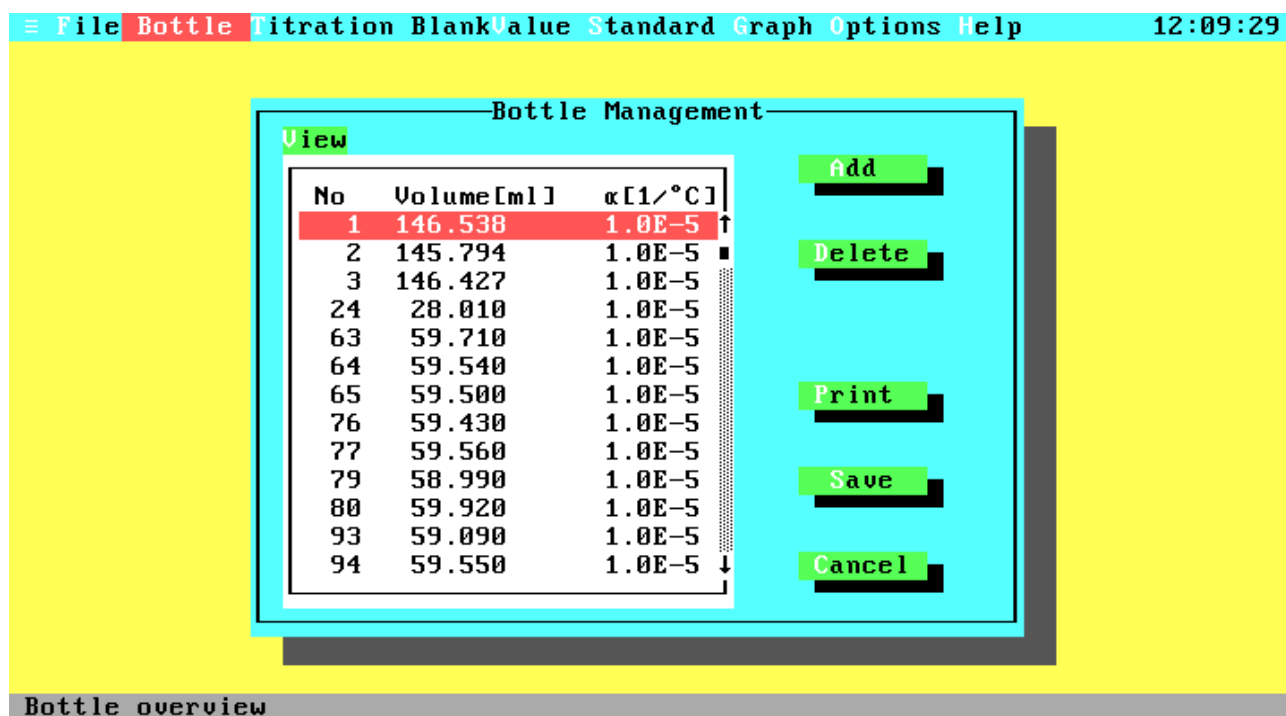


Figure 4.9 Bottle Management

The Bottles Window contains the data management for your bottles.

- View      A sorted list of all bottles. You can move through the list using the <Up>, <Down>, <PgUp> and <PgDn> key, or by using the scroll bar with the mouse.
- Add      To add a new bottle to the list or change the data of an existing bottle.
- Delete    Removes the currently selected bottle from the list.
- Print     Prints the complete list of bottles to line printer or text file.
- Save      Leaves the Bottles Window and saves all data on disk.
- Cancel    Leaves the Bottles Window without saving data.

### 4.3.9 Add Bottle

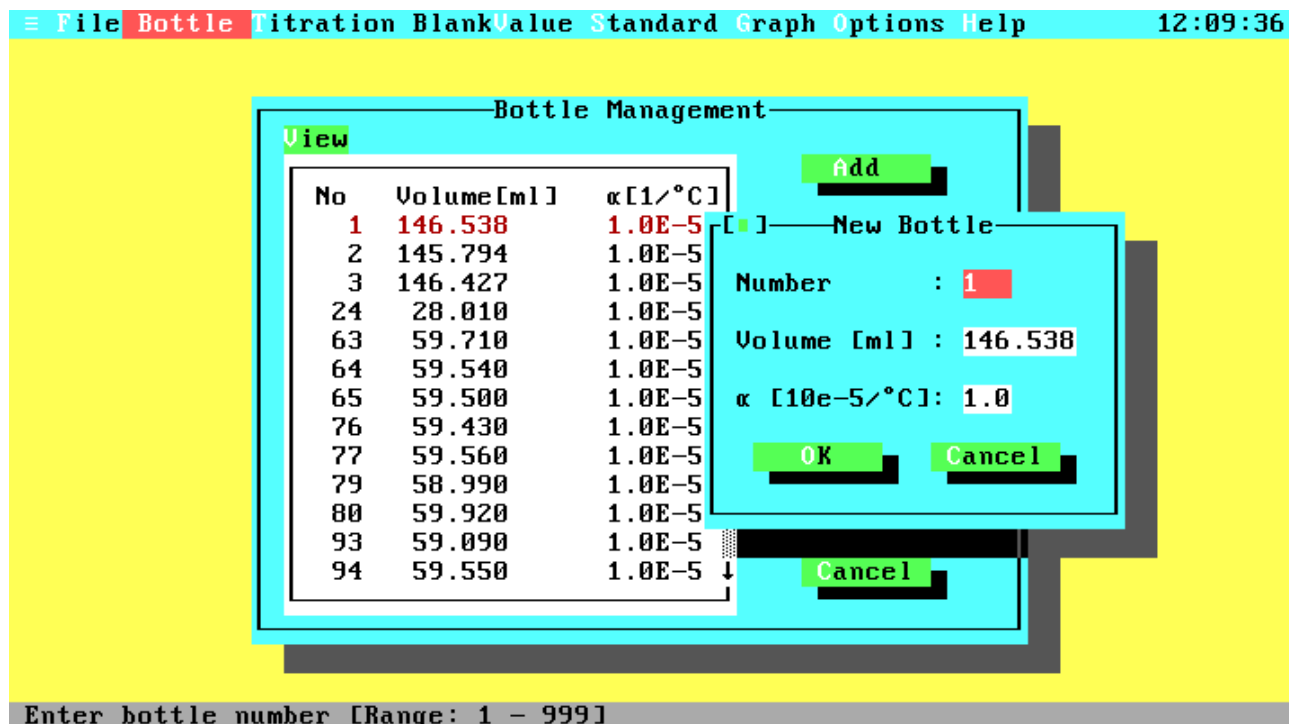


Figure 4.10 Add Bottle

Enter the data of a new bottle or change the data of an existing bottle. When this window pops up, all data will be preset to the values from the current list position in the Bottle management window.

**Number** The number of your bottle. The program will handle up to 999 different bottles with numbers from 1 to 999.

**Volume** The volume of your bottle in ml at the reference temperature of 20 °C. Valid volumes are in the range from 8 to 600 ml.

**α** The cubical coefficient of thermal expansion for the glass of your bottle. The coefficient is used to calculate the bottle volume for temperatures different from the reference temperature of 20 °C. Typical values for glass wares are  $1 \cdot 10^{-5}/^{\circ}\text{C}$  for borosilicate glass and  $2.5 \cdot 10^{-5}/^{\circ}\text{C}$  for soft glass. Valid coefficients are in the range from 0 to  $9.9 \cdot 10^{-5}/^{\circ}\text{C}$ .

**OK** Adds the bottle to the list. If a bottle with the specified number exists already, you will get a warning message.

**Cancel** Leaves this window without adding the bottle to the list.

### 4.3.10 Titration

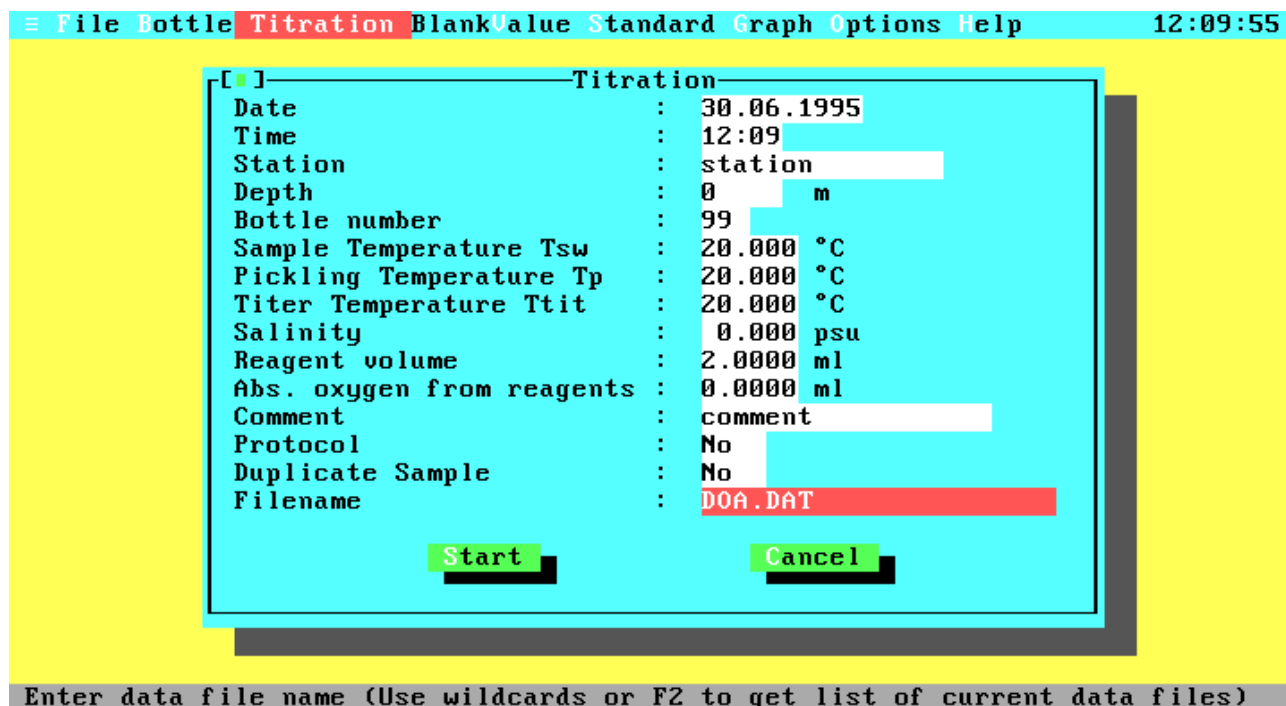


Figure 4.11 Titration

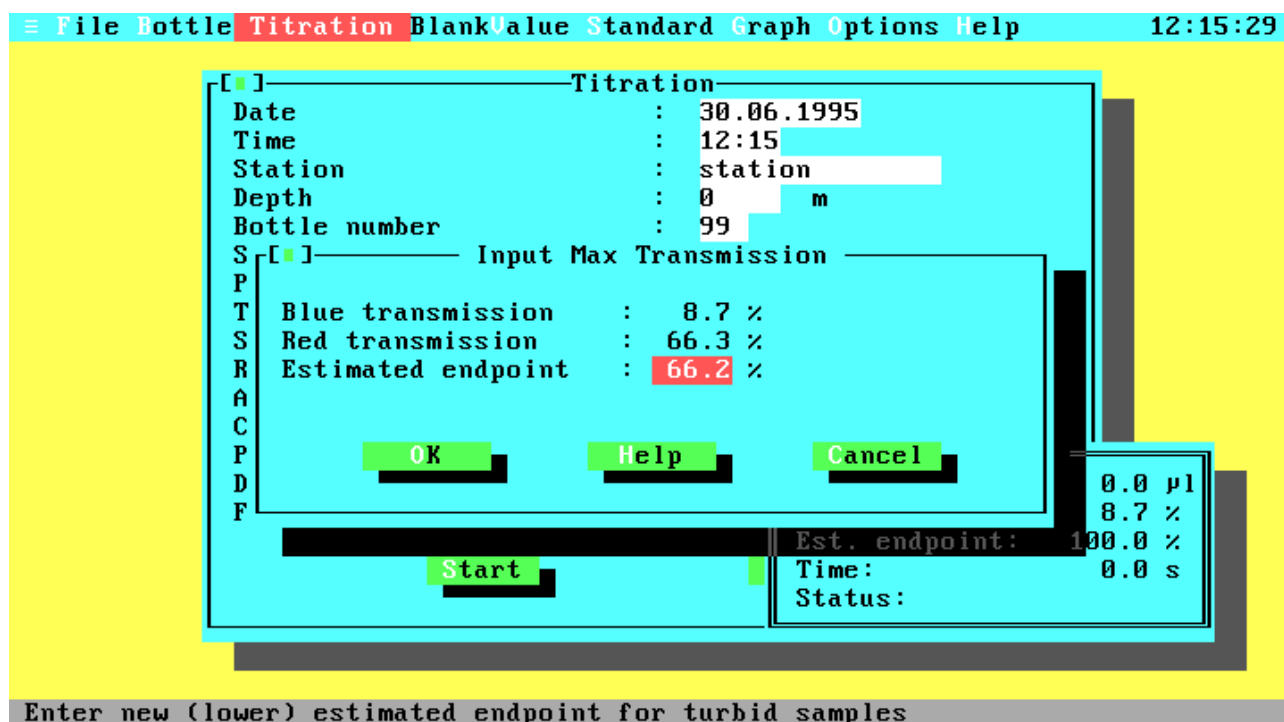
Use this window to measure the dissolved oxygen in a sample.

- |                  |   |
|------------------|---|
| Date             | The date of the titration. The Date is an optional part of a data set. By default this field will hold the current date. To enter a new date, use the format dd.mm.yy or dd.mm.yyyy.  |
| Time             | The time of the titration. The Time is an optional part of a data set. By default this field will hold the time when opening the Titration Window. To enter a new time, use the format hh:mm.   |
| Station          | The Station name is an optional part of a titration data set. Before starting a titration you can enter the name (max. 15 characters) of your station. By default this field holds the station name from the last titration.  |
| Depth            | The Depth is an optional part of a data set. Before starting a titration you can enter the depth of your sampling (max. 5 digits). By default this field holds the depth from the last titration.   |
| Bottle Number    | The number of your sampling bottle. Before you can start any titration you have to enter a valid bottle number. For new bottle numbers see the Add Bottle Window in the Bottles Window. If a bottle with the specified number is not part of the bottle list, you cannot leave this entry filed (except by closing the Titration window) and an error message is displayed. |
| Sample Temp. Tsw | The temperature of your sample at the time of sampling. This temperature is used to convert volumetric oxygen concentrations  |

(ml/l) into weight concentrations ( $\mu\text{M}/\text{kg}$ ) and  $\text{O}_2$  saturation. Valid inputs are in the range from -2 to 40 °C (Note that the calculations are only defined for temperatures from 0 to 40 °C).

Pickling Temp. Tpick	The temperature of your sample at the time of pickling (filling your bottle). The Pickling Temperature is used to calculate the real bottle volume at the time of filling. Valid inputs are in the range from -2 to 40 °C.
Titer Temp. Ttit	The temperature of your thiosulphate titer at the time of titration (probably now). The Titer Temperature is used to correct the titer volume relative to the titer temperature at standardization. Valid inputs are in the range from 0 to 40 °C.
Salinity	The salinity of your sample, if known. The salinity is used to convert volumetric oxygen concentrations into weight concentrations and $\text{O}_2$ saturation. Valid inputs are in the range from 0 to 43 psu.
Reagent Volume	The volume of your sample in ml displaced by the reagents.
Abs. Reag. Oxygen	The absolute amount of oxygen in ml added with the reagents. By default this field will hold the value from the last titration. The presetting value is 0.0017 ml for WOCE mode (Murray et al., 1968, valid for reagent volumes of each 1 ml) and 0 ml for ISO mode.
Comment	The Comment is an optional part of a data set. By default this field will hold the comment from the last titration. To enter a new comment just type in any printable character up to a maximal string length of 18 characters.
Protocol	Use the space bar to toggle this option on or off. When Protocol printing is enabled, titration results will be printed in a short form to your line printer after each titration. Be sure that your printer is ready before starting the titration.
Duplicate Sample	Use the space bar to toggle this option on or off. When Duplicate Control is enabled (see the Configuration Window in the Options Menu) you can specify that this titration will be a duplicate one. This option is not available if Duplicate Control is disabled.
File Name	The name (and optional drive or path) of the file to which the titration results will be written. To get a list of existing data files press the function key <F2> to open the File Select Window. Before you can start a titration you must enter a valid file name.
Start	Starts the titration of your sample. Be sure that all inputs are correct and your sample bottle is placed in the photometer.
Cancel	Leaves the Titration Window and takes you back to the Main Menu.

### 4.3.11 Input Maximal Transmission

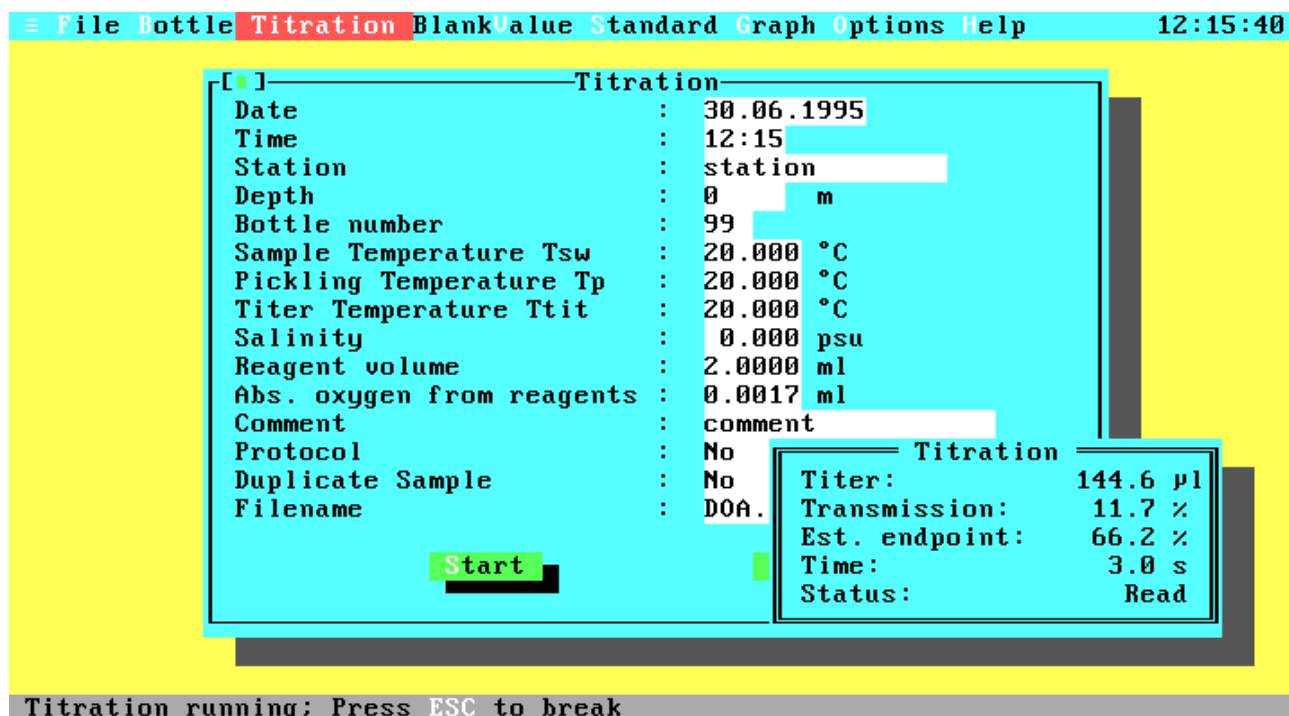


**Figure 4.12 Input Maximal Transmission**

This window exists only if you are working with a 2-channel photometer.

Blue Transmission	This value cannot be changed; it is the current percentage transmission of the blue beam.
Red Transmission	This value cannot be changed; it is the current percentage transmission of the red beam. The Estimated Endpoint entry field below will hold a value calculated from the red transmission and a correction factor.
Estimated Endpoint	The estimation of the percentage transmission value of your sample after titration. If your sample is turbid, this value may be too high. So you can change the value to avoid an over titration. Note that decreasing the estimated endpoint results in increasing titration times. Normally the Estimated Endpoint is calculated from the red transmission, a correction factor, and a general offset. Turbid samples, especially samples with photosynthetic microorganisms, will have a higher blue than red light absorption. Therefore, it is better to decrease the presetting in such a case.
OK	Starts the titration using the above specified estimated endpoint.
Help	Displays the help text about the endpoint estimation.
Cancel	Aborts the starting of titration and returns you to the Titration Window.

### 4.3.12 Titration Running



**Figure 4.13 Titration Running**

During titration the current titration values (titer amount, percentage transmission, estimated endpoint and titration time) are displayed continuously in the Titration Running Window. If you want to interrupt the titration, just press <Esc> and confirm the User Break Message with OK. Note that you can go on with the titration by selecting Cancel, but if you are already in the slow titration phase the results may be inexact for longer (more than two seconds) delay times.

The displayed values are:

Titer:	Total amount of dispensed titer.
Transmission:	Percentage transmission of the blue beam.
Est. Endpoint:	Estimated percentage transmission after end of titration.
Time:	Total time in seconds since starting the titration.
Status:	Current titration step.

The status line can contain the following titration steps:

Dispense:	Titer is dispensed into sample.
Read:	System reads transmission from photometer.
Wait:	Delay cycle to ensure the chemical reaction of the titer.

### 4.3.13 Titration Finished

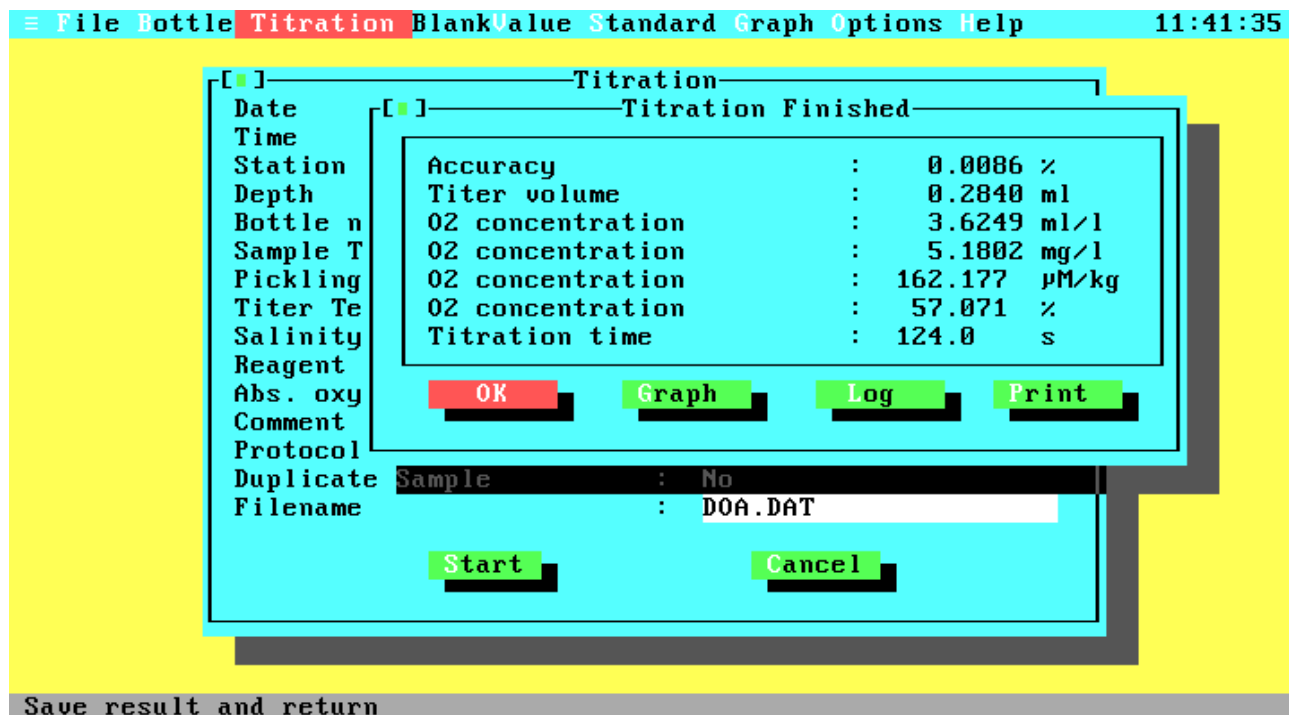


Figure 4.14 Titration Finished

This window will pop-up after a successful titration to display the titration results.

**OK** Leaves the Titration Finished Window, saves the results in the specified data file and returns you to the Titration Window. If you had selected a duplicate sample and the first titration was just finished, the results will not yet be saved and you will not return to the Titration Window. Instead another window will pop up, prompting you for the bottle number of the second bottle. After the second titration, this window will pop up again and the data of the duplicate sample will be saved after leaving this window.

**Graph** Displays the graph of the titration curve. For more information see The Graph Window in the Main Menu.

**Log** Opens the Log menu to write the titration data (titer-transmission pairs) to an ASCII file or to print them on a line printer.

**Print** Prints the complete data of the titration to line printer or text file. The print format will be the same when printing a single data set from a data file.

The displayed values are:

**Accuracy:** This value is calculated during the approximation of the titration curve and gives you information about the accuracy of the endpoint calculation. It is the percentage standard deviation relative to the calculated titer volume. If there are many titration steps and little noise the accuracy may be very good (better than 0.01 %), because of the optimization algorithm.

**Titer volume:** The calculated titer volume at the titration endpoint.



O2 concentration: The O<sub>2</sub> concentration in ml/l, mg/l, μM/kg and the percentage O<sub>2</sub> saturation.  
 Titration time: The total time for the titration.

### 4.3.14 Log Menu

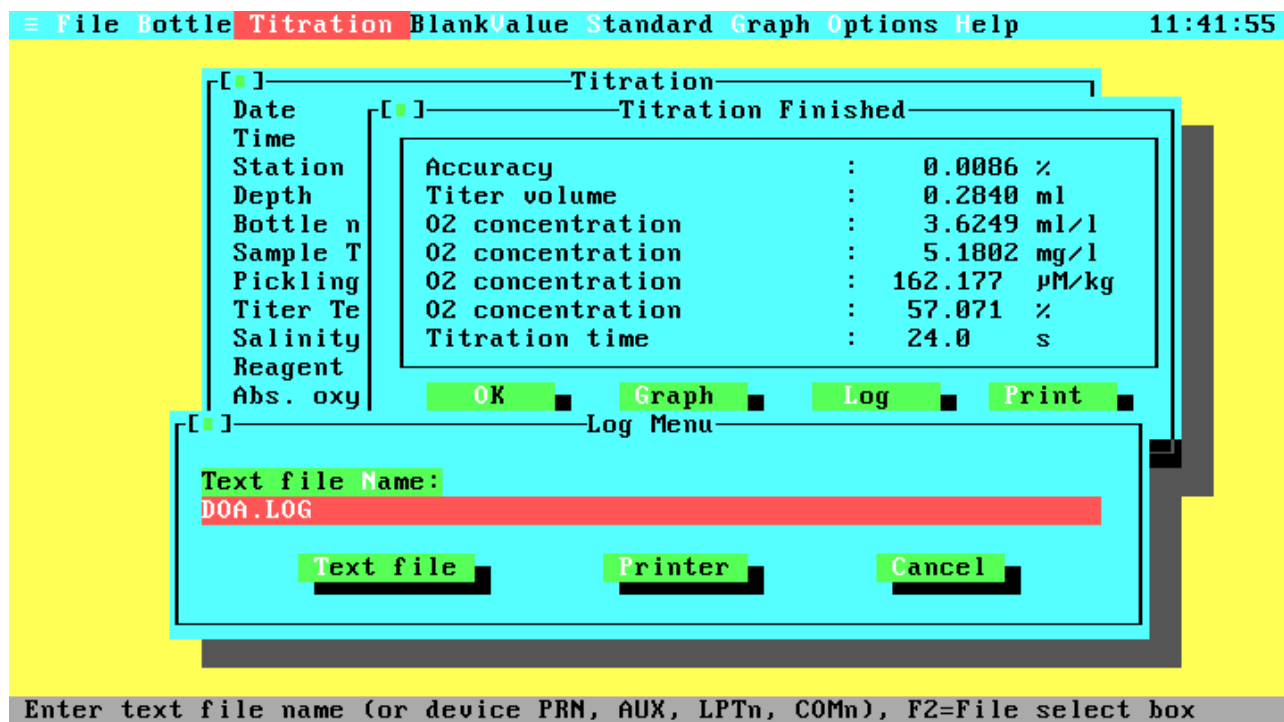


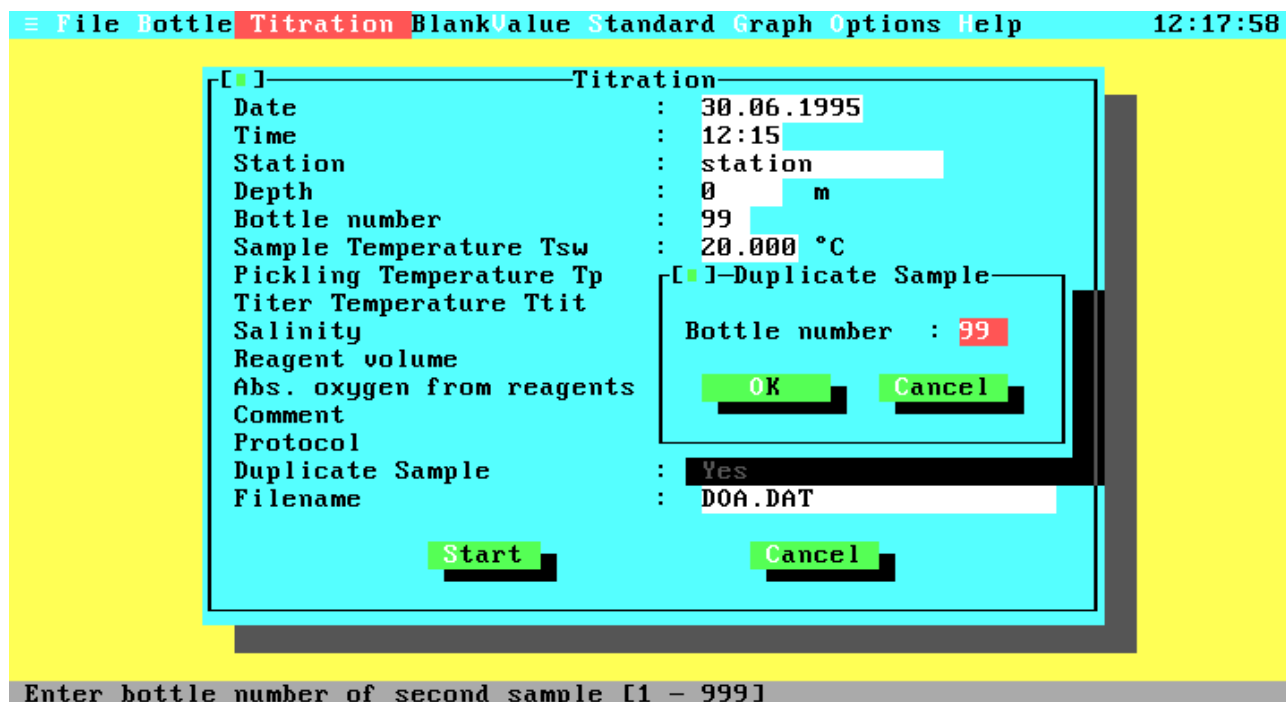
Figure 4.15 Log Menu

After each titration, regardless of the conditions (oxygen, standard or blank determination), the Log Menu can be activated to write the pure titration data to an ASCII file or to print them on a line printer. These titration data consist of a header, the titration data table with titer-transmission pairs, and the calculated endpoint with intermediate results from the titration algorithm. The data may be used to plot titration curves or check the titration algorithm. The Log menu is similar to the Print menu. If you have specified the command line option '/X' (see chapter 3, item 3.4 Command Line Syntax) the titration data will be written automatically to the log file after each titration.

**Text File Name**      The name and optional drive and/or path of the file, to which the output should be written. If the output file exists already, you will get a warning message, giving you the choice of overwriting the existing file, appending the data to the file or leaving the Log Menu. Note that also the DOS device names PRN, AUX, LPTn and COMn are valid names and that the output will be directed to the specified DOS device instead of a file. By pressing the function key <F2> you may open the File Select window to choose an existing file or to change the drive or directory.

- Text File            Logs the data to the file or device specified in the Text File Name field. The output will be done without any control characters except the carriage return and line feed sequences.
- Printer            Prints the data to the selected parallel printer. For parallel printer selection, open the Configuration Window in the Options Menu.
- Cancel            Leaves the Print Menu and returns you to the previous menu or window.

### 4.3.15 Second Bottle Number



**Figure 4.16 Second Bottle Number**

If you are inside a duplicate sample titration this window will pop up after the first titration, asking for the bottle number of the second sample.

- OK            Starts the titration of the second sample.
- Cancel       Stops duplicate sample titration. The data of the first titration will be treated as a normal titration.

### 4.3.16 Duplicate Sample Result

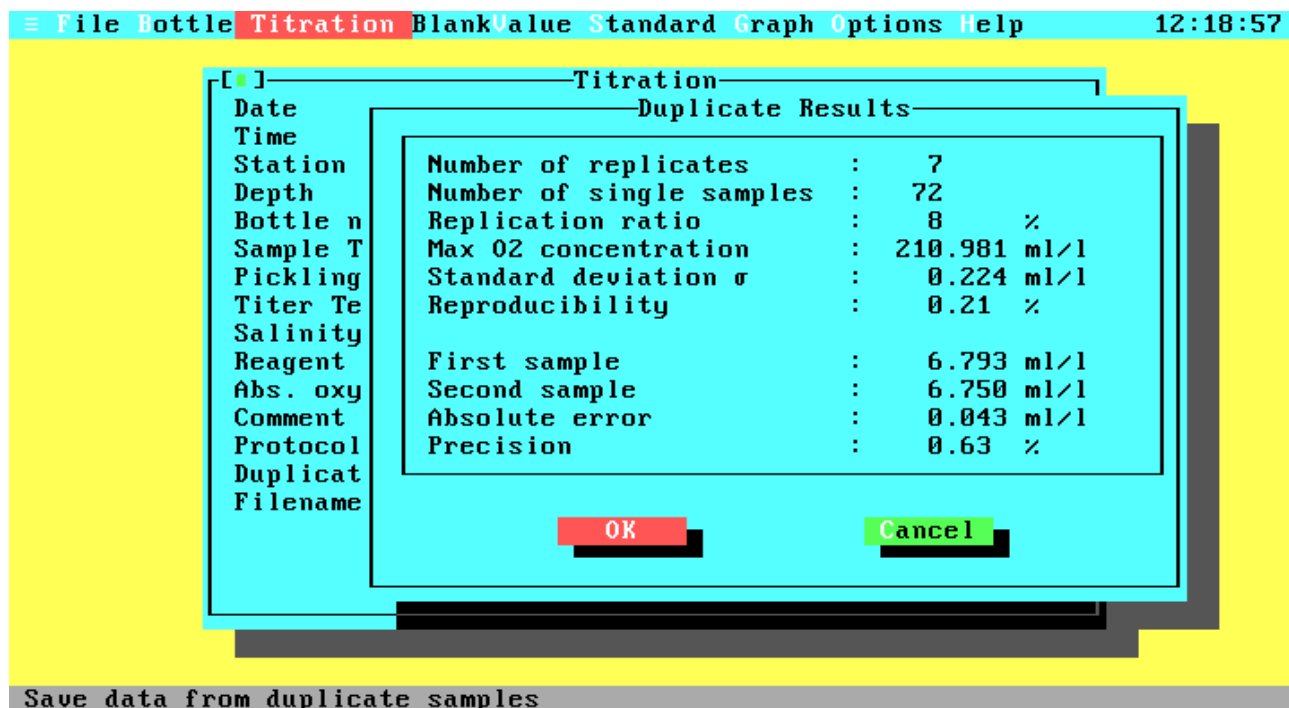
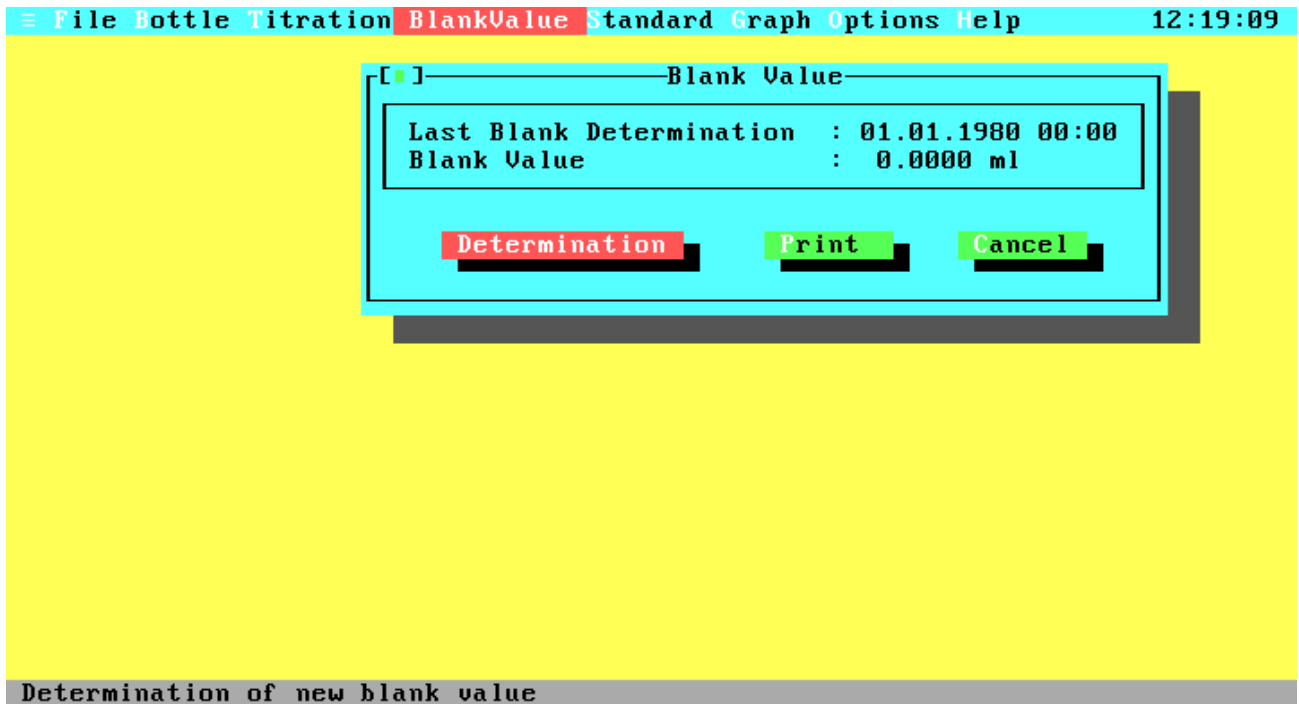


Figure 4.17 Duplicate Sample Result

After successful titrations of duplicate samples this window will pop up to give you some information about the difference of the two titrations and the reproducibility of all data in your file. The upper data are the same as displayed in the Replication and Precision window from the View Data command. Below the dissolved oxygen from both titrations, the absolute difference between these values (absolute error) and the relative error (precision) are displayed.

- OK Leaves the window, saves the data of the titrations and the statistics, and returns to the Titration window.
- Cancel Leaves the window without saving either the titration data or the statistics.

### 4.3.17 Blank Value



**Figure 4.18 Blank Value**

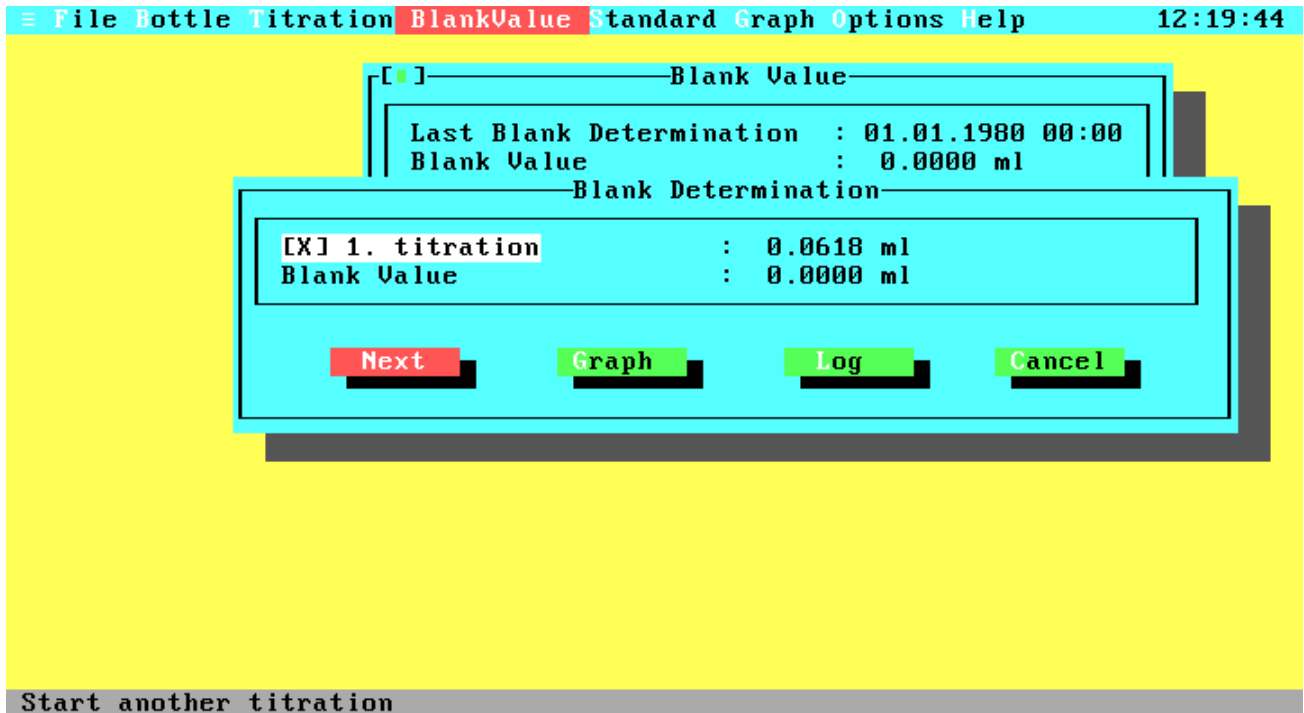
Displays the results of the last blank determination, lets you print them, and gives you the choice to start a new blank determination.

Determination Starts a new blank determination.

Print Prints the data of the last blank determination to line printer or text file.

Cancel Leaves the Blankvalue Window and returns you to the Main Menu.

### 4.3.17.1 First Blank Determination



**Figure 4.18.1 First Blank Determination**

This window will pop up after the first blank titration.

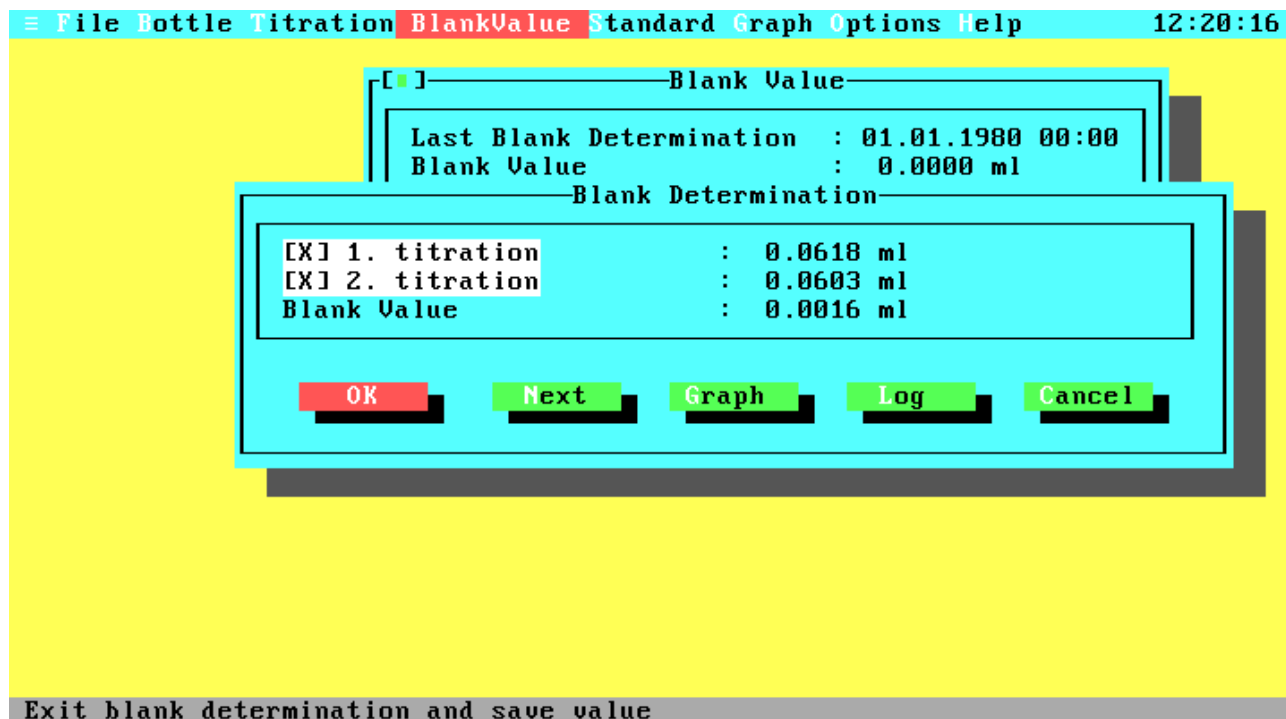
**Next** Starts the next blank titration.

**Graph** Displays the curve of the last titration.

**Log** Opens the Log menu to write the titration data (titer-transmission pairs) to an ASCII file or to print them on a line printer.

**Cancel** Interrupts the blank determination without saving data.

### 4.3.17.2 Additional Blank Determination

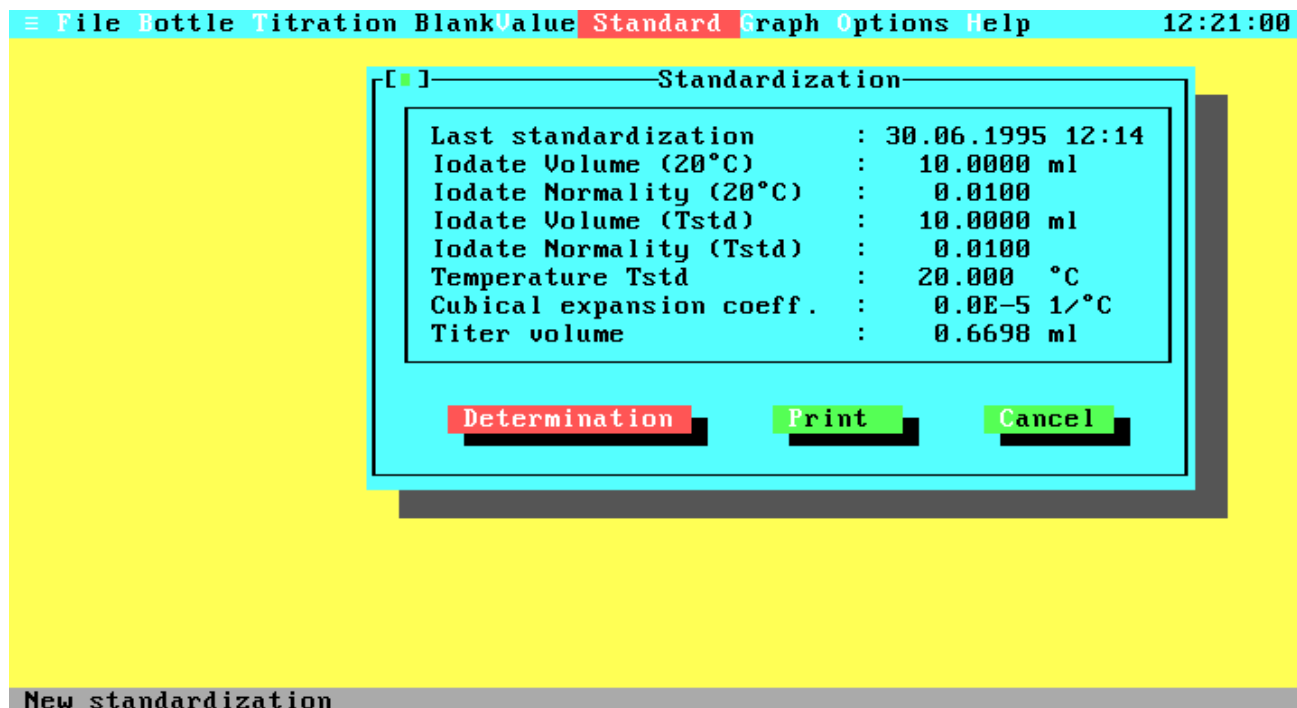


**Figure 4.18.2 Additional Blank Determination**

This is the window after some additional blank titrations. Note that the window contains another push button and that the blank value is now calculated from the first and the additional titrations. After each blank titration, the window contains one line more to display the results of all titrations. The maximum number of blank titrations is limited to eight. Therefore, the 'Next' button is not available after the eighth titration.

- OK            Leaves the blank determination and saves the new blank value.
- Next         Starts the next blank titration. This button does not exist after the last (eighth) titration.
- Graph        Displays the curve of the last titration.
- Log          Opens the Log menu to write the titration data (titer-transmission pairs) to an ASCII file or to print them on a line printer.
- Cancel       Leaves the blank determination without saving the blank value.
- 2...8        Enable or disable the result of the corresponding titration. Note that the first value cannot be disabled, because it is necessary to calculate the blank value.

### 4.3.18 Standard



**Figure 4.19 Standard**

Displays the results of the last standardization, lets you print them, and gives you the choice to start a new standardization.

**Determination**      Opens the Standard Parameter Window to enter the standard parameters and start a new standardization.

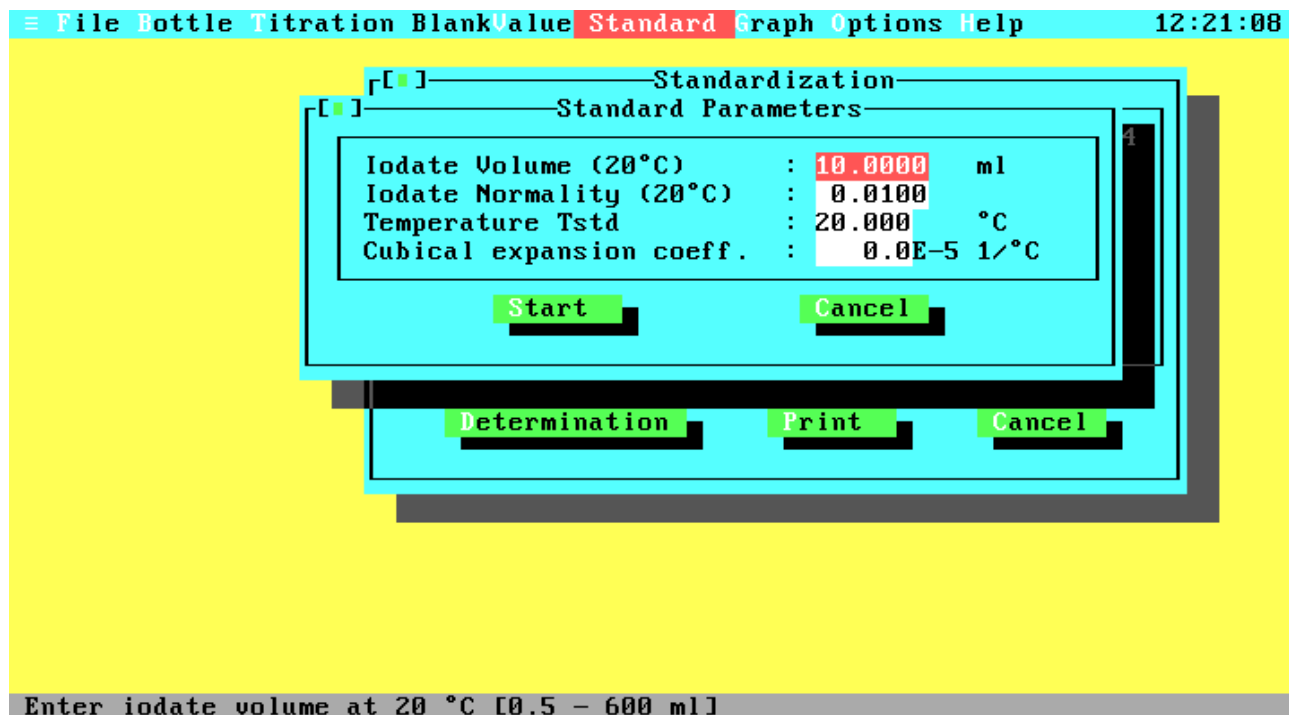
**Print**                Prints the data of the last standardization to line printer or text file.

**Cancel**              Leaves the Standard Window and returns you to the Main Menu.

The displayed values are:

Last standardization:	Date and time of the last standardization.
Volume (20 °C):	Volume of your iodate pipette at the reference temperature of 20 °C.
Normality (20 °C):	Normality of your iodate standard at the reference temperature of 20 °C.
Volume:	Corrected iodate pipette volume at standardization temperature.
Normality:	Temperature compensated normality of iodate standard.
Temperature:	Temperature of the iodate during standardization.
Cubical exp. coeff.:	Cubical coefficient of thermal expansion for the glass ware of your iodate pipette.
Titer volume:	The calculated amount of thiosulphate titer from standardization.
Titer concentration:	This value is only displayed if you are in the ISO mode.

### 4.3.19 Standard Parameters



**Figure 4.20 Standard Parameters**

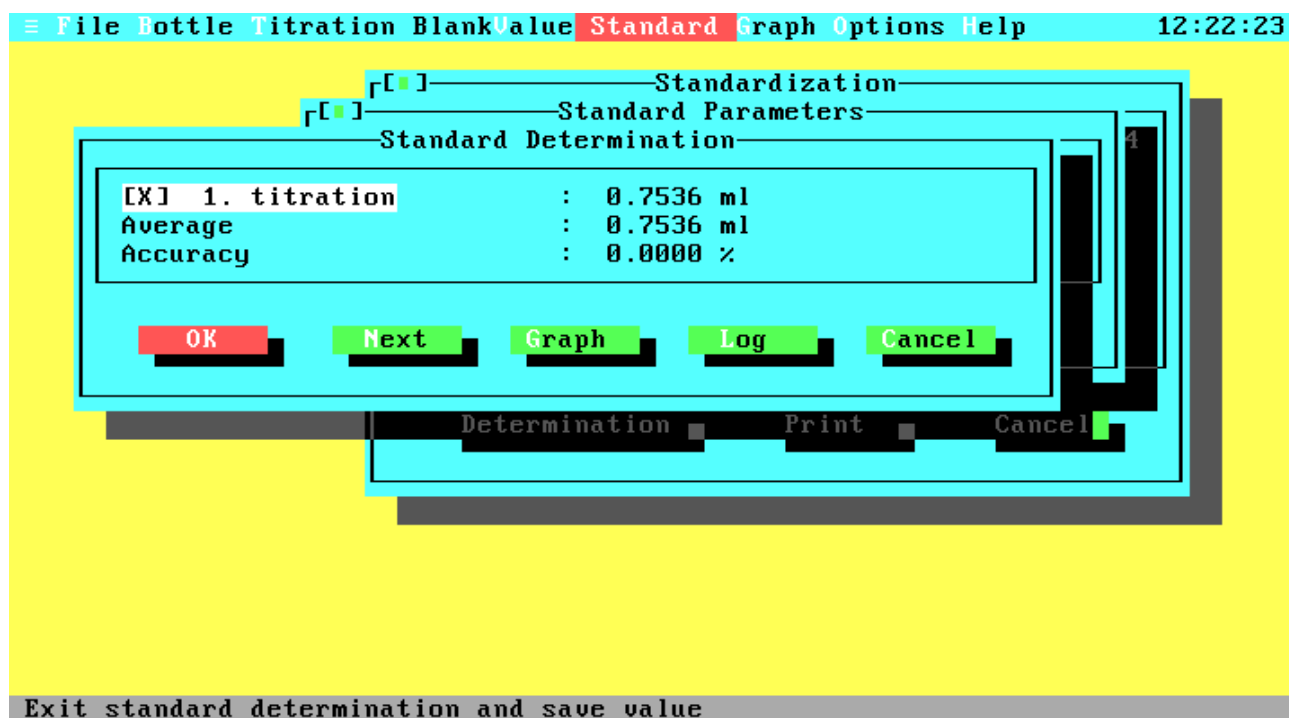
Enter the data for a new standardization and start standardization. The ISO standard does not support different parameters for standardizations. Therefore all parameters are set to the default values when this window pops up, but you may enter any other value.

If you are in WOCE mode the fields will contain the data from the last standardization or the default values if this is the first standardization.

Volume	The volume of your iodate standard at the reference temperature of 20 °C. Default volumes are 10 ml for the WOCE standard and 20 ml for the ISO standard.
Normality	The normality of your iodate standard (= 6 molarity) at the reference temperature of 20 °C. The default values are 0.01 N for the WOCE standard and 10 mmol/l for the ISO standard.
Temperature	The current temperature of your chemicals. Note that all reagents and the thiosulphate titer should have the same temperature. The default temperature is 20 °C for WOCE and ISO standard.
Cub. Exp. Coeff.	The cubical coefficient of thermal expansion for the glass of your iodate pipette. The default value is zero for WOCE and ISO standard.
Start	Starts the new standardization. After standardization you will return to the Standard Window which will display the new results, if the standardization was successful.
Cancel	Leaves the Standardization Window and returns you to the Standard Window.



### 4.3.19.1 First Standard Determination

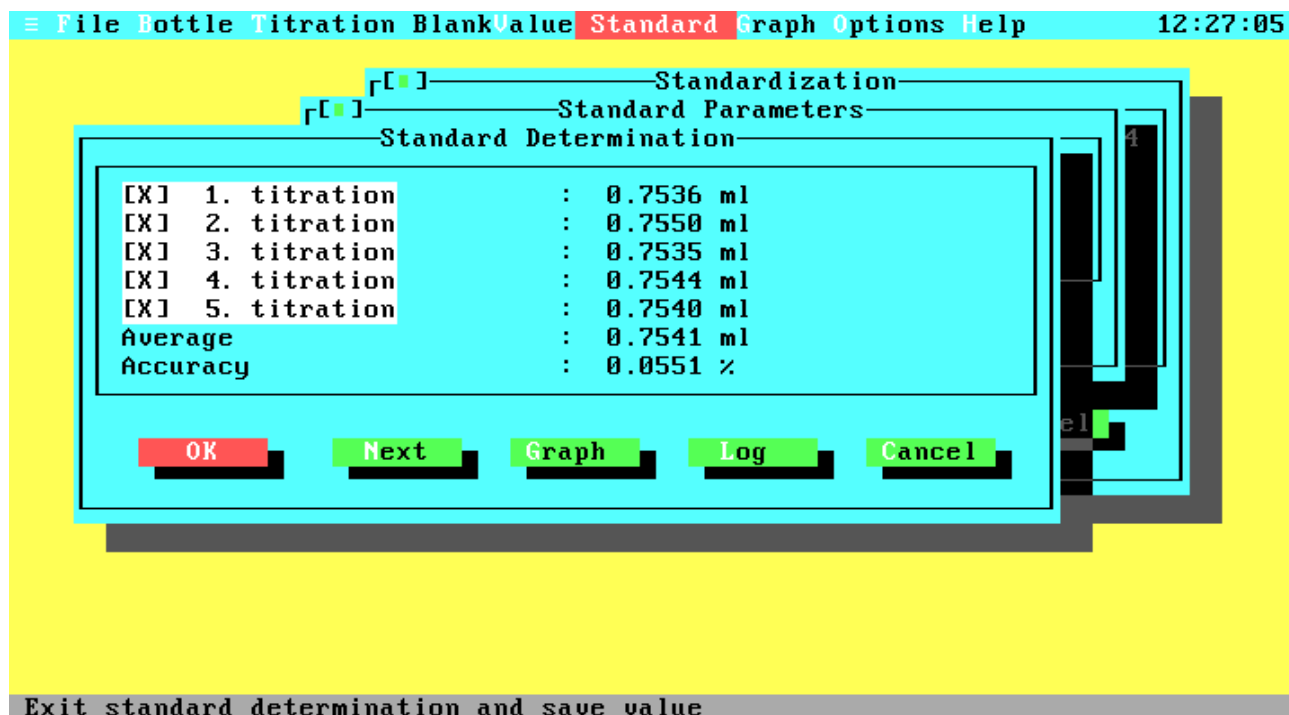


**Figure 4.20.1 First Standard Determination**

This window will pop up after the first standard blank titration.

- |           |  |
|-----------|--|
| OK        | Leaves the standard determination and saves the new standard value if the result of the first titration is not disabled.       |
| Next      | Start another standard titration.  |
| Graph     | Displays the curve of the first titration.   |
| Log       | Opens the Log menu to write the titration data (titer-transmission pairs) to an ASCII file or to print them on a line printer. |
| Cancel    | Leaves the standard determination without saving the standard value.   |
| 1         | Enable or disable the result of the first titration.   |
| Average:  | The resulting average from all marked titrations (the titer volume after the first titration if enabled, otherwise zero).      |
| Accuracy: | The percentage standard deviation of all marked titrations (zero if less than two titrations).                                 |

### 4.3.19.2 Additional Standard Determination

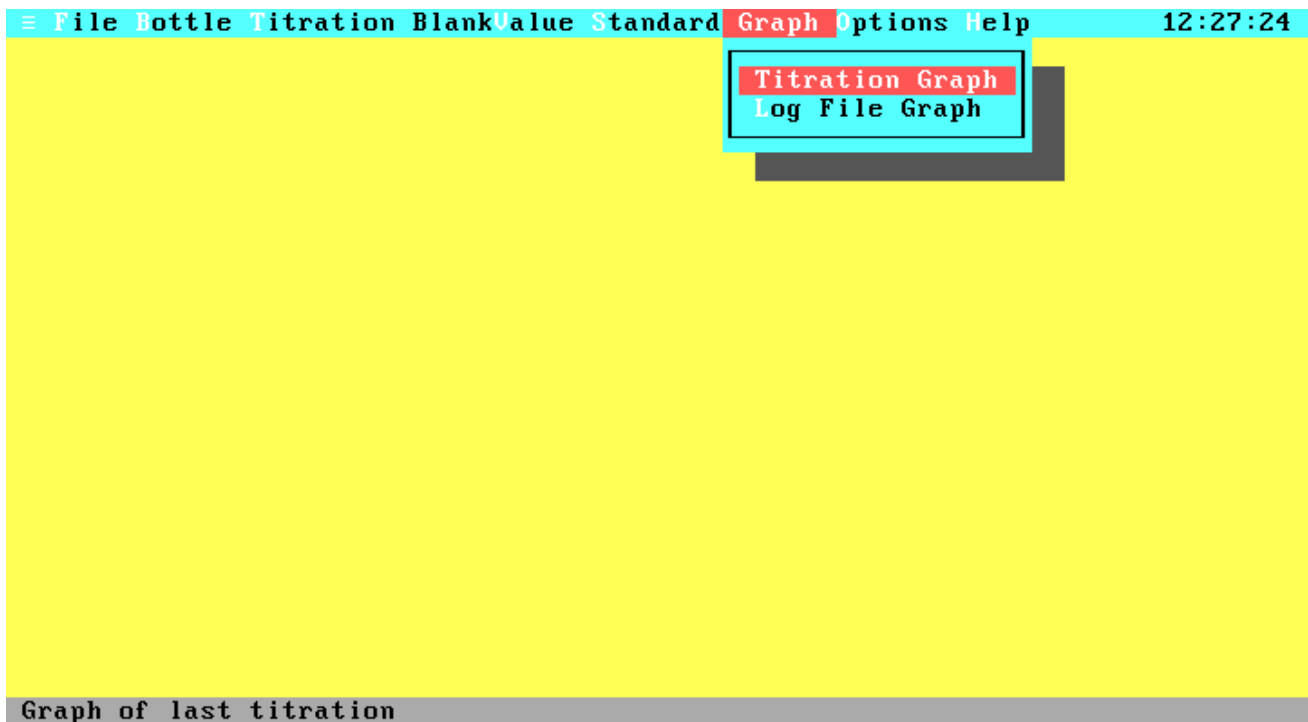


**Figure 4.20.2 Additional Standard Determination**

This is the window after some additional standard titrations. Note that the average is now calculated from all marked titrations. After each standard titration, the window contains one line more to display the results of all titrations. The maximum number of standard titrations is limited to ten. Therefore, the 'Next' button is not available after the tenth titration.

- |           |  |
|-----------|--|
| OK        | Leaves the standard determination and saves the new standard value if it is not zero (all titrations disabled).                                      |
| Next      | Starts another standard titration. This button does not exist after the last (tenth) titration.  |
| Graph     | Displays the curve of the last titration.  |
| Log       | Opens the Log menu to write the titration data (titer-transmission pairs) of the last titration to an ASCII file or to print them on a line printer. |
| Cancel    | Leaves the standard determination without saving the standard value.   |
| 1...9, 0  | Enable or disable the result of the corresponding (first to tenth) titration.  |
| Average:  | The resulting average from all marked titrations.  |
| Accuracy: | The percentage standard deviation of all marked titrations (zero if less than two titrations).   |

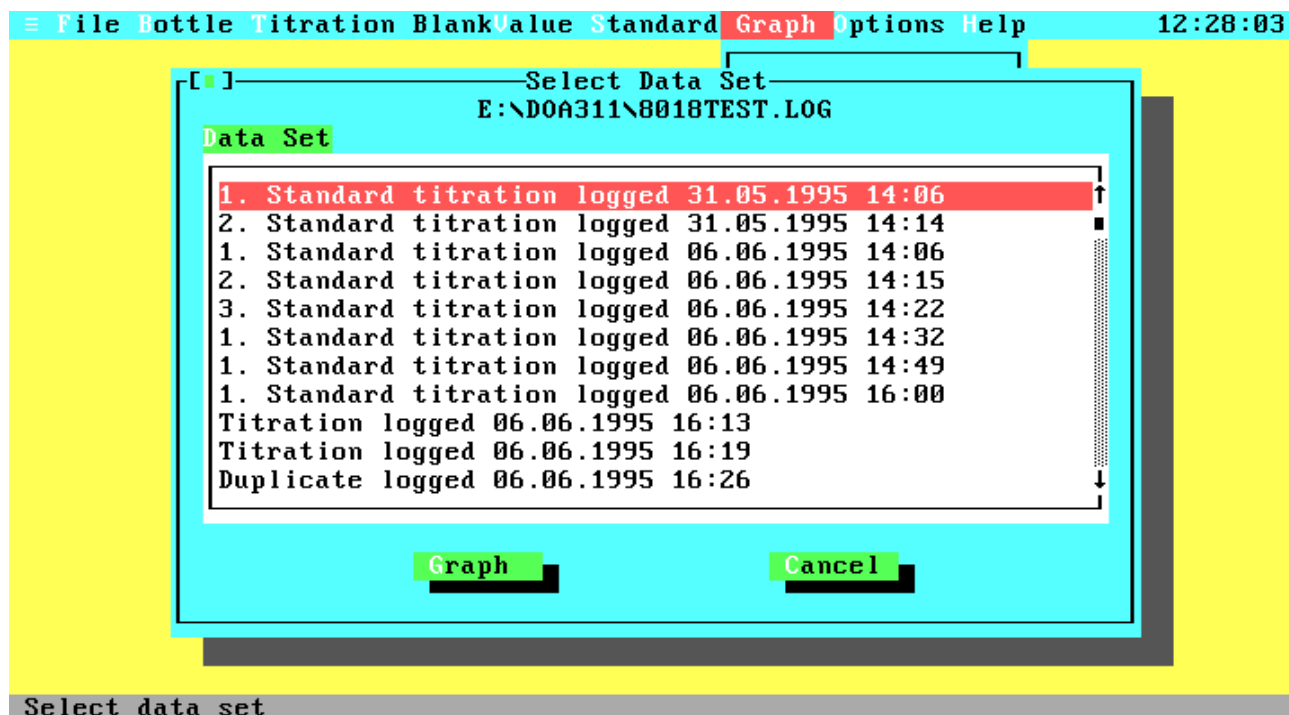
### 4.3.20 Graph Menu



**Figure 4.21 Graph menu**

Titration Graph	Displays the graph of the last titration. This command is not available if the last titration was not successful or no titration was done since the program start.
Log File Graph	Displays the graph of a titration that was saved with the Log command. After activation, the File Select window is opened to select the log file. After selection of the file another window is opened to select the data set from the log file.

### 4.3.21 Select Data Set from Log File



**Figure 4.22 Select Log File Data Set**

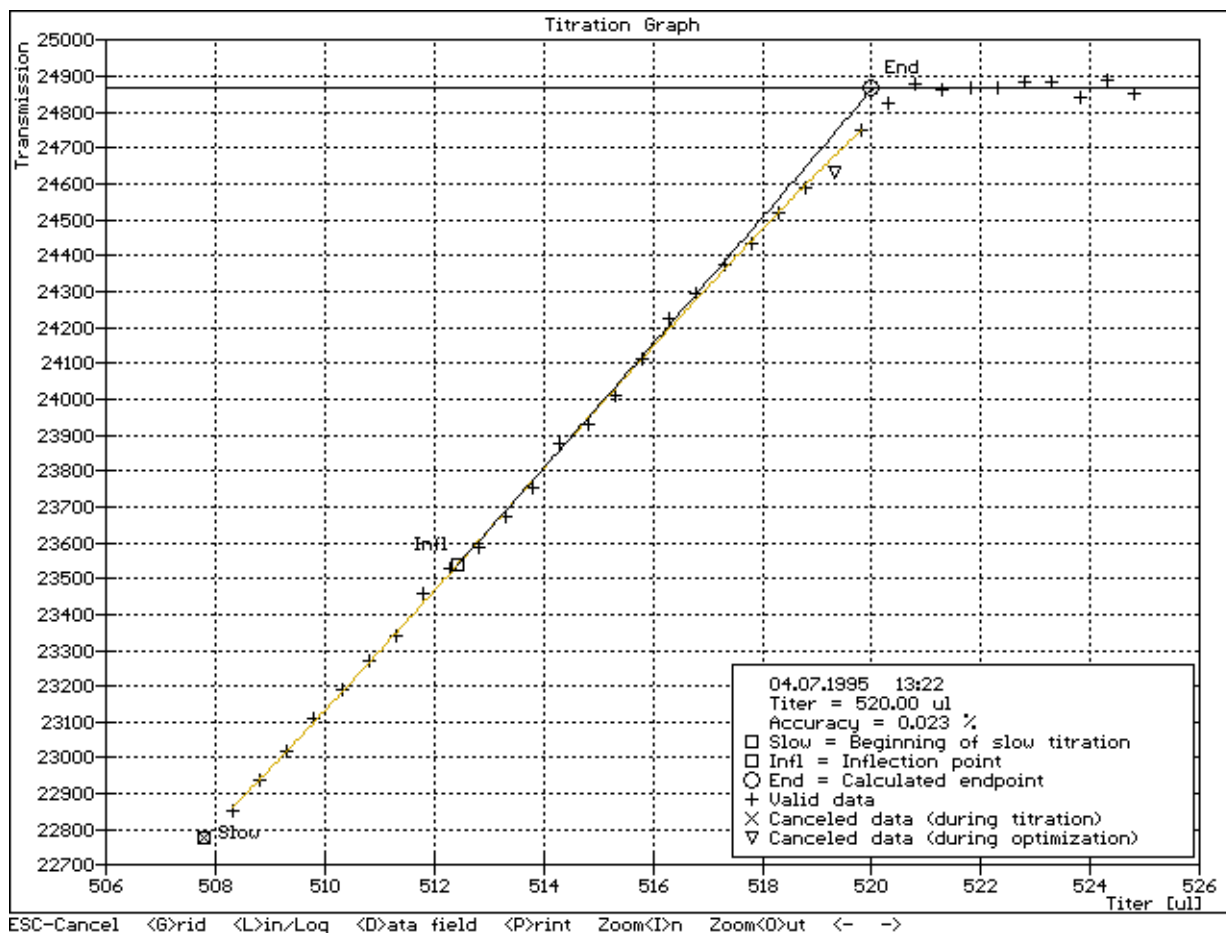
Select the data set for display of the titration curve.

**Graph** Displays the titration curve of the currently selected data set. After leaving the graphics display you are returned to this window for another selection.

**Cancel** Leaves the selection window.

Note that the displayed date and time stamp is not the time of titration, but the time of data logging.

### 4.3.22 Titration Curve



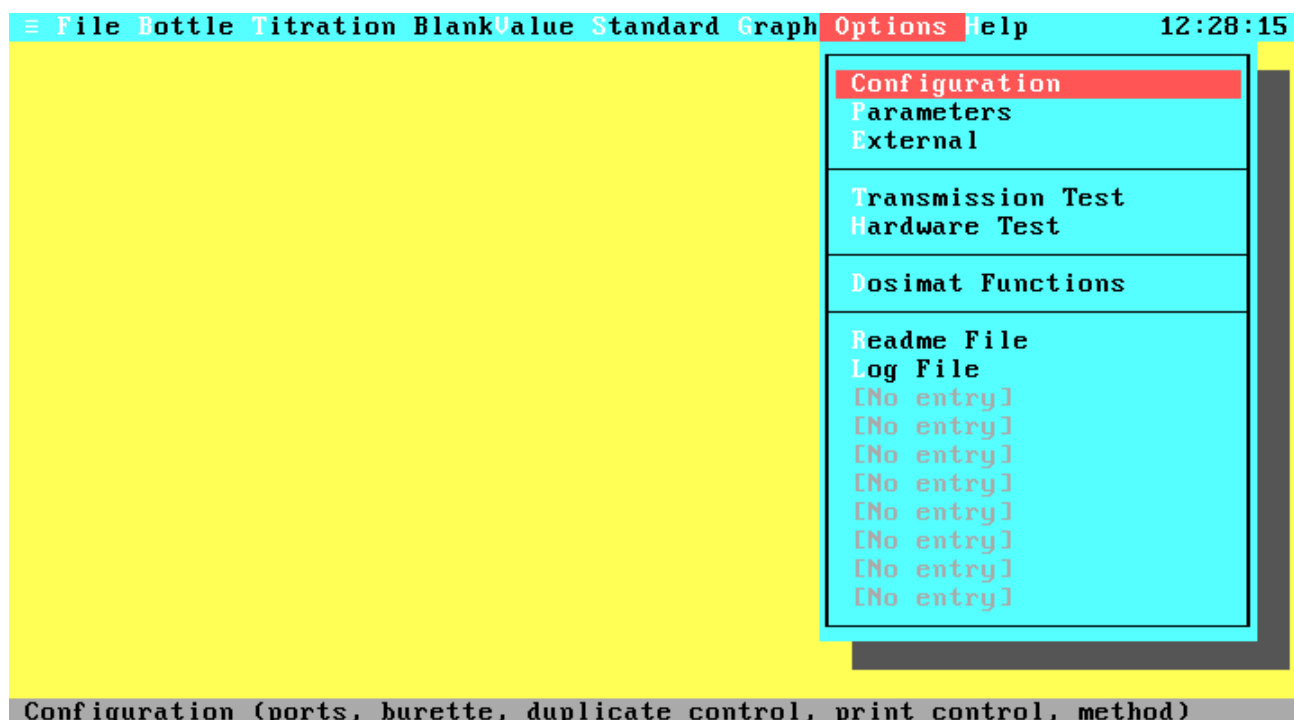
**Figure 4.23 Titration Curve**

Displays the graph of a titration.

- <Esc> Leaves graphic mode.
- <G>rid Graphics display with or without grid.
- <L>in/Log Graphics display with linear or logarithm transmission values.
- <D>ata field Displays/removes data field.
- <P>rint Prints graph to line printer (your printer must be EPSON-FX compatible for printing in graphic mode).
- Zoom <I>n Enlarges view port.
- Zoom <O>ut Reduces view port.
- Left Moves graph view port to left.
- Right Moves graph view port to right.

At the bottom right of the graph some important values relating to the curve are displayed. These include the current date and time, the calculated endpoint and the accuracy of the endpoint calculation. The graph itself will mark the beginning of the slow titration, the inflection point of the approximation function and the calculated endpoint. If an approximation was possible this function will be drawn from the slow point to the end line and the corresponding e-function will be drawn from the inflection point to the endpoint.

### 4.3.23 Options Menu

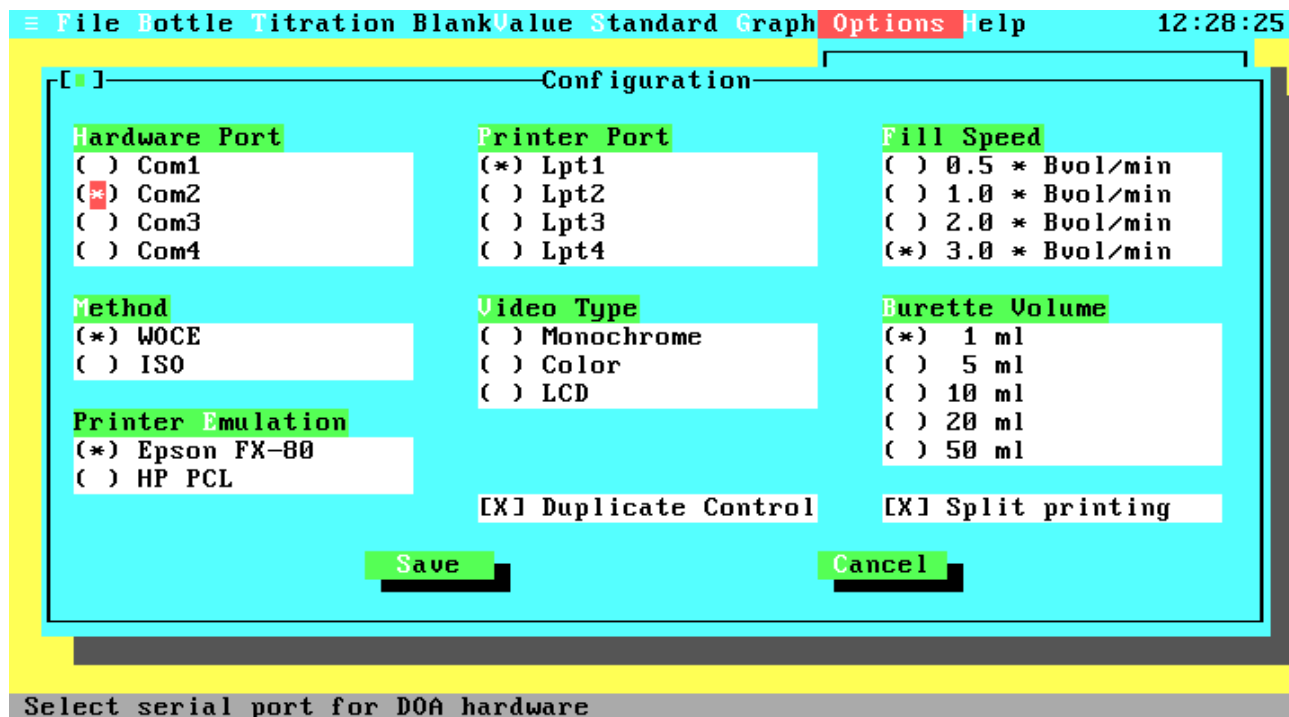


**Figure 4.24 Options Menu**

From this menu you can configure your system and make some hardware checks.

Configuration	The Configuration window contains settings like photometer port, printer port, burette volume, Dosimat fill speed, calculation method, monitor type, duplicate control, and split printing.
Parameters	The Parameters window allows you to change the titration parameters like delay times and titer amounts.
External	Lets you configure up to ten external programs that can be called from the Options menu.
Transmission Test	Continuously displays the photometer values as percentage of transmission.
Hardware Test	Checks the connection between your computer and the hardware (Dosimat and photometer) and displays the hardware version (1- or 2-channel system), and the remaining memory amount.
Dosimat Functions	The Dosimat Functions menu lets you use the Dosimat for dispensing specific titer volumes or flush the burette.
Readme File	An example for an external program call. The example calls the DOS program EDIT.COM with the file README.DOC.

### 4.3.24 Configuration

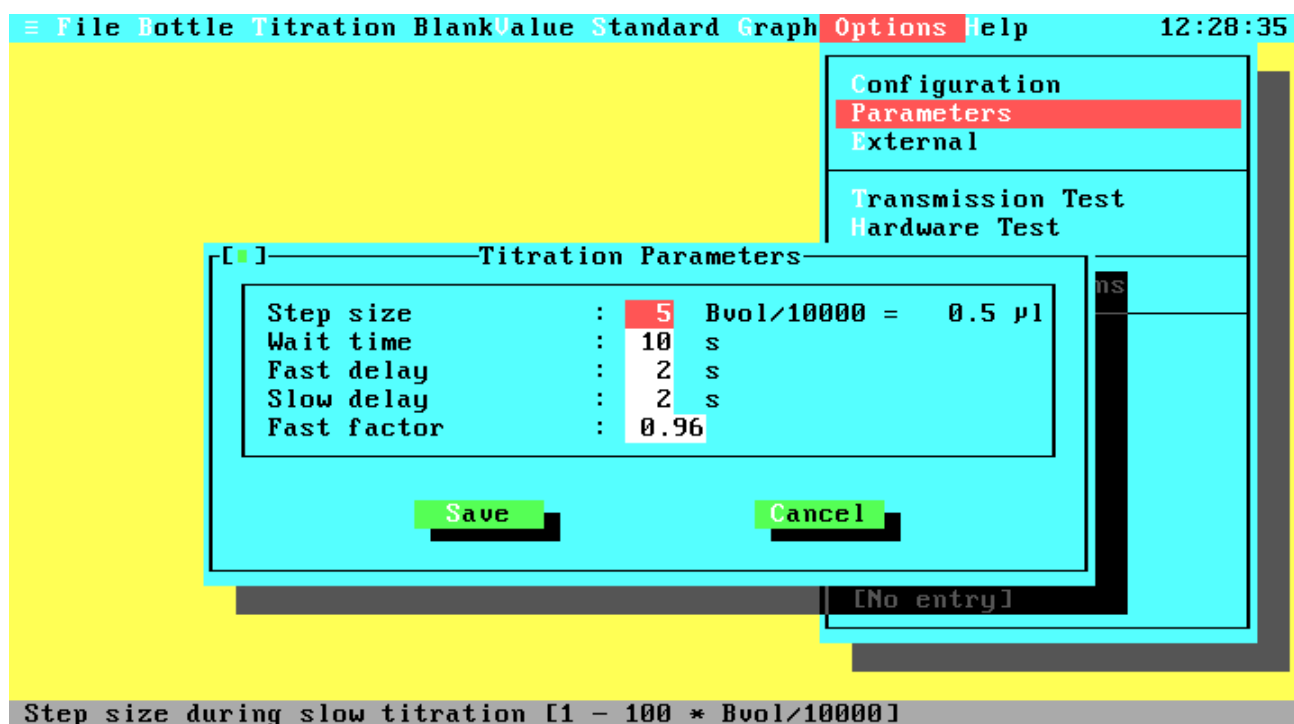


**Figure 4.25 Configuration**

- |                |   |
|----------------|---|
| Hardware Port  | Lets you select (by mouse or Up and Down key) the serial port for your DOA hardware. Note that no other hardware should be connected to this port and no device driver should be installed for this port, because this could produce unpredictable results. |
| Printer Port   | Lets you select (by mouse or Up and Down key) the parallel port for your line printer. All printer output (see Printer in the Print Menu and Protocol in the Titration Window) will be done to this port.   |
| Fill Speed     | Lets you select from four fixed burette fill speeds. The fill speed is only valid for burette filling by the program, not for filling by the user. The maximum fill speed (three burette volumes per minute) results in a filling time of 23 seconds.       |
| Method         | Selects WOCE or ISO standard. For the differences between the standards see Chapter 2 - Function Description, section 2.3 - Titration Procedures.   |
| Video Type     | Lets you select your monitor type and video card. You can choose between Monochrome (Black & White monitor with Hercules card), Color (Color monitor with color card, e.g. CGA, EGA, VGA) and LCD (Liquid Crystal Display or grey scale monitor).           |
| Burette Volume | Lets you select (by mouse or Up and Down key) the cylinder volume of your burette. Be sure to have the correct volume (it is printed in front of the exchange unit), because all titration results are based on the burette volume.                         |

- Printer Emulation** The DOA software supports two printer languages. These are Epson FX-80 for a wide range of pin writers and HP Laser Jet (PCL) for Laser Jets and compatibles.
- Duplicate Control** When this option is enabled you have the choice to titrate duplicate samples according to the WOCE specifications. Duplicate samples are two titrations from identical samples. The absolute difference between the oxygen concentrations of these titrations should be very small. The statistics about duplicate samples and the ratio between duplicate and single samples are stored in the data files. Therefore, we have two types of data files: Files with and without duplicate samples. So you need another data file for your titration data if you toggle this option on or off.
- Split Printing** Printing all data fields from a data set in one line will exceed the line width of standard printers. If you do not have a wide carriage printer, you can select Split Printing to print partial data sets on two pages.
- Save** Saves the settings in the configuration file, leaves the Configuration Window and returns you to the Options Menu.
- Cancel** Leaves the Configuration Window without saving the settings and returns you to the Options Menu.

#### 4.3.25 Titration Parameters



**Figure 4.26 Parameters**

- Step size** The step size defines the amount of titer that is dispensed on every step in the slow titration phase. The smallest possible amount is 1/10000 of the burette volume. The default value is 5; allowed inputs are in the range from 1 to 100. Greater volumes result in less accurate titration and smaller volumes increase



the titration time. The absolute amount of titer in  $\mu\text{l}$  is calculated according to the current burette volume and is displayed behind the entry field.

- Wait time** After the fast titration phase, the system has to wait some time to ensure that the total amount of dispensed titer has reacted. The default value is 10 seconds; allowed inputs are in the range from 1 to 60 seconds. This parameter has no effect in the demonstration version.
- Fast delay** This parameter specifies the delay time after each step in the fast titration phase. The default value is 2 seconds; allowed inputs are in the range from 1 to 60 seconds. If the delay time is too short, it could occur that the sample is over titrated. Greater times result in longer titration times. This parameter has no effect in the demonstration version.
- Slow delay** This parameter specifies the delay time after each step in the slow titration phase. The default value is 2 seconds; allowed inputs are in the range from 1 to 60 seconds. The time has to be long enough to ensure that the titer amounts can react. Note that the reaction time depends also on the step size (see above) and the mixing parameters (stirrer speed, type of bottle and stirring bar). This parameter has no effect in the demonstration version.
- Fast factor** This parameter exists only when a 2-channel system is used. The factor defines up to what transmission, relative to the estimated endpoint, the fast titration phase will run. The default value is 0.92; allowed inputs are in the range from 0.01 to 1.0. The greater the factor is, the faster the titration will run but with the risk of over titration.

#### 4.3.26 External Program Configuration

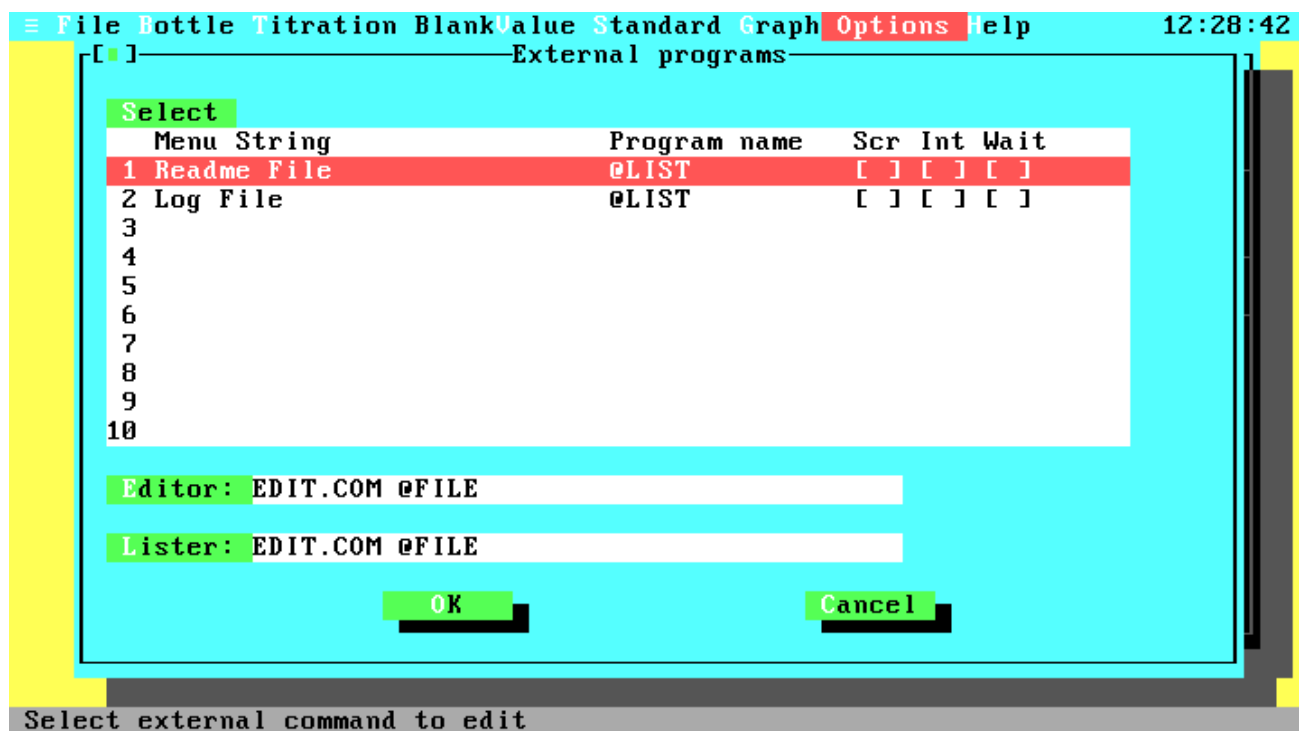


Figure 4.27 External Program Configuration

From within this menu you can configure up to ten external DOS programs that can be started from the Options menu.

- Select Choose an existing entry for editing or removing or an empty line to create a new one.
- Editor Specifies the file name and path of the external editor. The entry may contain additional command line parameters. Please insert the macro '@FILE' at the position for the working file name. Note that the Text File item from the File menu is not available if this field contains no entry to an existing editor. The default entry uses the MS-DOS editor and requires that the files EDIT.COM and QBASIC.EXE are stored in a directory that is part of the DOS PATH setting.
- Lister Specifies the file name and path of the external lister. The input format is identical to the Editor field.

#### 4.3.26.1 Edit External Program

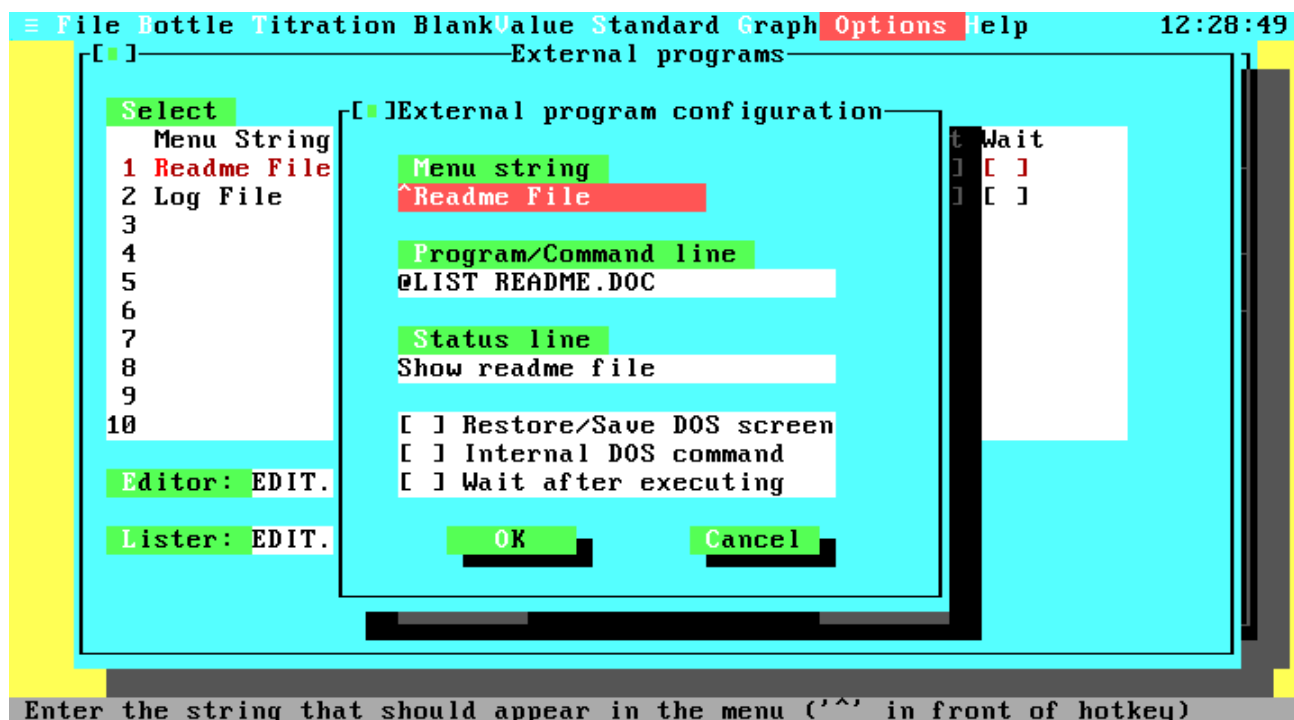
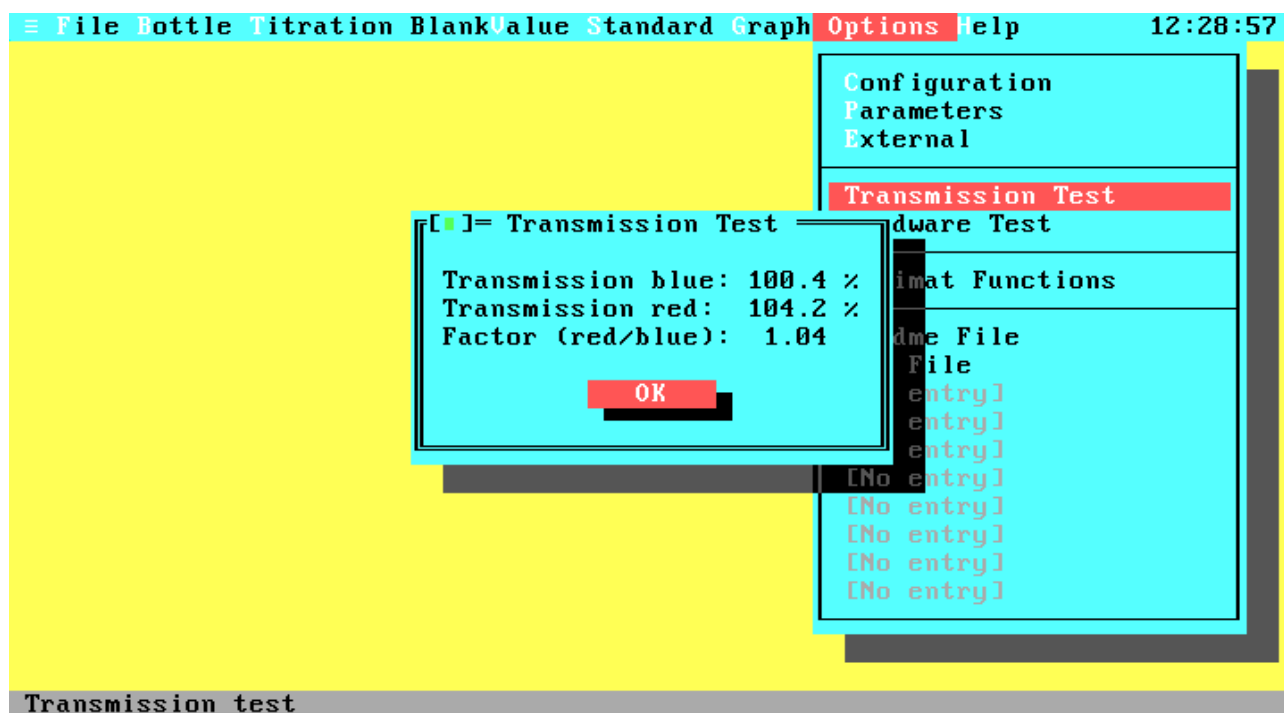


Figure 4.28 Edit External Program

- Menu String The string that is displayed in the Options menu. To remove this command from the list, clear this input field. Place a '^' in front of the hotkey.
- Command Line The command line that is passed to DOS when activating the corresponding Options menu entry. You may use these macros:
  - @LIST The external lister
  - @EDIT The external editor
  - @D The current data file name
  - @L The current log file name
  - @T The current text file from the Print menu

Status Line	The status message that is displayed when the cursor is on the corresponding line in the Options menu.
Restore/Save	When enabled, the old DOS screen is restored before executing the external program and saved after return. Otherwise the external program is started in a blank screen.
Internal Command	If the command is not an executable (BAT, COM or EXE) but an internal DOS command (e.g. DIR, TYPE) you must enable this option.
Wait Key	If this option is enabled, the program waits for a keystroke after executing the external command. This option is useful to have a look at the external program output before returning to DOA.

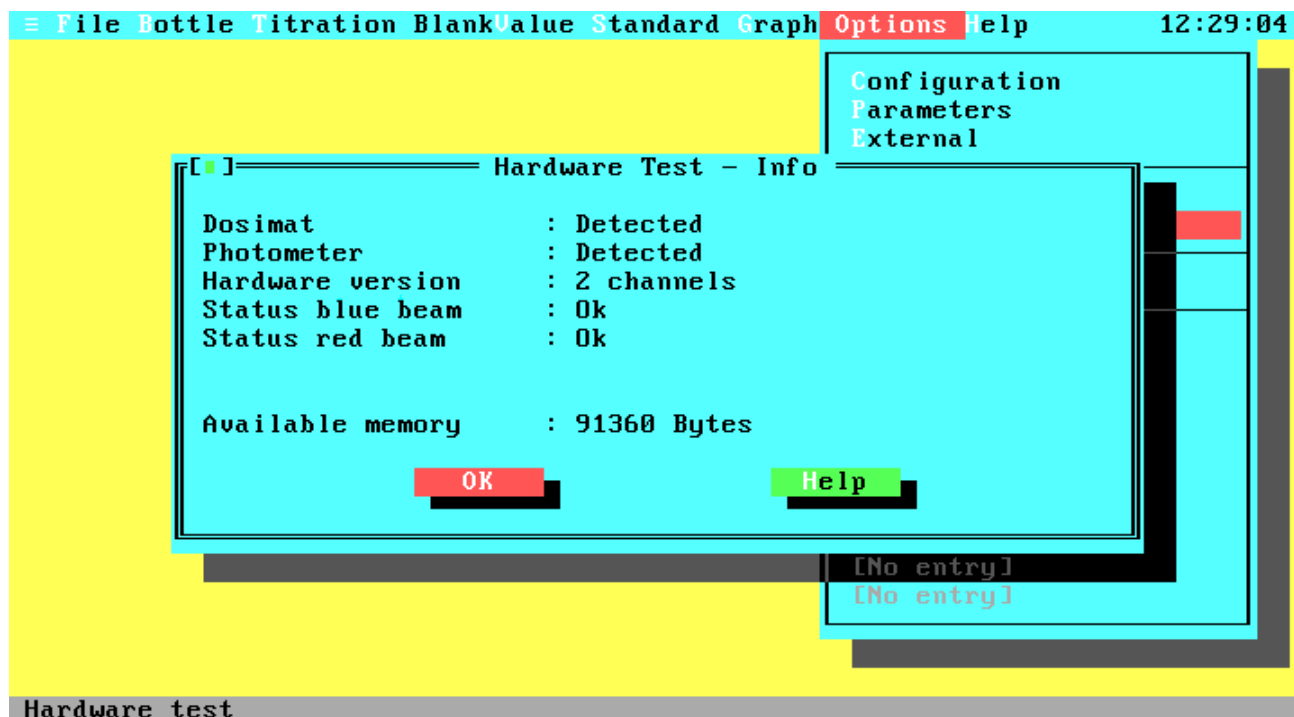
### 4.3.27 Transmission Test



**Figure 4.29 Transmission Test**

In this window the photometer values of the blue and red (for 2-channel systems) beams will be displayed continuously. The output is in percentage transmission relative to an absolute transmission value of 30,000. Note that greater values than 100% are possible and valid.

### 4.3.28 Hardware Test



**Figure 4.30 Hardware Test**

Checks the hardware (Photometer, Dosimat), the hardware version, and displays the amount of free memory.

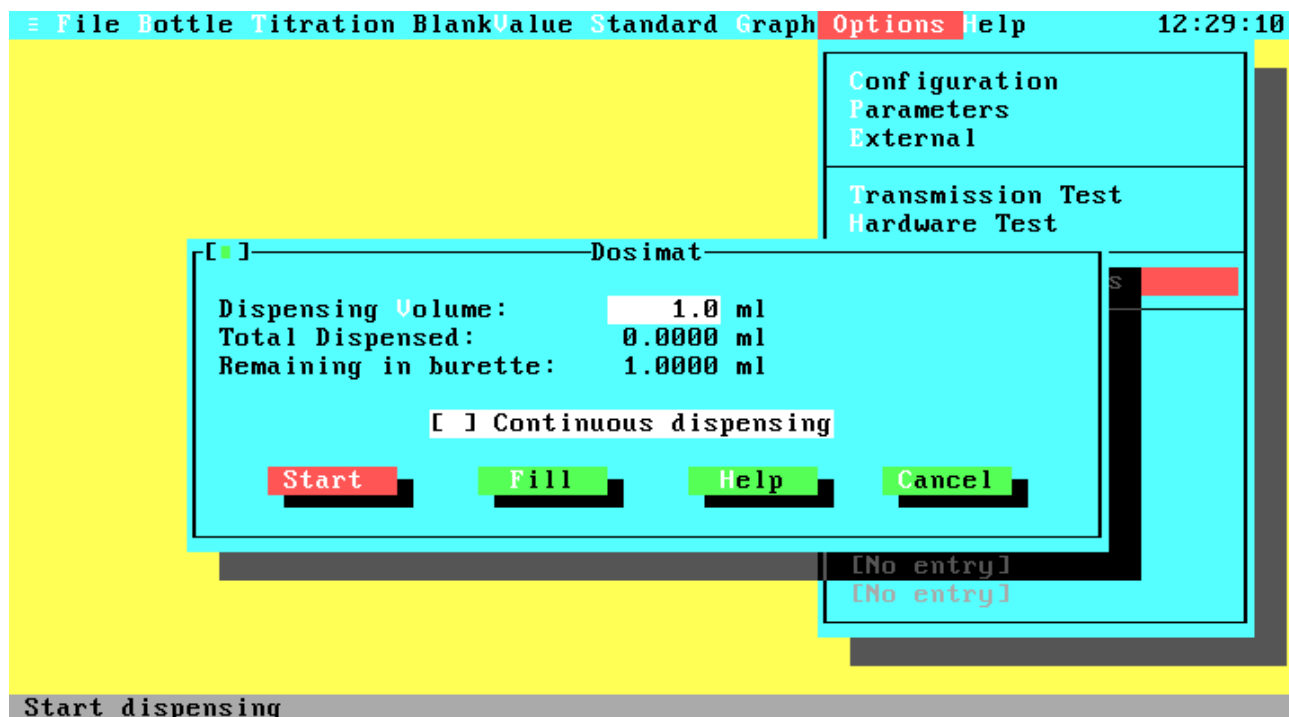
The status displayed for each test means:

- Detected: No errors (Photometer and Dosimat)
- Not Detected: Hardware not found (Photometer, Hardware Version and Dosimat)
- 1-/2-channels: The hardware version. If you are working with a 2-channel system and the program detects only a one channel system, check the cable between computer and titrator.
- OK (nnn %): The transmission is in the correct range.
- Too high (nnn %): Transmission is too high, calibration necessary
- Too low (nnn %): Transmission is too low, calibration necessary

If the transmission is too low or too high, a message will be displayed that a new calibration is necessary. If the transmission is too high you can still use the titrator providing the transmission for a bottle with pure water is below 93.4 % and the transmission without bottle is below 109 %. If the transmission is too low (less than 93.4% without bottle) the system will not work.

Note that the photometer has a warmup time of about five minutes and that the transmission values in the warmup phase could be out of range.

### 4.3.29 Dosimat Functions



**Figure 4.31 Dosimat Functions**

Dispensing Volume	Entry field for the volume that will be dispensed when activating the Start button.
Continuous dispensing	Continuously dispense and fill burette. This option is useful if you want to flush your burette.
Start	Start dispensing.
Stop	Stop current dispensing. After activating the Start button it will change to a Stop button.
Fill	Fill the burette and reset the total volume.
Help	Opens the help screen for the Dosimat functions.
Cancel	Leave the Dosimat window.
Total dispensed:	Total amount of dispensed titer since last Fill activation.
Remaining in burette:	Current amount of titer in the burette.

### 4.3.30 Help Menu



Figure 4.32 Help Menu

Get Help on some specific items.

Help on Help        Displays the help text about the usage of the help system.

Help Index         Displays the Help Index list.



Figure 4.33 Help Index

To select an item use the <Up>, <Down>, <PgUp> or <PgDn> key and press return or use the scroll bar with the mouse and double click on the left button at the desired item.

## Chapter 5 Printings

### 5.1 Printers

To produce readable printer output your printer must be able to print the IBM PC character set. For printing complete data files, titration protocols or titration curves, your printer must be EPSON-FX or HP PCL compatible.

If you don't have a compatible printer, you may use a screen capture program to send the graphics screen image to your printer. Some capture programs make it possible to merge screen images into documents produced by some word processors. These programs are useful with any program including DOA, from which you want to capture a graphics screen image.

Most screen capture programs are resident programs that must be run **before** you start DOA. They are usually activated by pressing the <PrintScreen> key.

### 5.2 Printing Formats

This section will give you an overview of the printing formats produced on line printer or text file output. The frames are not part of the printings.

#### Figure 5.1 Bottle List

No.	Volume	a
63	59.710 ml	1.0E-5 1/°C
64	59.540 ml	1.0E-5 1/°C
65	59.500 ml	1.0E-5 1/°C
77	59.560 ml	1.0E-5 1/°C
79	58.990 ml	1.0E-5 1/°C
80	59.920 ml	1.0E-5 1/°C
93	59.090 ml	1.0E-5 1/°C
98	59.790 ml	1.0E-5 1/°C
99	59.710 ml	1.0E-5 1/°C

#### Figure 5.2 Standard data (WOCE mode)

Last standardization	: 03.12.1992 11:42
Volume (20°C)	: 10.0000 ml
Normality (20°C)	: 0.0100
Volume (Tstd)	: 10.0000 ml
Normality (Tstd)	: 0.0100
Temperature Tstd	: 20.000 °C
Cubical expansion coeff.	: 1.0E-5 1/°C
Titer volume	: 0.8844 ml



### Figure 5.3 Blank Data

Last blank determination	: 01.12.1992 11:21
Blank value	: -0.0002 ml

### Figure 5.4 Single Data Set (WOCE mode)

Method	: WOCE
Date	: 01.02.93
Time	: 13:27
Station	: SiS
Depth	: 0 m
Bottle number	: 64
Bottle volume (Tp)	: 59.531 ml
Bottle volume (20°C)	: 59.540 ml
Cubical expansion coeff.	: 1.0E-5 1/°C
Sample temperature Tsw	: 3.200 °C
Pickling temperature Tp	: 4.100 °C
Titer temperature Ttit	: 19.100 °C
Salinity	: 31.400 psu
Burette volume	: 1 ml
Blank volume	: -0.0016 ml
Standard volume	: 0.7223 ml
Iodate volume	: 10.0000 ml
Iodate normality	: 0.0100
Reagent volume	: 2.0000 ml
Abs. oxygen from reagents	: 0.0017 ml
Accuracy of endpoint	: 0.029 %
Titer volume	: 0.3794 ml
O2 concentration	: 5.0918 ml/l
O2 concentration	: 7.2765 mg/l
O2 concentration	: 221.853 mM/kg
O2 concentration	: 67.091 %
Comment	: Demo measurement

### Figure 5.5 Deviation Data

Replication and precision	
File	: C:\DOA\DEMO\WOCE_D.DAT
Number of replicates	: 3
Number of single samples	: 32
Replication ratio	: 8 %
Max O2 concentration	: 8.980 ml/l
Standard deviation s	: 0.017
Reproducibility	: 0.37 %

## Figure 5.6 Log File

```
Titration logged 22.05.1995 09:05
Date           : 22.05.95
Time          : 09:04
Station       : station
Depth        : 0
Bottle number : 99
 1      0.0    5007 1
 2     54.7    6602 1
 3    103.3    8453 1
 4    144.8   10451 1
 5    178.6   12423 1
 6    204.8   14197 1
 7    224.2   15694 1
 8    237.9   16853 1
 9    247.1   17684 1
10    253.1   18266 1
11    256.9   18637 1
12    259.3   18895 1
13    260.7   19059 1
14    261.4   19181 1
15    261.9   19258 0
16    262.4   19338 0
17    262.9   19405 0
18    263.4   19483 0
19    263.9   19558 0
20    264.4   19645 0
21    264.9   19721 0
22    265.4   19795 0
23    265.9   19880 0
24    266.4   19957 0
25    266.9   20036 0
26    267.4   20107 2
27    267.9   20199 0
28    268.4   20272 0
29    268.9   20355 0
30    269.4   20448 0
31    269.9   20521 0
32    270.4   20597 2
33    270.9   20690 0
34    271.4   20776 0
35    271.9   20857 0
36    272.4   20940 0
37    272.9   20947 0
38    273.4   20945 0
39    273.9   20948 0
40    274.4   20932 0
41    274.9   20943 0
42    275.4   20937 0
43    275.9   20937 0
44    276.4   20944 0
45    276.9   20937 0
Slow titration index:          14
Inflection point index:       35
Optimize end point index:    35
End transmission:            20941
Used end point:               272.39 µl
No poly end point:           272.35 µl
Inflection point titer:       271.90 µl
Inflection point ln(transmission): 9.9455
Slope at inflection point:    0.00809627
Accuracy of endpoint detection: 0.011
Polynomial coefficient A:     1.46378098E+001
Polynomial coefficient B:     -6.57695760E-002
Polynomial coefficient C:     2.63590955E-004
Polynomial coefficient D:     -3.13248045E-007
```

**Figure 5.7 Complete Data File Part 1**

File: C:\DOA\WOCE_D.DAT												
Date	Time	Station	Depth	Bo#	BotVol	BVol20	Botσ	Tsw	Tpick	Ttit	Sal.	Bur
01.02.93	13:24	SiS	0	63	59.71	59.71	1.0E-5	14.30	14.70	19.10	0.00	1
01.02.93	13:27	SiS	0	64	59.53	59.54	1.0E-5	3.20	4.10	19.10	31.40	1
01.02.93	13:31	SiS	0	65	59.49	59.50	1.0E-5	-0.40	1.20	19.10	33.70	1
01.02.93	13:34	SiS	0	77	59.56	59.56	1.0E-5	17.30	17.45	19.10	17.60	1
01.02.93	13:37	SiS	0	79	58.99	58.99	1.0E-5	23.40	23.35	19.10	18.10	1
01.02.93	13:41	SiS	0	80	59.92	59.92	1.0E-5	17.30	17.30	19.10	23.80	1
01.02.93	13:44	SiS	0	93	59.08	59.09	1.0E-5	6.70	7.10	19.10	27.10	1
01.02.93	13:47	SiS	0	98	59.79	59.79	1.0E-5	18.30	18.30	19.10	31.40	1
01.02.93	13:50	SiS	0	99	59.71	59.71	1.0E-5	12.10	12.40	19.10	33.90	1
01.02.93	13:53	SiS	0	63	59.70	59.71	1.0E-5	4.50	4.90	19.10	28.60	1
01.02.93	13:55	SiS	0	64	59.54	59.54	1.0E-5	17.20	17.25	19.20	28.00	1
01.02.93	13:59	SiS	0*	65	59.50	59.50	1.0E-5	15.60	16.10	19.20	27.50	1
01.02.93	13:59	SiS	0*	77	59.56	59.56	1.0E-5	15.60	16.10	19.20	27.50	1
01.02.93	14:06	SiS	0	79	58.99	58.99	1.0E-5	13.20	13.40	19.20	33.90	1
01.02.93	14:10	SiS	0	80	59.92	59.92	1.0E-5	23.90	23.80	19.20	31.70	1
01.02.93	14:14	SiS	0	93	59.08	59.09	1.0E-5	2.20	2.80	19.20	29.80	1
01.02.93	14:17	SiS	0	98	59.79	59.79	1.0E-5	16.80	17.00	19.20	28.10	1
01.02.93	14:20	SiS	0	99	59.71	59.71	1.0E-5	18.10	18.10	19.20	21.80	1
01.02.93	14:24	SiS	0	63	59.71	59.71	1.0E-5	18.20	18.10	19.20	31.35	1
01.02.93	14:27	SiS	0	64	59.53	59.54	1.0E-5	3.20	4.10	19.20	18.90	1
01.02.93	14:31	SiS	0	65	59.49	59.50	1.0E-5	8.70	9.30	19.20	27.87	1
01.02.93	14:35	SiS	0	77	59.56	59.56	1.0E-5	14.30	14.70	19.20	29.20	1
01.02.93	14:40	SiS	0*	98	59.79	59.79	1.0E-5	15.40	15.80	19.20	24.20	1
01.02.93	14:40	SiS	0*	99	59.71	59.71	1.0E-5	15.40	15.80	19.20	24.20	1
05.02.93	12:38	SiS	0	63	59.71	59.71	1.0E-5	15.30	15.50	18.70	16.20	1
09.02.93	10:59	SiS	0	63	59.71	59.71	1.0E-5	17.60	17.70	18.30	28.30	1
09.02.93	11:07	SiS	0	99	59.71	59.71	1.0E-5	17.60	17.70	18.30	23.15	1
10.02.93	13:37	SiS	0	63	59.71	59.71	1.0E-5	12.30	12.50	18.90	31.05	1
10.02.93	13:42	SiS	0	64	59.54	59.54	1.0E-5	17.10	17.20	18.90	26.90	1
10.02.93	14:07	SiS	0	65	59.49	59.50	1.0E-5	8.60	8.90	18.90	18.50	1
10.02.93	14:10	SiS	0	77	59.56	59.56	1.0E-5	11.70	11.90	18.90	16.70	1
10.02.93	15:52	SiS	0	79	58.99	58.99	1.0E-5	17.10	17.10	19.10	28.30	1
10.02.93	15:56	SiS	0	99	59.71	59.71	1.0E-5	17.10	17.10	19.10	27.95	1
03.03.93	09:49	SiS	0	63	59.71	59.71	1.0E-5	17.10	17.10	18.40	20.60	1
03.03.93	09:55	SiS	0	64	59.54	59.54	1.0E-5	17.10	17.10	18.40	21.10	1
03.03.93	10:58	SiS	0	65	59.49	59.50	1.0E-5	10.20	10.70	18.60	16.50	1
19.04.93	11:07	SiS	0*	64	59.53	59.54	1.0E-5	10.20	10.70	18.60	31.25	1
19.04.93	11:07	SiS	0*	65	59.49	59.50	1.0E-5	10.20	10.70	18.60	31.25	1

**Figure 5.8 Complete Data File Part 2**

Page: 1													
Blank	StdVol	IOVol	ION	RegVol	DOReg	TitVol	Acc.	ml/l	mg/l	µM/kg	%	Comment	
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0107	0.3678	4.921	7.03	219.9	68.8	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0292	0.3794	5.092	7.28	221.9	67.1	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0137	0.3138	4.213	6.02	183.2	51.4	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0215	0.5678	7.620	10.89	336.2	126.2	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0143	0.6080	8.242	11.78	364.0	153.9	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0165	0.4517	6.023	8.61	264.5	103.6	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0141	0.4775	6.461	9.23	282.5	90.1	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0136	0.2796	3.733	5.34	163.1	68.5	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0128	0.3611	4.831	6.90	210.3	79.5	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0081	0.4103	5.491	7.85	239.8	73.4	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0131	0.4462	5.989	8.56	262.2	105.4	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0248	0.4477	6.013	8.59	263.3	102.2	Demo	duplicate
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0265	0.4478	6.008	8.59	263.1	102.1	Demo	duplicate
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0149	0.2785	3.771	5.39	164.2	63.5	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0294	0.2792	3.720	5.32	162.7	75.8	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0175	0.3881	5.250	7.50	229.0	66.7	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0137	0.4247	5.675	8.11	248.4	99.2	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0125	0.4298	5.751	8.22	253.0	99.3	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0148	0.2122	2.836	4.05	123.9	51.9	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0191	0.4326	5.807	8.30	255.5	70.4	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0166	0.3780	5.076	7.25	221.9	74.6	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0146	0.3023	4.054	5.79	177.2	67.8	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0131	0.3694	4.935	7.05	216.6	81.9	Demo	duplicate
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0105	0.3702	4.953	7.08	217.4	82.2	Demo	duplicate
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0108	0.6707	8.980	12.83	396.5	141.6	Demo	measurement
-0.0016	0.7223	10.000	0.0100	2.0000	0.0017	0.0110	0.3536	4.730	6.76	207.1	84.1	Demo	measurement
-0.0016	0.7117	10.000	0.0100	2.0000	0.0017	0.0270	0.4294	5.832	8.33	256.3	100.5	Demo	measurement
-0.0026	0.7117	10.000	0.0100	2.0000	0.0017	0.0223	0.3137	4.266	6.10	186.2	69.2	Demo	measurement
-0.0026	0.7117	10.000	0.0100	2.0000	0.0017	0.0151	0.4239	5.780	8.26	253.2	100.9	Demo	measurement
-0.0026	0.7117	10.000	0.0100	2.0000	0.0017	0.0135	0.5037	6.872	9.82	302.6	94.8	Demo	measurement
-0.0026	0.7117	10.000	0.0100	2.0000	0.0017	0.0116	0.4822	6.572	9.39	289.9	96.2	Demo	measurement
-0.0002	0.7806	10.000	0.0100	2.0000	0.0017	0.0164	0.4349	5.444	7.78	238.3	95.8	Demo	measurement
-0.0002	0.7806	10.000	0.0100	2.0000	0.0017	0.0090	0.4587	5.672	8.11	248.3	99.6	Demo	measurement
-0.0002	0.7410	10.000	0.0100	3.0000	0.0017	0.0140	0.5173	6.862	9.81	302.1	115.3	Demo	measurement
-0.0002	0.7410	10.000	0.0100	3.0000	0.0017	0.0147	0.5075	6.752	9.65	297.1	113.8	Demo	measurement
-0.0002	0.7410	10.000	0.0100	3.0000	0.0017	0.0216	0.6736	8.978	12.83	396.0	126.9	Demo	measurement
-0.0002	0.8409	10.000	0.0100	3.0000	0.0017	0.0114	0.5608	6.574	9.40	286.7	102.1	Demo	duplicate
-0.0002	0.8409	10.000	0.0100	3.0000	0.0017	0.0212	0.5609	6.580	9.40	287.0	102.1	Demo	duplicate

## Chapter 6

### Messages

#### 6.1 Warning Messages

**W0010: Hardware not detected**

This warning message will be displayed after starting the program if the photometer and/or the Dosimat are not ready. Remember that the photometer has a warmup time of about five minutes. Ignore the warning if you don't want to make a titration (e.g. if you only want to view data from previous titrations).

**W0011: Dosimat not powered or not connected**

The Dosimat is not powered (red mains switch at the rear side) or there is no connection between the interface box and the Dosimat (mains cable or data link cable). Ignore this warning if you only want to view or print data from previous titrations.

**W0020: Configuration file not found**

The configuration file could not be found. The program will use the default data. Note that you cannot start a titration, because the standard data will be set to zero.

**W0021: No bottle file**

The program could not find the bottle file. Before starting any titration you have to create the bottle file.

**W0030: Too many directory entries**

The selected directory contains more entries than the internal buffer can hold. The file list will not display all entries. Ignore this warning if the files you want are in the list or use a search mask to display a subset.

**W0040: Bottle number has not changed. Start titration?**

You did not enter a new bottle number before starting the new titration. Choose 'Yes' to start the titration or 'No' to go back to the Titration Parameter window.

**W0050: Duplicate sample ratio below 10%**

If duplicate control is enabled, this warning message will be displayed each time you are starting a normal titration (no duplicate) if the ratio of duplicates to all data sets in the current data file is below 10%.

**W0060: Burette was filled during titration**

The burette has to be refilled during titration (the dispensed titer volume was greater than the burette volume). Therefore, the titration result may be inaccurate.

**W0071: Approximation failed**

The endpoint calculation algorithm fails. Therefore, the results may be inexact. To decide if the detected endpoint is correct use the Graph command to display the titration curve for examination. This warning is produced when the endpoint calculation by polynomial approximation is not possible. But the endpoint is still calculated by a simpler method (linear regression).

**W0072: Titration is too fast**

At the end of the fast titration phase there is too many titer that has not reacted. To avoid this warning increase the stirrer speed, use bigger stirrer bars and / or increase the fast delay time.

**W0073: Not enough steps inside slow titration phase**

There are not enough titration steps during the slow titration phase. Therefore, an approximation of the titration curve is not possible and the result may be inexact. To avoid this warning, decrease the fast factor for 2-channel systems or decrease the primary shot or percentage endpoint for 1-channel systems.

W0074: Zero concentration detected

The system detected a zero concentration for the sample. If there is really a zero concentration choose OK. Choose Cancel if the zero concentration is sourced by an error (e.g. burette tip not inside sample bottle).

W0080: Too many data sets in log file

The selected log file for titration curve display contains more data sets than the internal buffer can hold. Therefore, the list box contains only the oldest data sets from the file. To select all data sets, the log file must be splitted into two or more files (e.g. with an ASCII editor).

W0090: File not saved; Save ?

The contents of the file has changed since the last saving or loading. Choose 'Yes' to save the file contents.

W0100: Bottle exists already; overwrite ?

There is already a bottle with the specified number in your bottle file. You can overwrite the old data or cancel the input.

W0110: File exists already

A file with that name exists already. You can choose from overwriting, appending data, or cancelling the operation.

## 6.2 Error Messages

E1010: Not enough memory

There is not enough memory to execute the selected option. To get more free memory leave the program and remove resident programs.

E1020: Graphics error

The program could not identify your graphic system. Therefore, the Graph command is not available. If you have a Hercules graphic card, this error will occur if the terminate-and-stay-resident program MSHERC.COM is not installed.

E1040: Internal error

Internal (menu system) error. Please contact SiS to report this error. (See note below).

E1050: User break

A running titration was interrupted by pressing the <ESC> key. Choose 'OK' to stop the titration or 'Cancel' to resume. Note that resuming could produce less accurate results if the titration was interrupted during the slow titration phase.

E1060: Input out of range

The entered value is out of range. The range for valid input is generally displayed at the status line.

E1070: Cannot execute command processor or child process

The command processor (COMMAND.COM) was not found or the argument list exceeds 128 bytes. The program tries to locate the command processor by the environment variable COMSPEC. If this fails, the shell command is not available. For further information see your DOS manual.

E2010: No bottle data available

The bottle file could not be found or it is empty. Before starting any titration you have to enter a valid bottle number. Therefore, you must create a bottle file first.

E2020: No data available

This error occurs when you select the Graph command and no titration was done since program start or the last titration was not successful.

E2030: Missing standardization data

Before starting any sample titration you have to standardize your titer.

E2040: Unknown bottle number

There is no bottle with the specified number in your bottle file. Check if you entered the correct number or tell the program the new bottle by using the Add Bottle command in the Bottles Menu.

E2050: Transmission not decreased with bottle

Before starting a titration the system has to know the red and blue transmission values without and with a bottle. If the blue transmission with bottle is not below the transmission without bottle minus 5 percent, this error occurs. So choose OK to restart the calibration procedure or Cancel the titration.

E2060: It seems that there is no bottle in the photometer

Before starting an additional titration for blank or standard determination the system checks the blue transmission value. If this value is greater than the transmission without bottle from the first titration minus 5 percent, there is probably no bottle in the photometer.

E3010: Photometer/Dosimat not detected

Before any titration the program will check if the photometer and the Dosimat are connected to the computer and powered. If the check fails, you will get this error message.

E3020: Time out reading photometer

The connection to the photometer is interrupted. If this error occurs inside a titration, cancel the process and check the hardware.

E3030: Time out sending to Dosimat

The connection to the Dosimat is interrupted. If this error occurs inside a titration, cancel the process and check the hardware.

E3050: Invalid port number

Your computer has no interface with the specified number. Use the configuration menu to select a valid port.

E3060: Mouse active at selected hardware port

There is an active mouse driver at the serial port. Change the hardware port or leave the program and disable the mouse driver.

E4000: Too many titration steps

The titration was interrupted, because the number of titration steps is greater than the internal buffer can hold (1000). This error can occur when you enter a very low estimated endpoint (or percentage transmission start value for 1-channel systems) or your titer concentration is very small. In these cases a greater buffer would not be an advantage, because the titration results would be too inexact.

E4010: Titration failed

The titration was not successful. The frequent source for this error is an over titration. To avoid over titrations enter a lower estimated endpoint (or primary shot for 1-channel systems) or use a smaller titer concentration.

E5000: Can't open file or device

Reading: The device is an output device.

Writing: The file or disk is write protected or the device is an input device.

E5001: Seek error

Seek error during disk access. Leave the program (e.g. by the OS-shell command) and check your disk and drive.

E5002: Read error

Read error during disk access. Leave the program (e.g. by the OS-shell command) and check your disk and drive.

E5003: Write error

Write error during disk access. Leave the program (e.g. by the OS-shell command) and check your disk and drive.

E5010: Device not ready

Drive or device not ready (e.g. no disk in drive, printer off line).

E5011: Printer not ready

Your printer is not powered, not on line, busy, or not connected to the selected port.

E5012: DOS device error

Critical DOS device error. Clear the error source and choose RETRY.

E5020: Disk full

Your disk is full. Change the disk or delete files and restart output operation.

E5030: File/path not found

A file and/or path with that name does not exist.

E5040: No matching file/directory found

There are no directories and no files that match the search mask on your disk.

E5050: Invalid drive/path

A drive and/or path with that name does not exist.

E5051: Invalid file name

The file name does not match the MS-DOS specifications for file names (max. 8 characters for name, 3 characters for extension).

E5060: Invalid configuration file

The file is not a valid DOA configuration file.

E5061: Invalid data file

The file is not a valid DOA data file.

E5062: Invalid bottle file

The file is not a valid DOA bottle file.

E5063: Invalid data file type

The data file does not match the current settings. There are four types of data files: with or without duplicates and WOCE or ISO mode. Select a matching file or enter a new file name.

E5064: Invalid log file

The selected log file for titration curve display is not a DOA log file or it was modified.

E5070: File is read only

The read only attribute of the file is set. To get write access, you must reset the R/O attribute (e.g. with the DOS command ATTRIB).

E5080: File is not executable

The file is not a COM, EXE or BAT file or it has an invalid executable-file format.

E60xx: DOS device error

Critical DOS device error. The only way to go on is to clear the error source and to choose 'Retry'. If you choose 'Abort' the program will terminate without saving any data! (Sorry, that's MS-DOS).

E700x: Math error

Mathematical function error. Please contact SiS to report this error. (See note below).

E800x: FP87 error

Floating point error. Please contact SiS to report this error. (See note below).

EXXXX: Internal error in error function

During error handling an internal (menu system) error occurs. XXXX is the number of the original error. (See note below).



Note to all errors that appear during titration (E40xx):

If a titration fails, the titration data will be written to the ASCII file DOA.ERR in the current directory. If the file exists already, the data will be appended. Therefore the file should be renamed or deleted after some time. The error file may be useful if too many titration failures occur to detect the error sources.

Note to errors E1040, E700x, E800x and Internal error in error function:

We have tried to make this program error free, but nobody is perfect. To prevent system 'hangups', resulting in lost data, we have included many error checks for critical errors to save all data before leaving the program. If one of these errors occurs, please report the error and the circumstances (current program step, menu level) to us.

## **Chapter 7**

### **Customer Service**

#### Warranty:

SiS warrants this instrument to the original purchaser to be free of defects in material or manufacturing for a period of one year. Liability is limited to repair or replacement of the defective part which will be done without charge if the instrument is returned to our factory prepaid. This warranty does not apply to any glass or plastic parts or to instruments subjected to misuse or tampering. No responsibility or warranty for consequential damage is included in the sale of this instrument.

#### Software updates:

SiS guarantees a free of charge software update for one year.

Please report errors or make suggestions in writing or phone us for questions, that can only be answered by phone.

SiS Sensoren Instrumente Systeme GmbH  
Mühlenkoppel 12  
D-24222 Schwentinental  
Germany  
Tel.: +49 431 79972 0  
Fax: +49 431 79972 11  
Email: [info@sis-germany.com](mailto:info@sis-germany.com)  
WWW: <http://www.sis-germany.com>

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