





Metrohm AG
CH-9101 Herisau
Switzerland
Phone +41 71 353 85 85
Fax +41 71 353 89 01
info@metrohm.com
www.metrohm.com



Tutorial

8.101.8003EN

01.2009 jb/ek

Teachware
Metrohm AG
CH-9101 Herisau
teachware@metrohm.com

This documentation is protected by copyright. All rights reserved.

Although all the information given in this documentation has been checked with great care, errors cannot be entirely excluded.

Should you notice any mistakes please send us your comments using the address given above.



Table of contents

1	Introduction	1
1.1	Structure of the tutorial	1
1.2	Program structure	2
1.3	Symbols and conventions	3
2	Titration without automation	4
2.1	Configuration	4
2.1.1	Connecting a Titrando including a stirrer	4
2.1.2	Connecting a Titrino	5
2.1.3	Adding and configuring a titrant	9
2.1.4	Configuring a pH electrode	13
2.2	Creating a titration method	15
2.3	Carrying out a titration	27
2.3.1	Preparing the exchange or dosing unit	27
2.3.2	Carrying out a titration	29
2.4	Database	33
2.4.1	Overview	33
2.4.2	Adapting the layout	34
2.4.3	Reprocessing a determination	37
2.4.4	Printing out a report	38
3	Titration with automation	40
3.1	Configuration	40
3.1.1	Connecting a USB Sample Processor	40
3.1.2	Connecting a balance	41
3.1.3	Assigning lift positions	44
3.1.4	Defining special beakers	48
3.2	Creating an automation method	51
3.2.1	Loading the method	51
3.2.2	Extending the titration method	52



3.3	Performing a sample series	61
3.3.1	Creating a sample table	61
3.3.2	Performing a sample series	65
3.3.3	Displaying statistics results	67
3.4	Extending the automation method	69

1 Introduction

1.1 Structure of the tutorial

The present tutorial guides you through your first steps with the software *tiamo*TM. You will be introduced to the most important operating features by using a simple pH titration as an example.

The tutorial is structured in two parts:

Part 1: Titration without automation

- Configuration
 - Connecting a Titrando or a Titrino
 - Adding a titrant
 - Connecting a pH electrode
- Method
 - Creating a method using a template
 - Carrying out a titration
- Database
 - Results view in the determination database
 - Reprocessing a determination
 - Printing a report

Part 2: Titration with automation

- Adding a USB Sample Processor to an existing titration system and configuring it
- Modifying the titration method used in Part 1 in a few steps
- Creating a sample table in order to carry out a sample series



1.2 Program structure

tiamo[™] comprises the following program parts:

Workplace



- Open/Close workplaces
- Start single determinations and determination series
- Create sample tables

Database



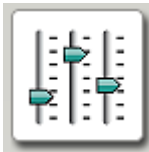
- Open/Close databases
- Manage databases
- Reprocess determinations
- Create method templates

Method



- Create new methods
- Open/Close existing methods
- Manage methods

Configuration



- Configure devices, solutions, sensors, common variables and rack data
- Security settings
- User administration
- Audit Trail

Manual




- Dosing
- Preparing exchange/dosing unit
- Measuring
- Stirring
- Automation functions

Detailed information on *tiamo*[™] can be found in the online help. **[F1]** opens the help for the corresponding dialog.

1.3 Symbols and conventions

The following symbols and styles are used in this documentation:

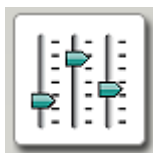
1	Instruction step Carry out these steps in the sequence shown.
Method	Dialog text, parameter in the software
File ► New	Menu or menu item
[Next]	Button or key
	Note This symbol marks additional information and tips.



Proceed as follows to connect a Titrimo:

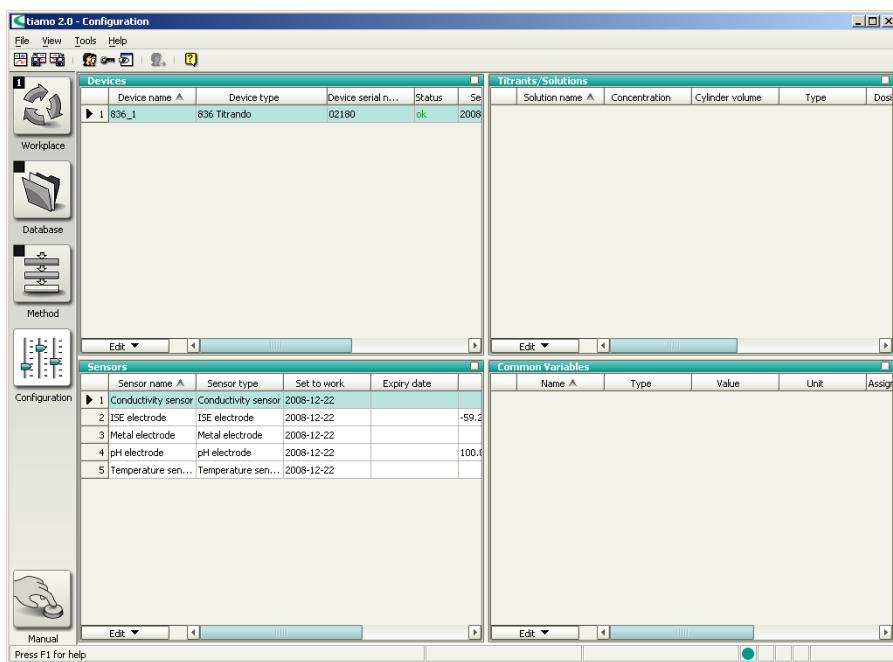
1 Connect the devices

- Connect the Titrimo to the RS-232 interface COM1, COM2, ... of the computer.
- Connect the Titrimo to the mains supply.
- Switch on the Titrimo.



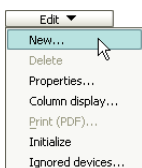
2 Start the software

- Start tiamo.
- In the sidebar, click on the symbol **[Configuration]**.



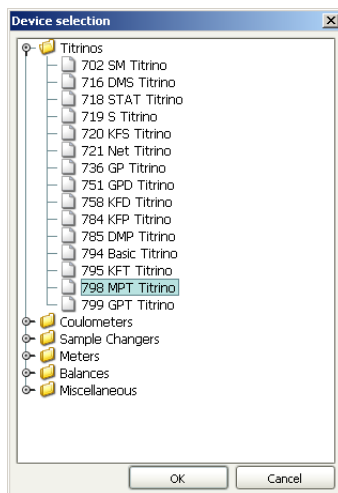
The program part **Configuration** has the following subwindows:

Devices	List of automatically recognized and manually added devices.
Titrants/Solutions	List of automatically recognized and manually added titrants and auxiliary solutions.
Sensors	List of all sensors defined.
Common Variables	List of all common variables defined.
Sample solutions (TC conductivity)	List of the solutions a temperature coefficient has been determined for.



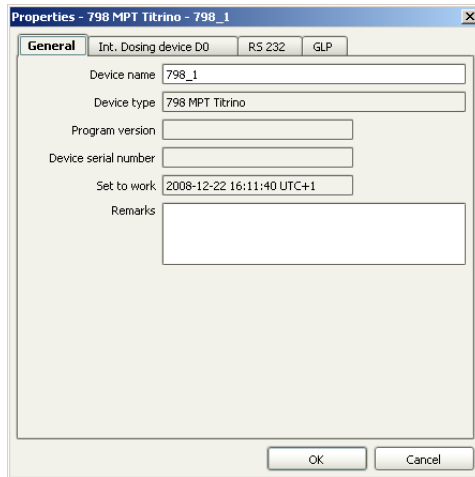
3 Add the device

- In the subwindow **Devices**, click on the menu item **Edit ► New...**
- Double-click the item **Titrinos**.
The list of the Titrinos available is displayed:



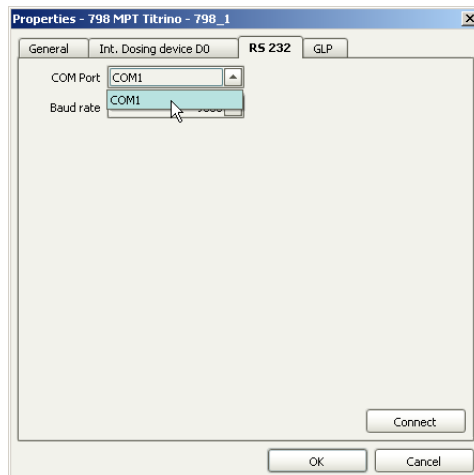
- Select the Titrimo from the list and confirm with **[OK]**.

The properties dialog of the Titrimo is opened:



4 Configure the device

- Under **Device name**, enter a designation that describes the Titrimo unambiguously.
- Click on the tab **RS 232**.



- Select the RS-232 interface of the computer the Titrimo is connected to.

- Confirm the entries with **[OK]**.

The Titrino is added to the the list of devices.

2.1.3 Adding and configuring a titrant

Titrant in an exchange or dosing unit with data chip



Note

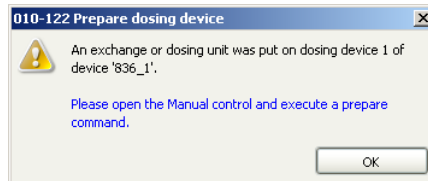
The following description only applies if a Titrando is used. For Titrinos: *see page 11*.

Proceed as follows to add a titrant to the list of titrants:

1 Attach the exchange or dosing unit

- Attach the exchange unit to the Titrando or the Dosino to the dosing unit.

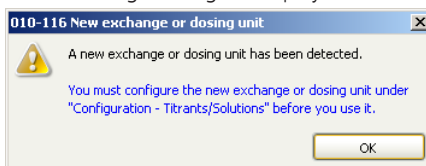
As soon as the exchange or dosing unit has been recognized the following message is displayed:



All tubings and cylinders are rinsed with the **Prepare** function. Preparing exchange or dosing units is described in *chapter 2.3.1, page 27*. The exchange or dosing unit must first be configured.

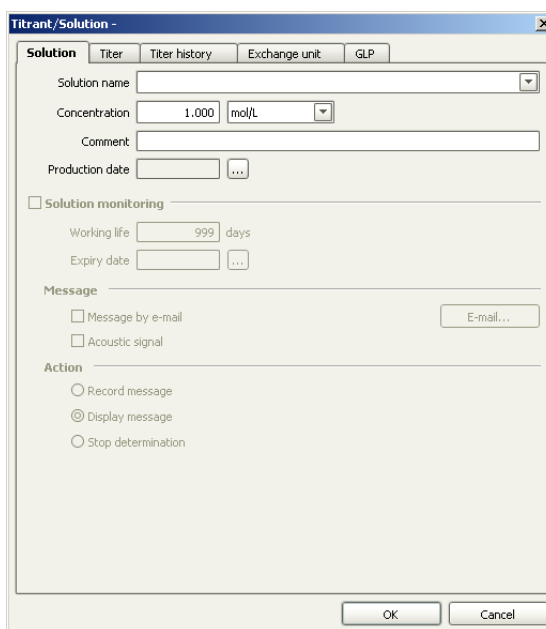


- Confirm the message with **[OK]**.
The following message is displayed:



- Confirm the message with **[OK]**.

The properties dialog of the titrant is opened:



2 Configure the titrant

- Enter a solution name or select an existing name from the list.
- Define the concentration of the titrant.
- Switch on the option **Solution monitoring**.
- As working life enter, for example, 60 days.



- Confirm the entries with **[OK]**.

The titrant is added to the list of titrants.

Titrant in an exchange or dosing unit without data chip

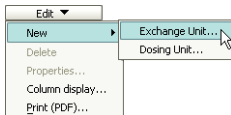
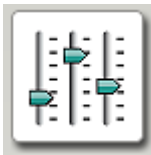
A titrant in an exchange or dosing unit without data chip must be added manually to the list of titrants. The exchange or dosing unit does not need to be attached for this.



Note

If you use an exchange unit with data chip with a Titrino you will also have to manually add the titrant to the list of titrants.

Proceed as follows to add a titrant to the list of titrants:



1 Open the program part "Configuration"

- In the sidebar, click on the symbol **[Configuration]**.

2 Add a titrant

- In the subwindow **Titnants/Solutions**, click on the menu item **Edit ▶ New ▶ Exchange or Dosing Unit...**

The properties dialog of the titrant is opened:



Titration/Solution -

Solution | Titer | Titer history | Exchange unit | GLP

Solution name: [dropdown]

Concentration: 1.000 mol/L [dropdown]

Comment: [text]

Production date: [calendar]

Solution monitoring

Working life: 999 days

Expiry date: [calendar]

Message

Message by e-mail [E-mail...]

Acoustic signal

Action

Record message

Display message

Stop determination

OK Cancel

3 Configure the titrant

- Enter a solution name or select an existing name from the list.
- Define the concentration of the titrant.
- Switch on the option **Solution monitoring**.
- As working life enter, for example, 60 days.

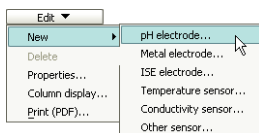
- Click on the tab **Exchange unit** or **Dosing unit**.

- Select the cylinder volume.
- Enter the number printed on the cylinder under **Cylinder serial number**.
- Confirm the entries with **[OK]**.

The titrant is added to the list of titrants.

2.1.4 Configuring a pH electrode

Proceed as follows:



1 Add a pH electrode

- In the subwindow **Sensors**, click on the menu item **Edit ▶ New ▶ pH electrode...**

The properties dialog of the sensor is opened:



The image shows a software dialog box titled "Sensor -" with a close button (X) in the top right corner. The dialog has four tabs: "Sensor", "Calibration data", "Limits", and "History". The "Sensor" tab is selected and contains the following fields and options:

- Sensor name:** A text input field.
- Sensor type:** A dropdown menu with "pH electrode" selected.
- Order number:** A text input field.
- Sensor serial number:** A text input field.
- Device:** A dropdown menu.
- Comment:** A text input field.
- Set to work:** A date field showing "2008-12-22" and a calendar icon.
- Sensor monitoring:** A checkbox that is currently unchecked.
- Working life:** A text field with "999" and the unit "days".
- Expiry date:** A date field showing "2011-09-17" and a calendar icon.
- Message:** Two checkboxes: "Message by e-mail" and "Acoustic signal". An "E-mail..." button is located to the right.
- Action:** Three radio buttons: "Record message", "Display message" (which is selected), and "Stop determination".

At the bottom right of the dialog are "OK" and "Cancel" buttons.

2 Configure the pH electrode

- On the **Sensor** tab, enter a sensor name and the order number.

- Click on the tab **Calibration data**.

- Switch on the option **Calibration data monitoring**.
- Enter a calibration interval of, for example, 7 days.
- Confirm the entries with **[OK]**.

The pH electrode is added to the list of sensors.

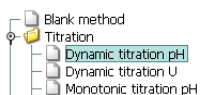
2.2 Creating a titration method

Below you will find a description of how to use a template for DET pH titrations to create your own method.



Loading the method template

Proceed as follows to load the method template:




1 Open the program part "Method"

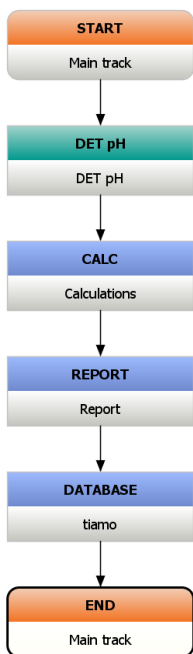
- In the sidebar, click on the symbol **[Method]**.

The method editor is displayed.

2 Select the method template

- Click on the symbol  or the menu item **File ▶ New....**
- Double-click the item **Titration**.
- Select the method template **Dynamic titration pH** and confirm with **[OK]**.

The method is loaded:



The method template consists of the following commands:

- **DET pH**: Titration command
- **CALC**: Calculation command
- **REPORT**: Command for printing a determination report
- **DATABASE**: Command for saving the determination in the database

The method is now already complete except for a few parameters which you are just going to set.

Editing the titration command DET pH

Proceed as follows:



1 Open the properties dialog

- Double-click the command **DET pH**.

The properties dialog of the command is opened:



Command name: DET pH

Potentiometric evaluation | Additional evaluations | Additional measured values

General/Hardware | Start conditions | Titration parameters | Stop conditions

Device

Device name: not defined

Device type: Titrande

Dosing device

Dosing device: 1

Solution: not defined

Sensor

Measuring input: 1

Sensor: pH electrode

Temperature measurement: automatic

Stirrer

Stirrer: 1

Stirring rate: 8

Switch off automatically

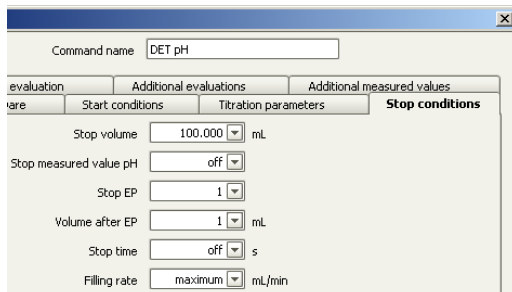
OK Cancel

2 General/Hardware

- Under **Device name**, select the connected Titrande or Titriano.
- Under **Dosing device**, select the MSB connector the dosing device is connected to. Select option **1** if you have attached an exchange unit to the Titrande / Titriano.
- Under **Solution**, select the newly configured titrant.
- Under **Sensor**, select the previously configured pH electrode.
- Under **Stirrer**, select the MSB connector the stirrer is connected to.

3 Stop conditions

- Click on the tab **Stop conditions**.

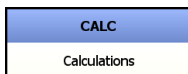


evaluation	Additional evaluations	Additional measured values
Start conditions	Titration parameters	Stop conditions
Stop volume	100.000 mL	
Stop measured value pH	off	
Stop EP	1	
Volume after EP	1 mL	
Stop time	off s	
Filling rate	maximum mL/min	

- Select the option **Stop EP = 1**.
- Under **Volume after EP**, enter the value **1**.
- Confirm the entries with **[OK]**.

Editing the calculation command CALC

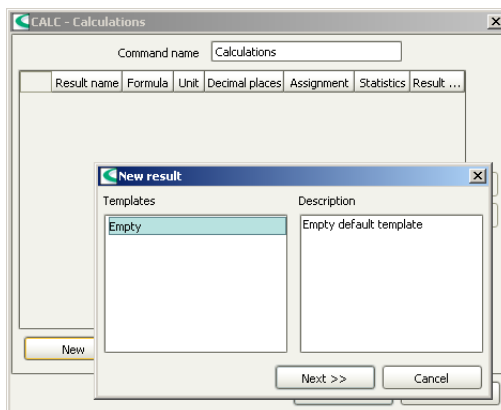
Proceed as follows:



1 Create a new calculation

- Double-click the command **CALC**.
- Click on **[New]**.

The dialog window **New result** is opened:



In this window predefined result templates can be loaded and modified for new calculations. Because you have not defined a template yet, the selection is empty.

2 Define result properties


- Click on **[Next >>]**.
The properties dialog for the new result is opened:

The screenshot shows a dialog box titled "Result New - RSXX" with three tabs: "Definition", "Monitoring", and "Options". The "Definition" tab is selected. It contains the following fields and controls:

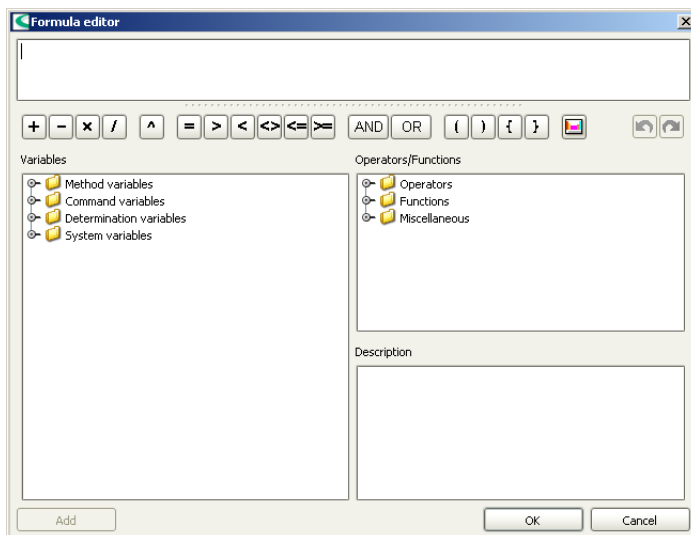
- Result name:** A dropdown menu showing "Res01".
- Formula:** A large text area for entering a formula, with a "+" icon on the right side.
- Unit:** A dropdown menu.
- Decimal places:** A dropdown menu showing "2".
- Assignment:** A dropdown menu showing "RS01".
- Statistics:** A checked checkbox.
- Description:** A large text area for entering a description.
- Buttons:** "Save as template", "OK", and "Cancel" at the bottom.

- As **Unit**, select the option **%**.

3 Open the formula editor

- Click on the symbol  or double-click the field **Formula**.

The formula editor is opened:



The calculation formula is entered in the upper window. Beneath, the most important mathematical functions are listed as symbols.

In the subwindow **Variables** all variables available for this method are listed in a tree-form structure. In the subwindow **Operators/Functions** further mathematical functions can be selected. Additionally, a short description is shown for each variable or function.

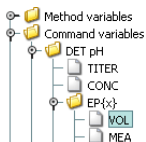
The following steps describe how you can enter the simple formula shown below for determining the content of a sample:

Formula:

'DET pH.EP{1}.VOL' x 'DET pH.CONC' x 'DET pH.TITER' x 40.00 x 0.1 / 'MV.Sample size'

DET pH.EP{1}.VOL	Volume of the first endpoint
DET pH.CONC	Concentration of the titrant used
DET pH.TITER	Titer of the titrant used

40.00	Equivalent mass of the sample, NaOH as an example here
0.1	Factor for conversion to %
MV.Sample size	Sample size in g



4 Enter the calculation formula

- Under the item **Command variables, DET pH, EP{x}**, select the variable **VOL** for the endpoint volume.
- Click on **[Add]**.
The variable is added to the formula.
- Replace the **x** in the variable by **1**, i.e. this variable contains the volume of the 1st endpoint.
- Insert the multiplication sign via the corresponding symbol or with the keyboard.
- In the same way insert the variables **CONC** and **TITER**.
- Enter the equivalent mass of the sample as well as the conversion factor.
- Under the item **Method variables**, select the variable **Sample size** and click on **[Add]**.
The variable is added to the formula.
- Confirm the entries with **[OK]**.

The formula editor is closed and the properties window of the result is displayed.

5 Apply the calculation

- Click on **[OK]**.
The calculation is entered in the result table.
- Click on **[OK]**.

The table dialog is closed.

Editing the database command DATABASE

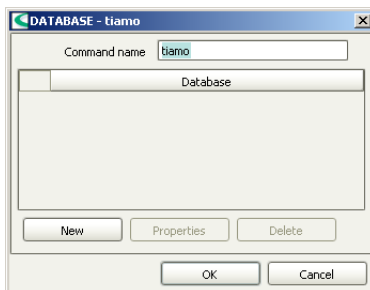
Proceed as follows:



1 Open the properties dialog

- Double-click the command **DATABASE**.

The properties dialog of the command is opened:

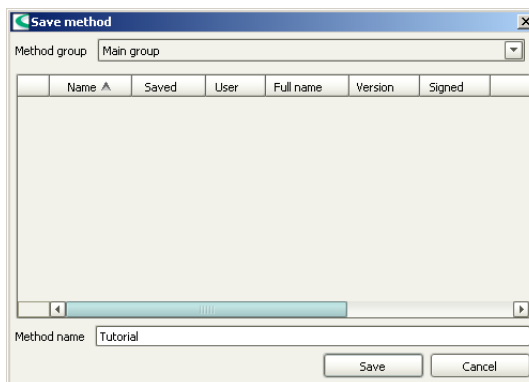


2 Select database

- Click on **[New]**.
- Select the standard database **tiamo** and confirm with **[OK]**.
- Click on **[OK]**.

The properties dialog is closed.

The method is now ready and can be checked with a method check and be saved afterwards.



2 Enter a method name

- As method name, enter **Tutorial** and confirm with **[Save]**.

The method is saved.

2.3 Carrying out a titration

2.3.1 Preparing the exchange or dosing unit

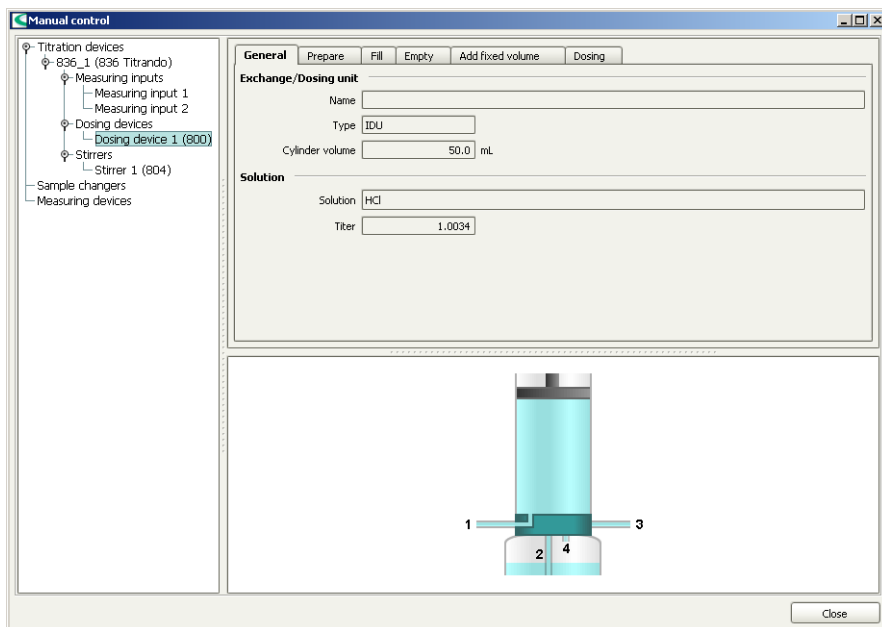
The **Prepare** function is used to rinse and fill air bubble-free the cylinder and tubings of the exchange or dosing unit. You should carry out this function before the first determination or once per day.

Proceed as follows:



1 Open the manual control

- In the sidebar, click on the symbol **[Manual]**.



In the left-hand part of the window the control devices connected are listed together with their peripheral devices. In the right-hand part of the window the functions of the device selected are displayed, in this example those of the dosing device.

2 Select the dosing device

- In the left-hand window, select the dosing device whose exchange or dosing unit is to be prepared.
- Click on the tab **Prepare**.

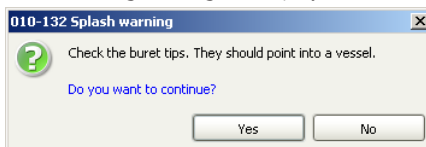
3 Start the preparing



Note

Make sure that the buret tip is directed into a vessel that can accommodate the volume of your exchange or dosing unit several times over.

- Click on **[Start]**.
The following message is displayed:



- Confirm the message with **[Yes]**.

Preparing is carried out with the default parameters. The parameters can be found in the online help. They are different for exchange and dosing units.

4 Close the manual control

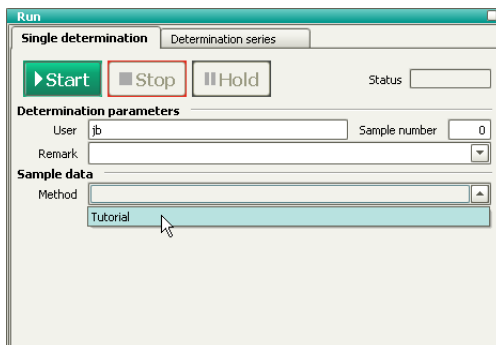
- Close the manual control after the preparing has been completed. Click on **[Close]**.

2.3.2 Carrying out a titration

The titration is carried out in the program part **Workplace**.

2 Load the method

- In the subwindow **Run** under **Method**, select the previously created method **Tutorial**.



3 Prepare the sample

- Weigh in the sample in a sample vessel.
- Add solvent.
- Place the sample vessel on the stirrer.
- Immerse electrode and buret tip in solution.

4 Enter the sample size

- Enter the sample size (**Sample size**), e.g. **5.0**.
- Select **Sample size unit = g**.

▶ Start

5 Start the titration

- Click on **[Start]**.

The titration is started.

The currently active command is highlighted with a red frame in the subwindow **Method**.



Configuring the live display

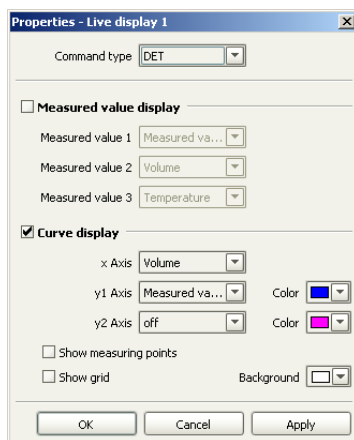
While the titration is running, configure the live display the way you can directly follow both the titration curve and the current measured values.

Proceed as follows:

1 Open the properties dialog

- Right-click the subwindow **Live display**.
The context menu is displayed.
- Click on the menu item **Properties Live display**.

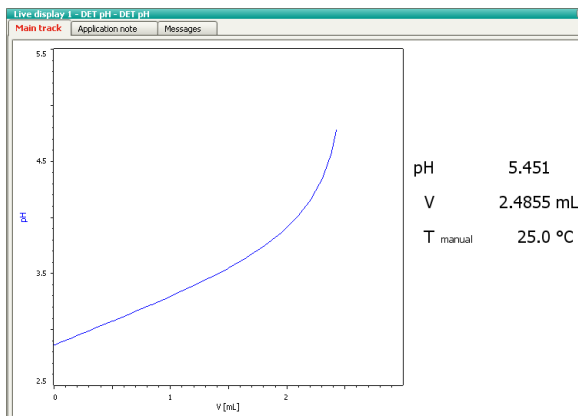
The properties dialog of the live display is opened:




2 Carry out settings

- Switch on the option **Measured value display**.
- Confirm the entry with **[OK]**.

The live display now looks like this:



With the symbol  in the upper right-hand corner of the live display you can enlarge or reduce the subwindow.

As soon as the determination is finished, a preview of the report is displayed in the subwindow **Report**. Printing out the report is described in the following chapter.

2.4 Database


2.4.1 Overview



1 Open the program part "Database"

- In the sidebar, click on the symbol **[Database]**.

2 Open the database

- Click on the symbol  or the menu item **File ► Open...**
- Select the standard database **tiamo** and confirm with **[Open]**.



The screenshot displays the tiamo 2.0 software interface. The main window is titled "Determination overview" and contains a table with the following data:

Determination start	Method name	ID1.Value	R501.Name	R501.Value	R501.Unit
2008-12-23 13:30:09 UTC+1	Tutorial		Res01	0.20	%

Below the table, there are three subwindows:

- Curves 1:** A graph showing a titration curve for "DET pH.1". The y-axis is labeled "pH" and ranges from 2 to 12. The x-axis is labeled "V [mL]" and ranges from 0 to 3. A sharp vertical increase in pH is observed around 2.5 mL, with a point labeled "EP1" at the top of this increase.
- Information:** A panel displaying determination details:
 - Identification:** Determination ID: -5aaa8c95:11e6, Server name: 127.0.0.1, Client name: jb-2, Sample number: 2, Start counter: 2.
 - Recording:** Determination start: 2008-12-23 13:3, Determination duration: 95 s, Determination run: regular with rem, User (short name): jb.
- Results:** A panel showing the command "Calculations" and the result "Res01: 0.20 %".

The program part **Database** has the following subwindows:

- Determination overview** List of the individual determinations, sorted according to date and time.
- Curves** Display of the titration curve.
- Information** General information on the determination such as determination start, method information, sample data, system configuration etc.
- Results** Display of the calculated results and the variables used for.

2.4.2 Adapting the layout

A short description is given about how to adapt the database view to your own requirements.



Configuring the curve window

Proceed as follows:

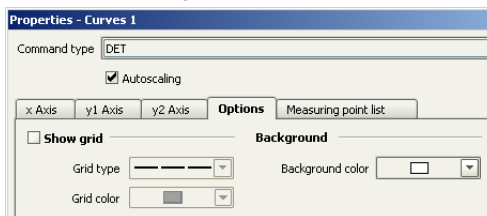
1 Open the properties window

- Right-click the subwindow **Curves**.
The context menu is displayed.
- Click on the menu item **Properties Curves**.

The properties dialog of the curve is displayed.

2 Display grid

- Click on the tab **Options**.



- Switch on the option **Show grid**.
- Confirm the entries with **[OK]**.

The titration curve is shown with a grid.

Configuring the determination overview

In the subwindow **Determination overview** you can define which columns are to be shown. You can also freely select the order of the columns.

For example, the columns **User (short name)** and **Remarks** are to be deleted and then the column **Method name** is to be moved.

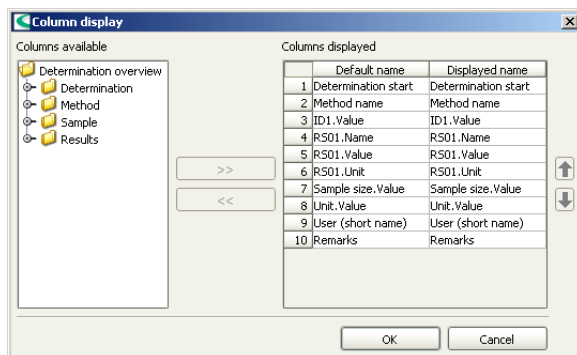


Proceed as follows:

1 Define the column display

- Click on the menu item **View ▶ Properties ▶ Column display**.

The following dialog window is opened:



2 Delete columns

- Under **Columns displayed**, select the column **User (short name)**.
- Click on the button [**<<**].
The column is removed from the list.
- Proceed in the same way for the column **Remarks**.
- Confirm the changes with [**OK**].

The two columns are no longer shown.


3 Move columns

- In the subwindow **Determination overview**, click on the column title **Method name** and move this column to the right by holding the mouse button pressed down.
- Insert the column after the column **RS01.Unit** (Drag & Drop).

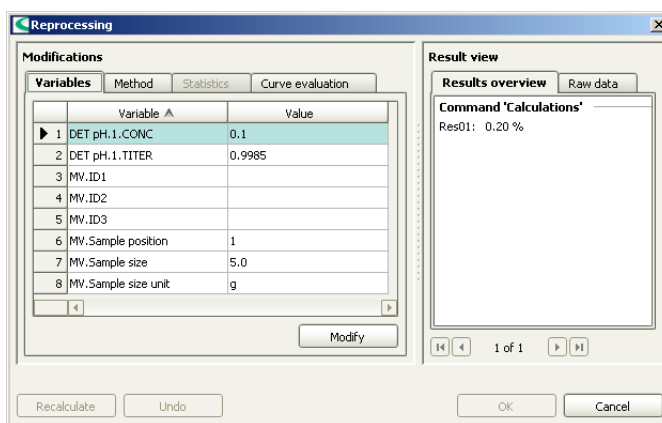
2.4.3 Reprocessing a determination

A simple example (modify the sample size) illustrates how to recalculate a determination. Proceed as follows:

1 Open the dialog window

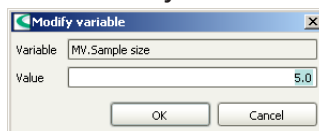
- Click on the symbol  or the menu item **Determinations** ► **Reprocess...**

The following dialog window is opened:



2 Modify the sample size

- Under **Modifications**, select the item **MV.Sample size**.
- Click on **[Modify]**.



- As new sample size, enter the value **5.3** and confirm with **[OK]**.



3 Titration with automation

For the second part of this tutorial you require a USB Sample Processor, a rod stirrer and a balance in addition to the titrator.

3.1 Configuration

3.1.1 Connecting a USB Sample Processor

Proceed as follows to connect a USB Sample Processor:

1 Connect the devices

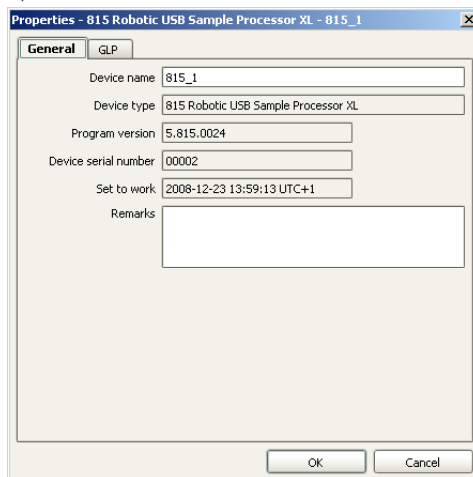
- Connect a stirrer to the stirrer connector of the tower.
- Attach a sample rack.
- Connect the controller connector of the USB Sample Processor with a USB connector on the computer or on the Titrande.
 - Use 6.2151.000 cable.
- Connect the USB Sample Processor to the mains supply.

2 Software settings

- Start tiamo.
The USB Sample Processor is recognized automatically:



- Confirm the message with **[Yes]**.
The properties dialog of the USB Sample Processor is opened:



- Under **Device name**, enter a designation that describes the USB Sample Processor unambiguously and confirm with **[OK]**.

The USB Sample Processor is added to the list of devices.

3.1.2 Connecting a balance



Note

Balances are not recognized automatically and must be added manually to the list of devices.

Proceed as follows to connect a balance:

1 Connect the devices

- Connect the balance to the RS-232 interface COM1, COM2, ... of the computer.

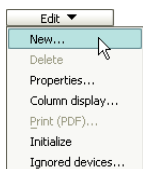


- Connect the balance to the mains supply.
- Switch on the balance.



2 Start the software

- Start tiamo.
- In the sidebar, click on the symbol **[Configuration]**.

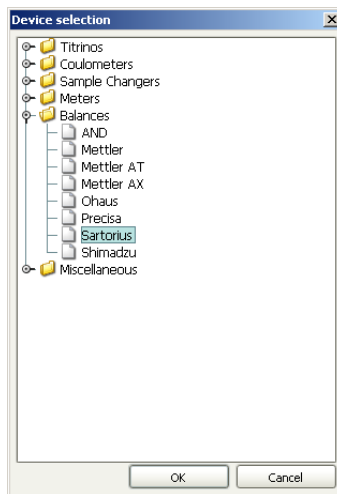


3 Add the device

- In the subwindow **Devices**, click on the menu item **Edit ► New...**

- Double-click the item **Balances**.

The list of the balances available is displayed:



- Select the balance from the list and confirm with **[OK]**.

The properties dialog of the balance is opened.

Properties - Sartorius - Sartorius_1

General RS 232 GLP

Device name: Sartorius_1

Device type: Sartorius

Program version:

Device serial number:

Set to work: 2008-12-23 14:27:09 UTC+1

Data storage under legal control

Remarks:

OK Cancel

4 Configure the device

- Under **Device name**, enter a designation that describes the balance unambiguously.
- Under **Device serial number**, enter the serial number of the balance.
- Click on the tab **RS 232**.

Properties - Sartorius - Sartorius_1

General RS 232 GLP

COM Port: COM1

Baud rate: 9600

Data bit: 8

Parity: None

Stop bit: 1

Handshake: None

Timeout: 2000 ms

Terminator for send: \\0D\\0A

Terminator for receive: \\0D\\0A

Code page: Cp437

Connect

OK Cancel



- Select the RS-232 interface of the computer the balance is connected to.
- Set the connection parameters. These settings must match the settings on the balance (see manual of the balance).

5 Test the connection

- Click on **[Connect]**.

The following dialog window is opened:

- Press the **[Print]** key on the balance in order to check the connection.
If the correct connection parameters have been entered, the corresponding data is inserted in the fields **Device name**, **Sample size** and **Sample size unit** will be filled in with the corresponding data.
- Click on **[OK]**.
- Confirm the entries with **[OK]**.

The balance is added to the list of devices.

3.1.3 Assigning lift positions

In this chapter you will learn how to define lift positions. This is necessary in order to carry out the subsequent titration with the Sample Processor.

Proceed as follows:

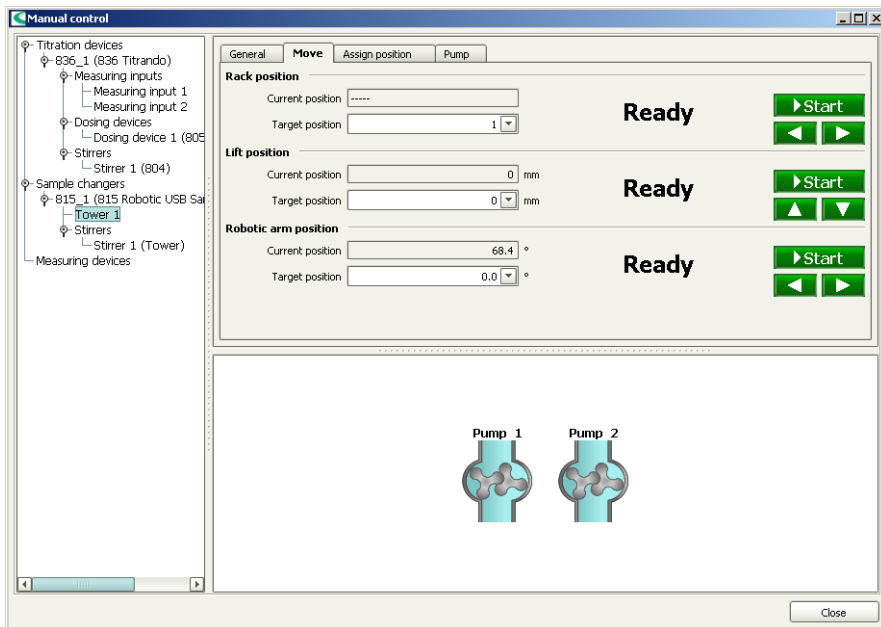
1 Equip the titration head

- Equip the titration head with all necessary accessories such as electrode, dosing tip etc. (see manual of the Sample Processor used).
- Place a sample vessel at position 1 of the rack.



2 Open the manual control

- In the sidebar, click on the symbol [Manual].



In the left-hand part of the window the control devices connected are listed together with their peripheral devices. In the



right-hand part of the window the functions of the device selected are displayed, in this example those of the tower of an 815 Robotic USB Sample Processor XL.

3 Select a tower

- In the left-hand window, select the tower of the Sample Processor used.
- Click on the tab **Move**.

4 Move to a lift position



Note

After initialization, the Sample Processor is not at a valid rack position. This is displayed with "----" under **Current position**.

- Under **Rack position**, click on the **[Start]** key or **[▶]**. Sample 1 is moved to.
- Under **Lift position**, move the life with the keys **[▲]** and **[▼]**.
- Set the lift height to be used as work position, i.e. the electrode is immersed.

5 Assign a work position

- Click on the tab **Assign position**. Under **Lift position**, the current lift height is entered. The option **Work position for = Tower** is preselected.

- Click on **[Assign]**.

6 Assign a shift position

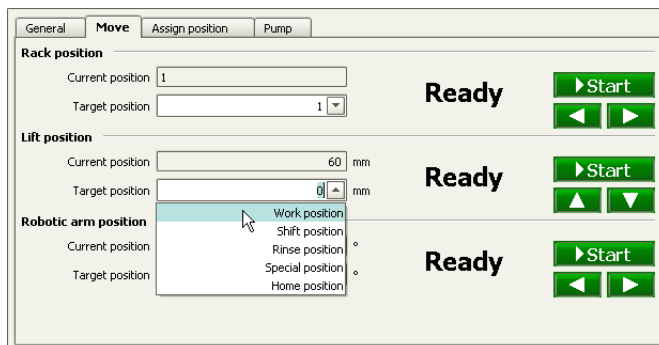
- Click on the tab **Move**.
- With the key **[▲]** move the lift up so far that the rack can freely rotate without damaging the electrode or sample vessels.
- Again, click on the tab **Assign position**.
- Under **Lift position**, select the option **Shift position for = Tower** and click on **[Assign]**.

7 Assign a rinse position

- Define the rinse position in the same way, but with the option **Rinse position for = Tower**.

8 Test the settings

- Click on the tab **Move**.



- Under **Lift position**, select the option **Target position = Work position** and press **[Start]**. The lift now moves to the height that has just been defined.
- Check the shift and rinse position in the same way.

3.1.4 Defining special beakers

Special beakers are particular rack positions which can be used, for example, as rinsing or conditioning beakers. Special beakers are preferably set at high rack positions so that sample series can start from rack position 1. Lift positions must be separately assigned for special beakers.

Proceed as follows:

1 Move to a rack position

- Click on the tab **Move**.
- Under **Rack position**, enter the required position and click on **[Start]**.

The rack position is moved to.

2 Assign a rack position

- Click on the tab **Assign position**.
Under **Rack position**, the current position is entered. The option **Special beaker = 1** for the first special beaker is preselected.

- Click on **[Assign]**.

3 Test the settings

- Click on the tab **Move**.
- Under **Rack position**, click on the key **[▶]**.
The next sample position is moved to.



- Under **Rack position**, select the option **Target position = Special beaker 1** and click on **[Start]**.

The rack position that has just been defined will be moved to.

4 Move to a lift position

- Under **Lift position**, move the life with the keys **[▲]** and **[▼]**.
- Set the lift height to be used as work position, i.e. the electrode is immersed.

5 Assign a work position

- Click on the tab **Assign position**.
Under **Lift position**, the current lift height is entered.

- Under **Lift position**, select the option **Work position for = Special beaker 1** and click on **[Assign]**.

6 Test the settings

- Click on the tab **Move**.
- Under **Lift position**, click on the key **[▲]** or **[▼]**.
The lift is moved.
- Under **Lift position**, select the option **Target position = Work position** and press **[Start]**.

The lift now moves to the height that has just been defined.

7 Close the manual control

- Click on **[Close]**.

3.2 Creating an automation method

The method created in part 1 is now to be extended to an automation method so that a sample series with 3 samples can be automatically processed.



Note

It is assumed that a Sample Processor with *one* tower is used for creating the automation method.

3.2.1 Loading the method

Proceed as follows:




1 Open the program part "Method"

- In the sidebar, click on the symbol **[Method]**.

The method editor is displayed.

2 Open the method

- Click on the symbol  or the menu item **File ► Open...**
- Select the method **Tutorial** and confirm with **[Open]**.

The method is loaded.



Meaning of the individual commands

The following commands are required for a simple automation method:



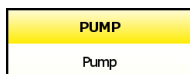
With the command **MOVE** a rack position or an external position (with Swing Head only) is moved to.



With the command **LIFT** the lift is moved to the required height.



With the command **STIR** a stirrer connected to the Sample Processor is switched on or off.

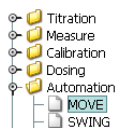


With the command **PUMP** an internal or external pump on the Sample Processor is switched on or off.


3.2.2 Extending the titration method

Moving to the first sample

In front of the titration command **DET pH**, insert a command to move to the first sample. Proceed as follows:



1 Insert the command MOVE

- Select the command **DET pH**.
The command is shown in a black frame.
- Click on the symbol  or the menu item **Insert ▶ New command...**
- Double-click the item **Automation**.
- Select the command **MOVE** and confirm with **[OK]**.

The command is inserted in front of the titration command **DET pH**.



2 Open the properties dialog

- Double-click the command **MOVE**.

The properties dialog of the command is opened:

The screenshot shows a dialog box titled "MOVE - Move". It contains the following fields and options:

- Command name:** Move
- Device:**
 - Device name: not defined
 - Device type: 814 USB Sample Processor
- Target:**
 - Tower: 1
 - Move: Sample position
- Beaker test:**
 - Display message
 - Stop determination
 - Stop determination and series
- Parameters:**
 - Shift rate: 20 %/s
 - Shift direction: auto
 - Swing rate: 55 %/s

Buttons for "OK" and "Cancel" are located at the bottom right of the dialog.

3 Carry out settings

- Under **Device name**, select the Sample Processor connected.
The other parameters are already set correctly and do not need to be modified.
- Confirm the entry with **[OK]**.

3 Carry out settings

- Under **Device name**, select the Sample Processor connected.
The other parameters are already set correctly and do not need to be modified.
- Confirm the entry with **[OK]**.

Switch on the stirrer

After the command **LIFT**, insert a command to switch on the stirrer. Proceed as follows:

1 Insert the command STIR

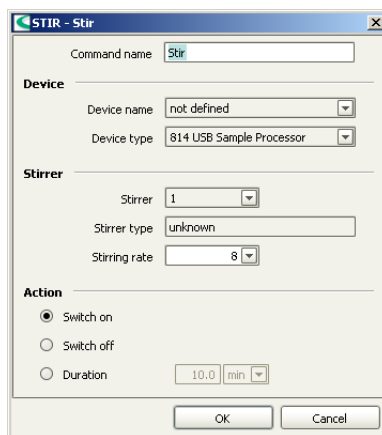
- In the same way, after the command **LIFT**, insert the command **STIR**.



2 Open the properties dialog

- Double-click the command **STIR**.

The properties dialog of the command is opened:





3 Carry out settings

- Under **Device name**, select the Sample Processor connected.
The other parameters are already set correctly and do not need to be modified.
- Confirm the entry with **[OK]**.

4 Edit the titration command



Note

As the stirrer is controlled by the command **STIR**, it must be switched off in the titration command **DET pH**.

- Double-click the command **DET pH**.
- On the **General/Hardware** tab under **Stirrer**, select the option **Stirrer = off**.
- Confirm the entry with **[OK]**.

Switching off the stirrer

After the command **DATABASE**, insert a command to switch off the stirrer after the titration finished. Proceed as follows:

1 Insert the command **STIR**

- After the command **DATABASE**, insert the command **STIR**.



2 Open the properties dialog

- Double-click the command **STIR**.

The properties dialog of the command is opened:

STIR - Stir

Command name: Stir

Device

Device name: not defined

Device type: 814 USB Sample Processor

Stirrer

Stirrer: 1

Stirrer type: unknown

Stirring rate: 8

Action

Switch on

Switch off

Duration: 10.0 min

OK Cancel

3 Carry out settings

- Under **Device name**, select the Sample Processor connected.
- Under **Action**, select the option **Switch off**.
- Confirm the entries with **[OK]**.

Rinsing

In the following steps you will insert the commands in order to rinse the electrode, dosing tip and stirrer in special beaker 1. Proceed as follows:



1 Insert the command MOVE

- After the command **STIR**, insert the command **MOVE**.
- Double-click the command **MOVE**.

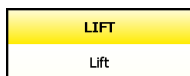
The properties dialog of the command is opened.

2 Carry out settings

- Under **Device name**, select the Sample Processor connected.



- Under **Target**, select the option **Move = Special beaker**. The option **Number = 1** is preselected for the first special beaker.
- Confirm the entries with **[OK]**.



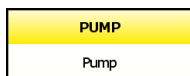
3 Insert the command LIFT

- After the command **MOVE**, insert the command **LIFT**.
- Double-click the command **LIFT**.

The properties dialog of the command is opened.

4 Carry out settings

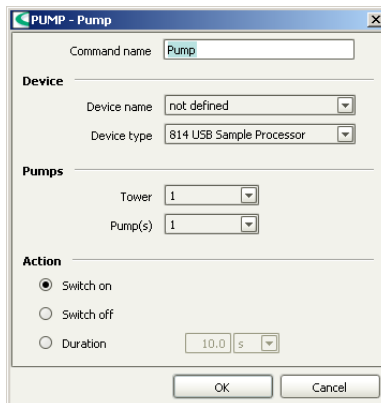
- Under **Device name**, select the Sample Processor connected.
- Under **Target**, select the option **Lift position = Rinse position**.
- Confirm the entries with **[OK]**.



5 Insert the command PUMP

- After the command **LIFT**, insert the command **PUMP**.
- Double-click the command **PUMP**.

The properties dialog of the command is opened:



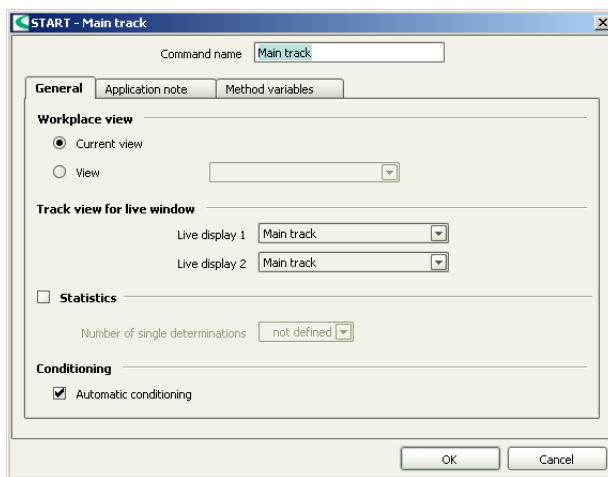
6 Carry out settings

- Under **Device name**, select the Sample Processor connected.
- Under **Pump**, select the option **Pump(s) = 1+2**. With built-in pumps, pump 1 is used for rinsing the titration head and pump 2 is used for aspirating the solution so that the special beaker does not overflow.
- Under **Action**, select the option **Duration = 3 s**.
- Confirm the entries with **[OK]**.

7 Edit method properties

- Double-click the command **START**.

The properties dialog of the command is opened:



8 Switch on statistics

- Switch on the option **Statistics**.
- Enter the number of determinations to be carried out, in this example **3**.
- Confirm the entries with **[OK]**.

3.3 Performing a sample series

3.3.1 Creating a sample table

You will now create a sample table in order to carry out a series of three determinations fully automatically. In a second step you will configure the sample table the way the sample size is directly transferred from the balance to the sample table. Proceed as follows:

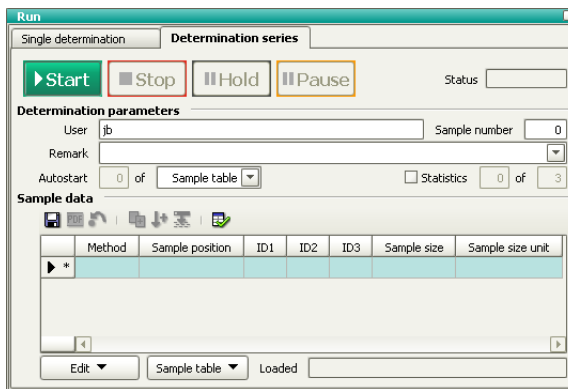


1 Open the program part "Workplace"

- In the sidebar, click on the symbol **[Workplace]**

2 Open the sample table

- In the subwindow **Run**, click on the tab **Determination series**.




3 Open the entry dialog

- Under **Sample data**, double-click the highlighted line.




The entry dialog for the individual samples is opened:

4 Enter the sample data for the first sample

- Under **Method**, select the previously created method **Tutorial Automation**.
- Under **ID1**, enter a sample identification for the first sample, e.g. **Sample 1**.
- Click on the symbol .

The data is entered in the first line of the sample table. A second line is automatically added to the table. The method and the sample identification are copied. The sample position is increased automatically.

5 Enter the sample data for the samples 2 + 3

- Modify the sample identification for the second sample, e.g. **Sample 2**.
- Click on the symbol . The data is entered in the second line of the sample table.
- In the same way, modify the sample identification for the third sample.
- Confirm this last entry with **[Apply]**.

6 Close the entry dialog

- Click on **[Close]**.

In the next step you will configure the sample table the way the sample size is automatically transferred to the sample table.

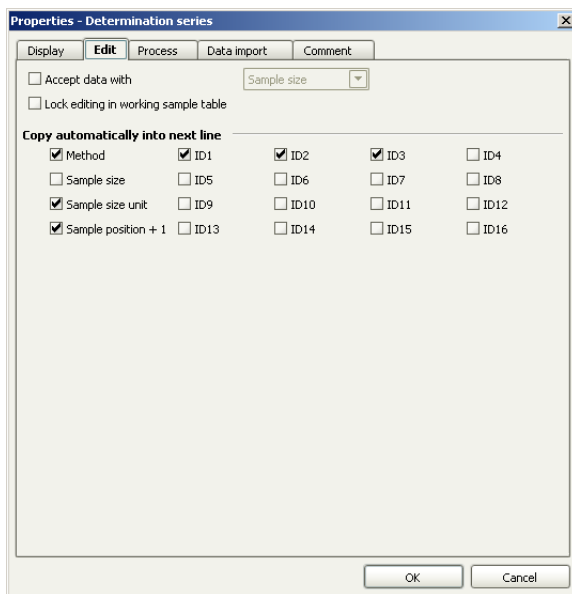
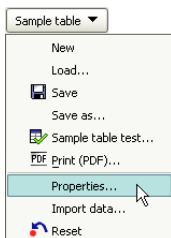
Configuring the sample table

Proceed as follows:

1 Open the properties dialog

- In the subwindow **Run**, click on the menu item **Sample table ► Properties...**

The properties dialog of the determination series is opened:

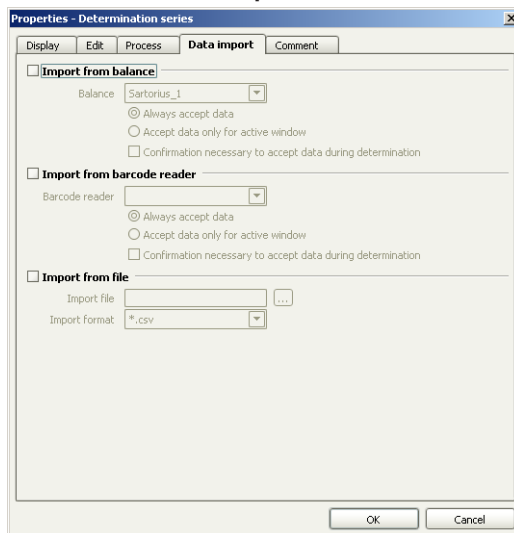


2 Define the data entry

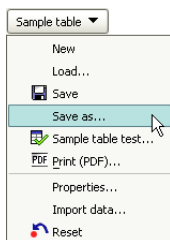
- Click on the tab **Edit**.




- Switch on the option **Accept data with. Sample size** is preselected.
If this parameter is switched on then a switch will be made to the next line as soon as the sample size has been transferred from the balance to the selected sample line.
- Click on the tab **Data import**.



- Switch on the option **Import from balance**.
- Select the balance connected.
- Confirm the entries with **[OK]**.



3 Save the sample table

- In the subwindow **Run**, click on the symbol  or the menu item **Sample table ► Save as....**
- As name, enter **Tutorial** and click on **[Save]**.

The sample table is saved.

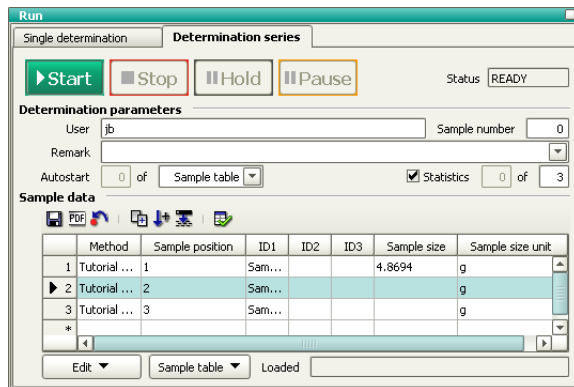
3.3.2 Performing a sample series

Proceed as follows:

1 Prepare the sample

- Select the first line of the sample table.
- Weigh in the sample in a sample vessel.
- Add solvent.
- Press the **[Print]** key on the balance.

The sample size is inserted in the first line. The line for sample 2 is highlighted:



2 Prepare the sample 2 and 3

- In the same way, prepare the second and third sample.

3 Place the samples on the rack

- Place the samples at positions 1 to 3 on the rack.



Note

Under **Determination parameters**, the option **Autostart = Sample table** is selected by default. This means that the whole sample table will be processed. If you wish to only partly process the sample table, then simply enter the corresponding number of samples here.

▶ Start

4 Start the titration

- Click on **[Start]**.

The titration is started.

In the sample table the current sample is highlighted in orange, samples that have already been processed are shown with a gray background:

Run

Single determination | **Determination series**

▶ Start Stop Hold Pause Status: BUSY

Determination parameters

User: jb Sample number: 2

Remark: []

Autostart: 2 of Sample table [v] Statistics 2 of 3

Sample data

	Method	Sample position	ID1	ID2	ID3	Sample size	Sample size unit
1	Tutorial Autom...	1	Sample 1			4.8694	g
2	Tutorial Autom...	2	Sample 2			5.1236	g
3	Tutorial Autom...	3	Sample 3			4.8469	g
▶ *							

Edit [v] Sample table [v] Loaded Tutorial (modified)

Now the titration runs automatically. The following buttons allow manual intervention:



Cancel the entire determination series.



Pause the running determination.



Pause the series after the running determination.

3.3.3 Displaying statistics results


Proceed as follows to display the statistics results of a sample series:



1 Open the program part "Database"

- In the sidebar, click on the symbol **[Database]**.

2 Open the database

- Click on the symbol  or the menu item **File ► Open...**
- Select the standard database **tiamo** and confirm with **[Open]**.



The screenshot shows the tiamo 2.0 software interface. The main window is titled "Determination overview" and contains a table with the following data:

Determination start	Method name	ID1.Value	R501.Name	R501.Value	R501.Unit
1 2008-12-23 16:25:43 UTC+1	Tutorial Automation	Sample 3	Res01	0.21	%
2 2008-12-23 16:23:43 UTC+1	Tutorial Automation	Sample 2	Res01	0.19	%
3 2008-12-23 16:21:35 UTC+1	Tutorial Automation	Sample 1	Res01	0.21	%

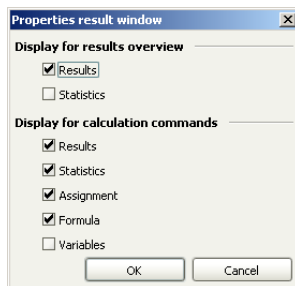
Below the table, there are three sub-windows:

- Curves 1:** A graph titled "DET pH.1" showing a titration curve. The y-axis is labeled "DET pH" and ranges from 2 to 12. The x-axis is labeled "V [mL]" and ranges from 0 to 3. A sharp vertical increase in pH is visible around 2.5 mL, with a point labeled "EP1" marked on the curve.
- Information:** A panel showing details for the selected determination. It includes sections for "Identification" (Determination ID: -1554777:1166, Server name: 127.0.0.1, Client name: jb-2, Sample number: 3, Start counter: 5) and "Recording" (Determination start: 2008-12-23 16:2, Determination duration: 103 s, Determination run: regular with rem, User (short name): jb).
- Results:** A panel titled "Results overview" showing the command "Calculations" and the result "Res01: 0.21 %".

3 Open the properties window

- Right-click the subwindow **Results**.
The context menu is displayed.
- Click on the menu item **Properties Results**.

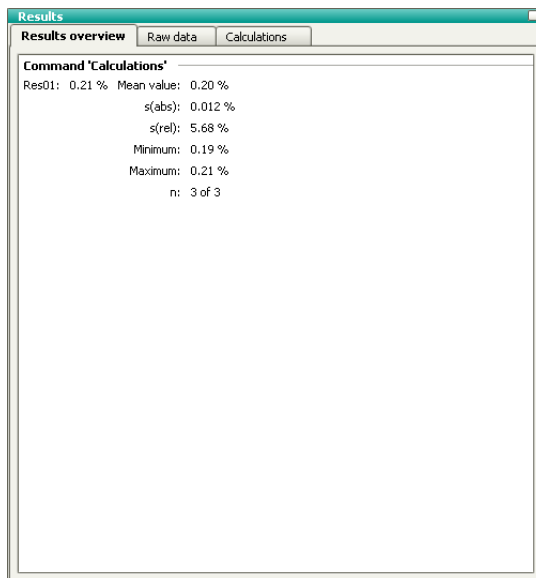
The properties dialog for the result view is displayed.



4 Show the statistics data

- Switch on the option **Statistics**.
- Confirm the entry with **[OK]**.

In the subwindow **Results**, the statistics data for the sample series is displayed:



3.4 Extending the automation method

A samples series is processed in the following three phases:

1. **Start sequence:** Commands that are carried out once at the start of a sample series.
2. **Sample sequence:** Commands that are carried out for each sample.
3. **End sequence:** Commands that are carried out once at the end of a sample series.



In *tiamo*[™], these single sequences can be subdivided into **part sequences**, the so-called **tracks**. Each track contains a START and an END command which cannot be deleted. Any commands can be inserted between them.

In the following steps the automation method that has just been created will be correspondingly modified.



Note

The method will be programmed the way the electrode will be stored in a beaker filled with conditioning solution at the end of the sample series. A second special beaker has to be defined for this purpose (see Chapter 3.1.4, page 48).

Creating a series start track

Create a series start track and insert a command resetting the Sample Processor to normal status at the start of the sample series. Proceed as follows:




1 Open the program part "Method"

- In the sidebar, click on the symbol **[Method]**.

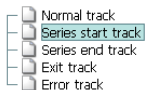
The method editor is shown.

2 Open the method


- Click on the symbol  or the menu item **File ► Open...**
- Select the method **Tutorial Automation** and confirm with **[Open]**.

The method is loaded.






3 Create a series start track

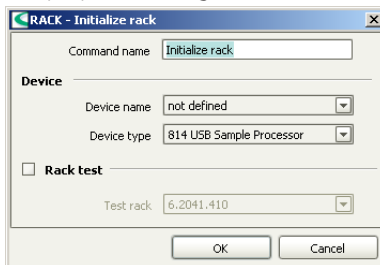
- Click on the symbol  or the menu item **Insert ► New track...**
- Select the item **Series start track** and confirm with **[OK]**.

A new, empty track will be inserted beside the previous track.

4 Initialize the Sample Processor

- Click on the symbol  or the menu item **Insert ► New command...**
- Double-click the item **Automation**.
- Select the command **RACK** and confirm with **[OK]**.
- Double-click the command **RACK**.

The properties dialog of the command is opened:



- Under **Device name**, select the Sample Processor connected.
- Confirm the entry with **[OK]**.

Creating a series end track


Create a series end track and insert commands to store the electrode in special beaker 2 (filled with conditioning solution). Proceed as follows:



Note

Make sure a rack position is defined as special beaker 2.

1 Create a series end track

- Click on the symbol  or the menu item **Insert ▶ New track...**
- Select the item **Series end track** and confirm with **[OK]**.

A new, empty track will be inserted beside the previous track.



2 Move to the special beaker

- Insert the command **MOVE**.
- Double-click the command **MOVE**.
The properties dialog of the command is opened.
- Under **Device name**, select the Sample Processor connected.
- Under **Target**, select the option **Move = Special beaker**.
- Under **Number**, enter **2** for the second special beaker.
- Confirm the entries with **[OK]**.



3 Move to the work position

- After the command **MOVE**, insert the command **LIFT**.
- Double-click the command **LIFT**.
The properties dialog of the command is opened.
- Under **Device name**, select the Sample Processor connected.
The other parameters are already set correctly and do not need to be modified.
- Confirm the entry with **[OK]**.

4 Method check

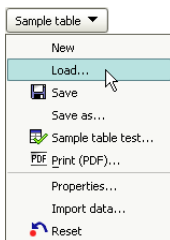
- Check the method modified with a method check.

5 Save the method

- Save the method under the name **Tutorial Automation extended**.

Adapting the sample table

Finally assign this new method to the individual samples of the previously created sample table (see Chapter 3.3.1, page 61). Proceed as follows:



1 Open the program part "Workplace"


- In the sidebar, click on the symbol [Workplace].

2 Load the sample table

- In the subwindow **Run**, click on the menu item **Sample table ► Load...**
- Select the sample table **Tutorial** and confirm with [Load].

The sample table is loaded.

3 Assign the method

- Under **Sample data**, double-click the first line. The entry dialog is opened.
- Under **Method**, select the previously created method **Tutorial Automation extended**.
- Click on the symbol .



- In the same way, modify the method for the second and third sample.
- Confirm this last entry with **[Apply]**.
- Click on **[Close]**.

4 Save the sample table

Save the sample table under the name **Tutorial extended**.

A sample series can now be carried out with the extended automation method and the correspondingly modified sample table (*see Chapter 3.3.2, page 65*).