

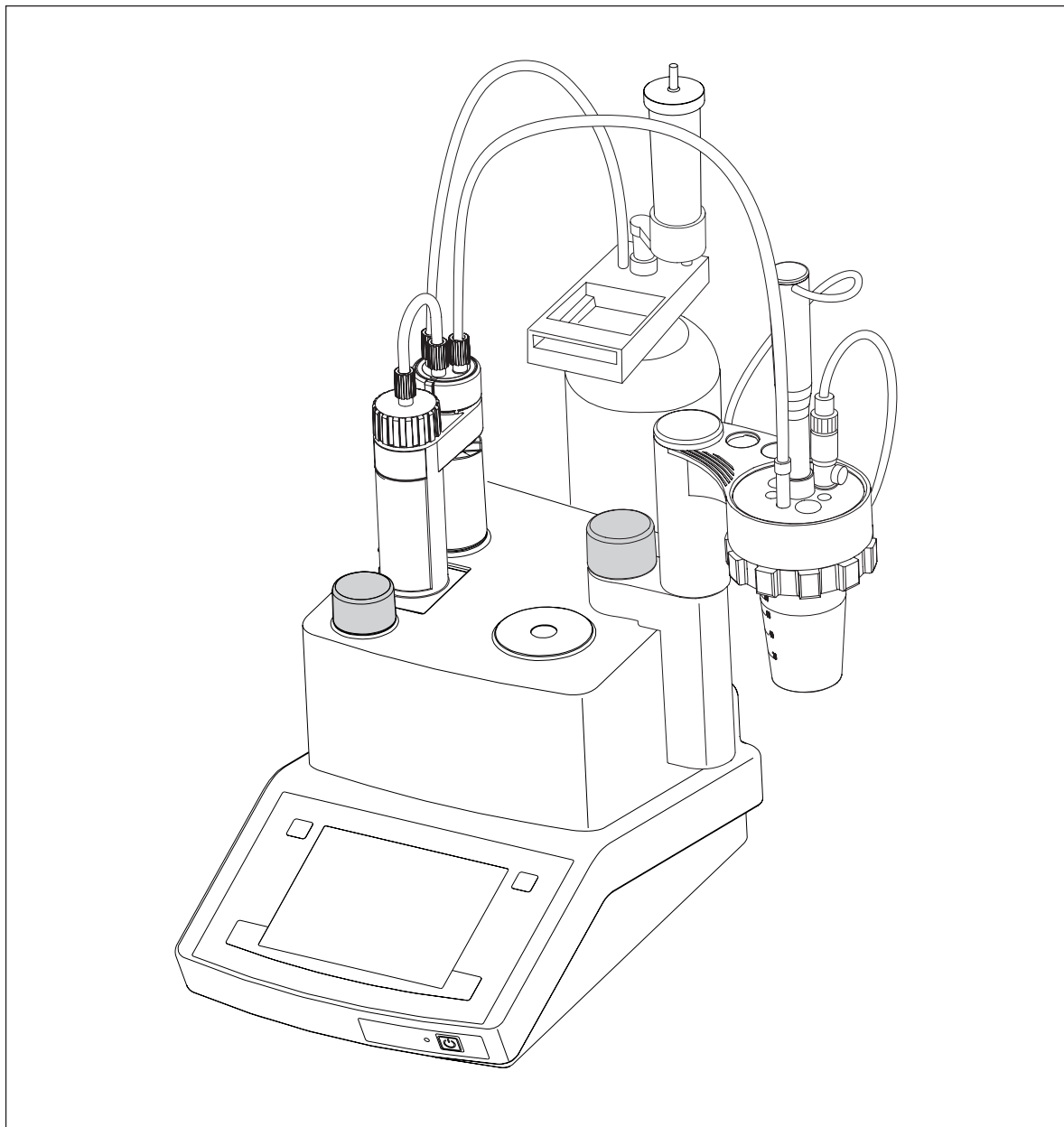


Table of Contents

1	Introduction	7
2	Description of Functions	8
	2.1 Layout of the Terminal	8
	2.2 Operating the Touchscreen	8
	2.3 The Homescreen	8
	2.4 The User Interface	8
	2.4.1 Entering Data in the User Interface	9
	2.4.2 Shortcuts and Direct Shortcuts	9
	2.4.3 The Start Analysis Dialog	10
	2.4.4 The Online Dialog	10
3	Setup	12
	3.1 Chemicals	12
	3.1.1 Titrants	13
	3.1.2 Auxiliary reagents	13
	3.1.3 Calibration standards	14
	3.1.4 Titer standards	15
	3.1.5 Substances	15
	3.2 Hardware	16
	3.2.1 Sensors	16
	3.2.1.1 Value ranges from sensor measuring units and control band	18
	3.2.1.2 Sensor Calibration and Sensor Test	19
	3.2.2 Pumps	21
	3.2.3 Peripherals	21
	3.2.3.1 Balance	21
	3.2.3.2 Barcode reader	22
	3.2.3.3 USB-Stick	22
	3.2.3.4 Printer and USB data export	23
	3.2.3.5 PC settings	24
	3.2.3.6 Network settings	24
	3.2.4 Titration stands	25
	3.2.5 Auxiliary instruments	25
	3.3 User settings	26
	3.3.1 Language	26
	3.3.2 Screen	26
	3.3.3 Beep	27
	3.3.4 Shortcuts	27
	3.3.5 Keyboards	27
	3.4 Global settings	27
	3.4.1 User Management	27
	3.4.2 Analysis and resources behavior	28
	3.5 Values	29
	3.6 Maintenance & Service	29
	3.6.1 MT service	30
	3.6.2 Import/Export	30
	3.6.3 Reset to factory settings	31
	3.6.4 Titrator firmware history	31
	3.6.5 Board firmware	31
	3.6.6 Terminal	31
	3.6.7 Board data	31
	3.6.8 Drives	31
	3.6.9 Burettes	32
	3.6.10 Update	32

4	Manual Operations	33
	4.1	Stirrer 33
	4.2	Pump 33
	4.3	Sensor 34
	4.3.1	Temperature sensor 34
	4.3.2	Potentiometric Sensor 35
	4.3.3	Polarized sensor 36
	4.4	Auxiliary Instrument 36
	4.5	Burette 38
	4.5.1	Rinse burette 38
	4.5.2	Rinse multiple burettes 39
	4.5.3	Dispense 39
	4.5.4	Manual titration 40
5	Methods	42
	5.1	METTLER TOLEDO Methods 42
	5.2	Creating Methods 43
	5.2.1	Method Templates 44
	5.3	Modifying or Deleting Methods 44
	5.4	Starting Methods 45
	5.5	Stopping Methods 45
	5.5.1	Suspending of ongoing analysis by the user 45
	5.5.2	Suspending of ongoing analysis by the titrator 46
	5.6	Method Syntax – Rules for Establishing a Method 46
	5.6.1	Types and Possible Number of Loops 46
	5.6.2	Sample Loops 46
	5.6.3	Inserting and Deleting Loops 47
	5.7	Overview of Method functions 47
	5.8	Method functions 48
	5.8.1	Title 48
	5.8.2	Sample 48
	5.8.3	Sample (titer) 49
	5.8.4	Sample (calibration) 50
	5.8.4.1	pH sensor test 50
	5.8.5	Titration stand 51
	5.8.6	Pump 52
	5.8.7	Stir 52
	5.8.8	Dispense (normal) 52
	5.8.9	Methods with subfunctions 52
	5.8.9.1	Measure (normal) 52
	5.8.9.2	Titration (EQP) 54
	5.8.9.3	Mode 58
	5.8.9.4	Titration (EP) 59
	5.8.9.5	Titration(LearnEQP) 60
	5.8.10	Calculation 61
	5.8.11	Record 62
	5.8.12	End of sample 63
	5.8.13	Titer 63
	5.8.14	Calibration 63
	5.8.15	Blank 64
	5.8.16	Auxiliary value 64

	5.8.17	Auxiliary instrument	65
	5.8.17.1	Control type: 24V output	65
	5.8.17.2	Control type: Stirrer	65
	5.8.17.3	Control type: Out TTL (Single pin)	65
	5.8.17.4	Control type: TTL input (single pin)	66
	5.8.17.5	Control type: RS-232	66
	5.8.18	Drain	66
	5.9	Method functions Within a Loop	67
	5.10	Method functions Outside of a Loop	67
6	Series Templates		68
	6.1	Sample or Standard Parameters	68
7	Analysis Sequences		70
	7.1	Starting an Analysis	70
	7.2	Analysis Sequence Steps	71
	7.2.1	Analysis sequence	71
8	Titration Evaluation Procedure		74
	8.1	Standard Evaluation Procedure	74
	8.2	Minimum / Maximum	75
	8.3	Segmented Evaluation	75
	8.4	Asymmetric	76
9	Analysis Data		78
10	Calculation and Results		79
	10.1	Symbols for calculations	79
	10.2	Calculation formulas	80
	10.3	Results	80
	10.4	Results proposal lists	82
	10.4.1	Results proposal list inside loop	83
	10.4.1.1	Proposal list for "Calculation type=Direct titration"	83
	10.4.1.2	Proposal list for "Calculation type=Automatic back titration"	83
	10.4.1.3	Proposal list for "Calculation type=Manual back titration"	84
	10.4.1.4	Proposal list for "Calculation type=Blank-compensated"	84
	10.4.1.5	Proposal list for "Calculation type=2nd titration function"	85
	10.4.1.6	Proposal list for "Calculation type=Others"	86
	10.4.1.7	Proposal List for the Method type "Titer"	86
	10.4.2	Results proposal list outside loop	86
11	Appendix		87
	11.1	Predefined calibration standards for pH sensors	87
	11.1.1	Temperature related values	87
	11.1.1.1	METTLER TOLEDO	87
	11.1.1.2	DIN / NIST	88
	11.1.1.3	MERCK	88
	11.1.1.4	FLUKA	89
	11.1.1.5	FISHER	90
	11.1.1.6	JIS / JJG	90
	Index		92

1 Introduction

Simple and compact

The devices in METTLER TOLEDO's Titration Compact Line are modern, compact titrators for use in a wide variety of application areas. They can be used, for example, in quality control as well as in research and development and satisfy the most demanding of requirements.

The titrators in the Titration Compact Line perfectly combine simple, easy-to-understand operation with an extremely high level of precision and outstanding reliability. Thanks to automatic titrant recognition (Plug & Play burettes), the titrator independently identifies which titrant is required without intervention from the operator.

Titration Compact devices can either be controlled by touchscreen or by using LabX PC software. The large color touchscreen allows intuitive control by the user and flexibility in its adjustment options. All functions can be activated directly from the home screen via shortcuts which can be freely created, making everyday use extremely easier. The touchscreen control of the titrator and all adjustable parameters are described in detail in the operating instructions.

The separate installation information explains all the necessary steps for installing and commissioning your device. The enclosed "Quick Guide" then guides you through the first titration using a practical example. If you have any additional questions, METTLER TOLEDO is always available to assist you.

2 Description of Functions

2.1 Layout of the Terminal

The control panel of the terminal consists of an integrated touchscreen and the following buttons, located next to the touch-sensitive surface of the display:

- The **Reset button** ends all tasks that are currently running.
- The **Info button** accesses the interactive online help for the content of the current dialog.
- Two **Home buttons** always return you to the homescreen.

You can press these buttons any time, regardless of which dialog you are currently using.



The **Reset button** acts as an "EMERGENCY STOP" switch. If the titrator malfunctions or there is an operating error, you can stop all current tasks by pressing the reset button. Afterward, for each task, you can decide whether to end it completely or continue.

2.2 Operating the Touchscreen

The touchscreen is automatically activated when the instrument is switched on.

To select a button or an input element in the dialog window, you simply touch the screen using a soft blunt object or a fingertip.

It is also possible to select input elements using a USB mouse. To do this, simply connect the mouse to a suitable USB port on the instrument.



Never touch the surface of the touchscreen with pointed or sharp objects! This may damage the screen!

2.3 The Homescreen

The homescreen is the first screen that is displayed when you start up the titrator.

The homescreen contains five buttons that lead to the following dialog windows:

- **Methods:** This button takes you to the method editor, where you can create and manage methods.
- **Series templates:** In this dialog, you can create and manage series of individual samples, e.g. for using a sample changer.
- **Results:** You manage the results of your analyses here.
- **Setup:** The hardware and resources the titrator uses are configured in the Setup. You can also make global and user settings here.
- **Manual:** This button takes you to manual operations. You can operate stirrers, sensors, pumps, etc. here, independently of the analyses.

In addition, there is another area that can be configured individually by each user (with the necessary authorization). Each user can store up to 12 shortcuts here. You can use this shortcut to launch defined methods, series, and manual operations directly from the homescreen.



By tapping the **Home** key in the terminal control panel, you can return to the homescreen from any screen.

2.4 The User Interface

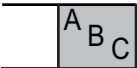
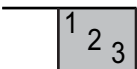
The graphical user interface consists of the following five basic elements:

- The **title bar** at the top of the display specifies the name of the current dialog.
- In the top right-hand corner, the **Tasks** button informs you which processes are currently running.
- The **navigation bar**, located below the title bar, specifies the path to the current dialog.
- The **scroll bar** on the right-hand side of the screen becomes visible if the content of the screen extends beyond the viewable area. If this occurs, use either the arrows or the area in between them to move the viewable area of the screen up or down.
- Five **buttons** are located at the bottom of the screen. The function of these buttons varies and depends on the context of the current dialog.

2.4.1 Entering Data in the User Interface

There are different types of input fields in the user interface. They allow you to enter data or select data from a list. Input fields can also be deactivated and their contents are then displayed as information only and cannot be changed in the corresponding dialog.

The various types of input fields are identified by an icon to the right of the screen:

Text input fields		Any text comprised of letters, numbers and symbols can be entered into these fields.
Number input fields		Numbers, formulas and auxiliary values can be entered into these fields. In some fields an auxiliary value can be selected from the Auxiliary Values list by pressing the "H" button.
Drop-down lists		Selecting these fields opens a drop-down list from which you can select an entry.
List fields		Selecting these fields opens a menu list in a new window.
Menu fields		Selecting these fields opens a new dialog with a number of additional menu options.
Formula fields		A formula must be entered in these fields. You can enter these manually or access a menu list by pressing the "Proposal" soft-key.
Info field		The values in deactivated input fields are displayed as information only and cannot be edited in the corresponding dialog.

In addition to the input fields there are checkboxes that can be checked in order to select certain functionalities. Checkboxes can affect the scope of the corresponding dialog, i.e. input fields can be hidden or visible depending on whether the checkbox is checked.

Sorting Lists

All of the lists displayed in the user interface can be sorted alphabetically or numerically by column in ascending or descending order. To do this, simply touch the parameter in the header row by which you would like to sort the list. A small arrow in the header row indicates the parameter by which the list is sorted and whether it is sorted in ascending or descending order.

2.4.2 Shortcuts and Direct Shortcuts

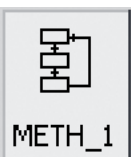
Shortcuts allow you to start methods, series, and manual operations directly from the homescreen. You can place shortcuts on the homescreen by pressing the **"AddToHome"** button. **"AddToHome"** is located in the start dialog of each method, series and manual operation.

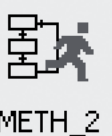
Two types of shortcuts are supported.

Direct shortcuts which, when selected, start the task immediately without warning (only if the other settings allow this), and

normal shortcuts which take you to the corresponding **Start analysis** start dialog from which you can start the task.

Shortcuts are user-specific, i.e. each individual user can create shortcuts for the tasks that they would personally like to conduct. Shortcuts are managed in Setup, under the subcategory "User Settings". Here you can delete or modify shortcuts, or change their position on the Homescreen.

 METH_1	 SERI_1	 MANU_1	Shortcuts for methods, series or manual operations that take you to the corresponding start dialog.
---	---	---	---

 METH_2  SERI_2  MANU_2	Shortcuts for methods, series or manual operations with integrated reference symbols in the icon that start the corresponding task when selected provided the other settings allow for it.
---	--



Tasks started using the shortcuts can begin immediately without warning. Therefore, always make sure that all tubes are connected to suitable vessels prior to using a shortcut.



Once the maximum number of shortcuts (4) has been created in the Homescreeen, the "AddToHome" button is deactivated in the **Start analysis** dialog for methods, series and manual operations.

2.4.3 The Start Analysis Dialog

An analysis - whether it be a single or multiple determination - can be started on the titrator in several different ways:

- By choosing **Start** from the method editor.
- By choosing **Start** from the Homescreeen.
- By using a shortcut (or direct shortcut) from the Homescreeen.
- By choosing **Start** from the screen **Series**.
- By choosing **Calibration** or **Titer** from the screen **Setup** dialog (in order to start a calibration or titer determination).

The screen **Start analysis** is always the first screen to appear once you choose **Start**, **Calibration**, **Sensor test** or **Titer** or the corresponding shortcut.



- When a direct shortcut is activated, the screen **Start analysis** does not appear and the respective method starts immediately, provided that the other settings allow this.
- The parameters for the previously used method or series appear in the screen **Start analysis**, so that the same method can immediately be started again.
- Of course, all of the settings can also be adjusted prior to pressing **Start**. The type and number of settings displayed in the screen **Start analysis** depends on the type of analysis to be started and the resources used.

2.4.4 The Online Dialog

The Online dialog is displayed when an analysis or manual operation is being performed. The method ID of the current method or the type of manual operation is displayed in the title bar.

The navigation path is displayed in the navigation bar while a manual operation is being performed. The remainder of the online dialog is divided into a graphical area (left) and a data area (right). During a titration or measurement, the graphical area displays the measurement curve. During a titration or measurement, the graphical area displays the measurement curve.

The Online dialog for a titration contains the following buttons:

Results

The **Results** button is used to display the results and statistics for the analyzed samples after the analysis.

Axes

You can select the units for the horizontal and vertical axes from a list.

Measured values

As an alternative to the online dialog, you can use the **Measured values** button to display a table of measured values during the analysis.

Samples

Choose **Samples** to change sample and series data.

Suspend

You can choose **Suspend** to cancel the current analysis. This displays the **Suspending options** dialog. You can save the series data or skip the sample. In this dialog, you also have the option to continue the analysis or to end it completely.



Depending on the type of method function being performed, the online dialog displays various data such as measured values, remaining run times, volume dispensed, stirrer speed, duration of the analysis, or temperature.

3 Setup

This section tells you how to set up the titrator in accordance with your requirements so that you can carry out titration.

Chemicals	Titants
	Auxiliary reagents
	Calibration standards
	Concentration and titer standards
	Substances
Hardware	Sensors
	Pumps
	Peripherals
	Titration Stands
	Auxiliary Instruments
User settings	Language
	Screen
	Beep
	Shortcuts
	Keyboard
Global settings	System
	User management
	Analysis and resources behavior
Values	Blank
	Auxiliary values
Mainten. & Service	MT-Service
	Import / Export
	Reset to factory settings
	Titration firmware history
	Board firmware
	Terminal
	Board data
	Drives
	Burettes
	Update

3.1 Chemicals

Navigation: **Home > Setup > Chemicals**

In Chemicals, configure and manage the titrant, auxiliary reagents, titer standard, and other substances. You can view and print out lists of chemicals that have already been defined. You can also specify new chemicals or delete created chemicals. Auxiliary reagents must be assigned to a pump with which they can be added.

Settings	Explanation
Titants	Titants are managed together with burettes and burette drive.
Auxiliary reagent	Auxiliary reagents are liquid chemicals that can be used to aid the titration process.
Calibration standards	Calibration standards are used for the calibration of sensors.
Titer standards	The titer standards required to determine the titer for the titrant used can be stored and managed.
Substances	Any chemical substances that are required for performing your analyses can be managed using name, empirical formula, molecular weight, and equivalent number.

3.1.1 Titrants

Navigation: **Home** > **Setup** > **Chemicals** > **Titration**

Titration is managed together with burettes and burette drive (PnP with chip and traditional burettes without chips).

For classical burettes, the relevant titration data is entered manually. For PnP (Plug&Play) burettes, the data is automatically read from the chip and automatically transferred to the instrument. If the chip is still blank, the data must be entered in **Setup** or assigned to a titration. The data is saved in both the titration and in the chip.

Adding a titration

– In **Titration** choose **[New]**.

⇒ The windows to edit the parameters opens.

Define the following parameters for each titration here:

Parameters	Description	Values
Type	The type of titration. You can select from the following types of titration. General titration: for general titration (GT). Auxiliary reagent: if you are adding reagents manually using a burette.	General titration Auxiliary reagent
Name	Specify a descriptive name of your choice.	Arbitrary
Concentration	The concentration of the titration, in [mol/L]. For Type = General titration . The non-dimensional concentration of an auxiliary reagent. For Type = Auxiliary reagent .	0.00001...100 0.00001...10 ⁴
Titer	The titer for the titration. For Type = General titration .	0.00001...10
Lot/Batch	The lot or batch of the reagent. Enter any designation.	Arbitrary
Fill rate	The filling rate of the burette in percent. 100% stands for maximum filling rate.	30...100
Burette volume	Select the burette volume in [mL].	1 5 10 20
Drive	Defines the drive on which you will use the burette containing the titration.	1 2
Serial number	The serial number of the relevant device type.	Arbitrary



- Titrations (independently of the type) must each be assigned to a drive.
- A maximum of 100 titrations can be defined in the instrument.
- In PnP burettes, the serial number is entered automatically. This can, however, be changed.

3.1.2 Auxiliary reagents

Navigation: **Home** > **Setup** > **Chemicals** > **Auxiliary reagents**

Auxiliary reagents are liquid chemicals that can be used to aid the titration process. Auxiliary reagents must be added using a pump and can be used via the method functions **Pumps** and **Rinse**.

Adding an auxiliary reagent

– In **Auxiliary reagents** choose **[New]**.

⇒ The windows to edit the parameters opens.

Define the following parameters for each auxiliary reagent here:

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Pump	Use this setting to select a pump.	List of available pumps



- Auxiliary reagents must be assigned to a pump with which they can be added.
- A maximum of 50 auxiliary reagents can be defined in the instrument.

3.1.3 Calibration standards

Navigation: **Home > Setup > Chemicals > Calibration standards**

Calibration standards are used for the calibration of sensors. The instrument contains various calibration standard lists for the calibration of pH sensors (pH buffer lists), ISE sensors (ISE standard lists) and conductivity sensors (conductivity standard lists) (see Appendix). In this dialog, you can view and print the predefined lists stored in the titrator, and create additional user-defined calibration standard lists for pH buffers and ISE and conductivity standards.

Adding a user-defined calibration standard lists

- 1 In **Calibration standards**, choose [**New**].
⇒ The windows to edit the parameters opens.
- 2 Edit the parameters and save the settings.
⇒ After you have created a calibration standard list, you can add various buffers and standards to this list, depending on the type selected.

Parameters	Description	Values
Type	Select the corresponding type for the new calibration standard list.	pH pH Auto pH ISE Conductivity
Name	Specify a descriptive name of your choice.	Arbitrary
Unit	The unit of measure to be used will depend on the type selected.	pH pM pX ppm mS/cm µS/cm
Base list	Add the calibration standard lists of various pH buffers by selecting them from the list. Only for Type = Auto pH .	List of available calibration standards
Ref. temperature	Define the reference temperature of the buffer.	-20...200



- To delete a self-defined calibration standard list from the titrator, you must first access the parameters in the list via [**Info**]. From this dialog, you can delete the calibration standard list from the titrator memory by selecting [**Delete**].
- A maximum of 20 user-defined calibration standard lists and 10 auto pH buffer lists can be defined in the titrator.

Adding a pH Calibration Standard (pH Buffer)

- After creating a calibration standard list of the type **pH**, add various pH buffers to it.
- 1 Add various pH buffers by choosing [**New**].
 - 2 Enter the respective pH value of the buffer, based on the reference temperature from the calibration standard list and tap [**OK**].
⇒ To reflect the temperature influence of a pH buffer, enter a maximum of 20 value pairs for each individual buffer composed of the temperature and corresponding pH value.
 - 3 Choose a buffer and add various values by choosing [**New**].
 - 4 Enter the respective pH value of the buffer, based on the reference temperature from the calibration standard list.
 - 5 Save the list by tapping [**Save**].

Adding a pH Calibration Standard (pH buffer) of type Auto pH

- For a calibration standard list of the type **Auto pH**, the various pH buffers are detected by the titrator automatically. In order to ensure positive identification, the pH values of the individual solutions must differ from each other by at least two units.
- 1 Add various pH buffers to the calibration standard list by choosing [**Add**] and selecting them from the specified list.
 - 2 Save the list by tapping [**Save**].
- ⇒ By doing so, the titrator offers only suitable pH buffers in order to ensure that the selected pH buffers always differ from each other by at least two pH points.

Note

- The temperature dependency of the individual pH buffers is also taken from the base list and cannot be edited, only viewed.

Adding an ISE Calibration Standard (ISE Standard)

- After creating a calibration standard list of the type **ISE**, you can add various ISE standards to it.
 - 1 Add various ISE standards to it by choosing **[New]**.
 - 2 Enter the corresponding value for the standard in the desired unit of measure, based on the reference temperature from the calibration standard list and tap **[OK]**.
 - ⇒ To reflect the temperature influence of an ISE standard, enter a maximum of 20 value pairs for each individual standard composed of the temperature and corresponding standard value.
 - 3 Choose a buffer and add various values by choosing **[New]**.
 - 4 Save the list by tapping **[Save]**.

Adding a Conductivity Calibration Standard (Conductivity Standard)

- After creating a calibration standard list of the type **Conductivity**, add various conductivity standards to it.
 - 1 Add various conductivity standards to it by choosing **[New]**.
 - 2 Enter the conductivity for each standard based on the reference temperature from the calibration standard list and tap **[OK]**.
 - ⇒ To reflect the temperature influence of a conductivity standard, enter a maximum of 20 value pairs for each individual standard composed of the temperature and corresponding conductivity value.
 - 3 Choose a buffer and add various values by choosing **[New]**.
 - 4 Save the list by tapping **[Save]**.

3.1.4 Titer standards

Navigation: Setup > Chemicals > Titer standards

The titer standards required to determine the titer for the titrant used can be stored and managed in the titrator. To define a new standard, proceed as follows:

- Choose the **New** button in the **Titer standards** window. This opens the **Titer standard parameter** dialog.
 - Using the **Type** drop-down list, define whether you want to create a solid or liquid titer standard.

You can define the following parameters for the corresponding standards:

Parameters	Description	Values
Type	Defines whether it is a liquid or solid titer standard.	solid liquid
Name	Specify a descriptive name of your choice.	Arbitrary
Purity	The purity of a solid standard, in percent. Only for Type = solid .	0.001...100.000
Concentration	The concentration of a liquid standard, in [mol/L]. Only for Type = liquid .	0.00001...100
M	The molar mass of a solid standard, in [g/mol].	10 ⁻⁵ ...10 ³
Equivalent number	The equivalent number "z" of the standard	1...9
Density	The density of a liquid standard, in [g/ml]. (Type = liquid)	10 ⁻⁴ ...100
Lot/Batch	The lot or batch of the reagent. Enter any designation.	Arbitrary



- All fields except for "Lot/Batch" must be filled before the standard can be saved.
- A maximum of 50 titer standards can be defined in the instrument.

3.1.5 Substances

Navigation: Home > Setup > Chemicals > Substances

Any chemical substances that are required for performing your analyses can be managed using name, empirical formula, molecular weight, and equivalent number.

Adding a substance

– In **Substances** choose **[New]**.

⇒ The windows to edit the parameters opens.

Define the following parameters:

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Empirical formula	Defines the empirical formula of the substance.	Arbitrary
Molecular weight	Defines the molecular weight of the substance.	0.0001...10 ⁴
Equivalent number	The equivalent number "z" of the standard	1...9



- A maximum of 100 substances can be defined.

3.2 Hardware

In **Hardware**, configure all the hardware components connected to the titrator.

Navigation: **Home > Setup > Hardware**

Settings	Description
Sensors	Configure and manage sensors to be used with the titrator.
Pumps	Configure a maximum of 20 pumps for use with the titrator.
Peripherals	Peripherals encompasses all input and output devices that belong to the titrator environment.
Titration Stands	Configure the titration stands connected to the titrator.
Auxiliary Instruments	Auxiliary instruments can be any instruments that access a titrator's TTL or 24 V output, stirrer or RS-232 connection and that are to be used in a method.

3.2.1 Sensors

Navigation: **Home > Setup > Hardware > Sensors**

You can configure and manage sensors to be used with the titrator as well as change settings already stored in the titrator. The settings for an individual sensor can also be output to a printer. In addition, the corresponding method for sensor calibration can be accessed from here.



- A maximum of 50 sensors can be defined in the device.
- Each sensor is associated with a specific type. Each sensor type can deliver measured values in one or more units of measure. The following table provides information regarding which units of measure can be selected for a corresponding sensor type:

Sensor type	Default unit of measure	Eligible units of measure
mV	mV	mV
pH	pH	pH mV
ISE	pM	pM / pX ppm mV
Phototrode	%T	%T A mV
Polarized	mV	mV μ A
Temperature	°C	°C K °F

¹⁾Plug and Play sensors (PnP) are available for pH or mV measurements.

- Changing the unit of measurement for a sensor may render the calibration parameters and expiration date parameters meaningless and result in their subsequent omission. This may also mean that the calibration parameters are recalculated by the titrator (for temperature sensors), or that another set of calibration parameters is displayed (for ISE sensors).

Adding a sensor

– In **Sensors** choose [New].

⇒ The windows to edit the parameters opens.

Plug and Play sensors (PnP)

- If a PnP sensor is connected to the sensor input, this automatically generates an entry in the setup. All information (sensor name, type or inputs) is updated by the titrator (if a PnP sensor is not connected, the entry "PnP" appears for the sensor input).
- The setup may contain several PnP sensors with identical sensor IDs but with different sensor input information. When the analysis starts, a validation is carried out during which the user is prompted to remove a sensor. For several PnP sensors with the same ID, all entries apart from one are deleted when the sensors are removed.

The following settings are available for configuring a sensor depending on the sensor type selected:

Sensor type: mV

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV
Serial number	The serial number of the relevant device type.	Arbitrary

Sensor type: pH

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	pH
Serial number	The serial number of the relevant device type.	Arbitrary
Calibration	Determines the calibration type. Does not appear for Unit = pH .	Linear Segmented
Zero point	The pH value where the sensor reads 0.0 mV.	-100...100
Slope (TCalib)	The slope of the sensor at the calibration temperature in [mV/pH].	-100...100
Internal temperature sensor	Select this option if the sensor has an internal temperature sensor. In this case the system will automatically make an entry in the sensor setup for the internal temperature sensor.	Yes No
Calib. temperature	Here you can enter the calibration temperature during the calibration.	-20...200



- The parameters zero point, slope and the corresponding calibration temperature are required to convert the mV signal of the sensor to the selected unit. These appear only for the unit [pH].

Sensor type: Phototrode

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV %T A
Serial number	The serial number of the relevant device type.	Arbitrary
Wavelength	The Phototrode DP5 features a selection of 5 fixed wavelengths in [nm].	520 555 590 620 660
Zero point	The percentage of transmittance where the sensor reads 0.0 mV.	-100 ... 100
Slope	The slope of the phototrode in [mV/%T].	-100...100
Calib. temperature	Here you can enter the calibration temperature during the calibration.	-20...200



- The parameter **Calib. temperature** cannot be edited for segmented calibration; in this case, the system displays an information field.

Sensor type: Polarized

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV μ A
Sensor input	The input to which you want to connect the sensor.	AB1/Sensor2 More depending on configuration
Serial number	The serial number of the relevant device type.	Arbitrary

Sensor type: Temperature

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	°C K °F
Sensor input	The input to which you want to connect the sensor.	AB1/PT1000 More depending on configuration
Serial number	The serial number of the relevant device type.	Arbitrary
Zero point	The adjusted point from the theoretical value for reading 0.0 °C.	-20 ... 200 [°C] -4.0 ... 392 [°F] 253.2 ... 473.2 [K]

Sensor type: ISE

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	pM pX ppm
Sensor input	The input to which you want to connect the sensor.	AB1/Sensor1 AB1/Sensor2 More depending on configuration
Sensor input	The input to which you want to connect the sensor.	AB1/Sensor1 AB1/Sensor2 AB1/PT1000 CB1/Conductivity More depending on configuration
Serial number	The serial number of the relevant device type.	Arbitrary
Calibration	Determines the calibration type. Does not appear for Unit = pH .	Linear Segmented
Zero point	The pX value where the sensor reads 0.0 mV.	-100...100
Slope (TCalib)	The slope of the sensor at the calibration temperature in [mV/pX].	-100...100



- For ISE sensors there are two independent calibration sets, one for the units "pM" or "pX" and one for the unit "ppm".
- When calibrating an ISE sensor in ppm units, the sensor's slope and zero point are specified in pX or pM units.

3.2.1.1 Value ranges from sensor measuring units and control band

Sensor type	Measuring unit	Value range	Value range EP relative	Value range Control band
mV sensor	mV	$-2 \cdot 10^3 \dots 2 \cdot 10^3$	$-4 \cdot 10^3 \dots 4 \cdot 10^3$	$0.1 \dots 4 \cdot 10^3$
pH	pH	-100...100	-100.00...100.00	0.01...100
	mV	$-2 \cdot 10^3 \dots 2 \cdot 10^3$	$-4 \cdot 10^3 \dots 4 \cdot 10^3$	$0.1 \dots 4 \cdot 10^3$

Sensor type	Measuring unit	Value range	Value range EP relative	Value range Control band
ISE	pM I pX	-100...100	-100.00...100.00	0.01...100
	ppm	0...10 ⁶	-10 ⁷ ...10 ⁷	0.001...10 ⁷
	mV	-2*10 ³ ...2*10 ³	-4*10 ³ ...4*10 ³	0.1...4*10 ³
Phototrode	%T	0.001...100	-1*10 ³ ...1*10 ³	0.1...1*10 ³
	A	0...5	-10 ⁶ ...10 ⁶	0.01...10 ⁶
	mV	-2*10 ³ ...2*10 ³	-4*10 ³ ...4*10 ³	0.1...4*10 ³
Polarized sensor	mV	0...2*10 ³	-2*10 ³ ...2*10 ³	0.1...2*10 ³
	μA	0...220	-220.0...220.0	0.1...220
Temperature	°C	-20...200	-220.0...220.0	0.1...220.0
	K	253.2...473.2	-220.0...220.0	0.1...220.0
	°F	-4...392	-396.0...396.0	0.1...396.0

3.2.1.2 Sensor Calibration and Sensor Test

Navigation: Setup > Hardware > Sensors

You can calibrate pH, ISE and temperature sensors or you can test your pH sensors.

Sensor calibration

pH, ISE, temperature and conductivity sensors can all be calibrated with the titrator. The phototrod can only be manually calibrated. To do this the relationship between sensor signal and transmission capacity must be determined and the calibration parameter to be determined (normally only the gradient from a single point calibration) must be entered "manually" in the selected phototrod.

If you want to calibrate a sensor with the titrator, you can either directly start an appropriate calibration method or specifically for pH sensors use [**Calibration/ Sensor test**] in the sensor setup.

Temperature sensors are calibrated with the temperature standard "freezing water" (0°C). For conductivity sensors, you can choose the desired standard for the calibration from a standards list. Here a single point calibration is performed to determine the cell constant.

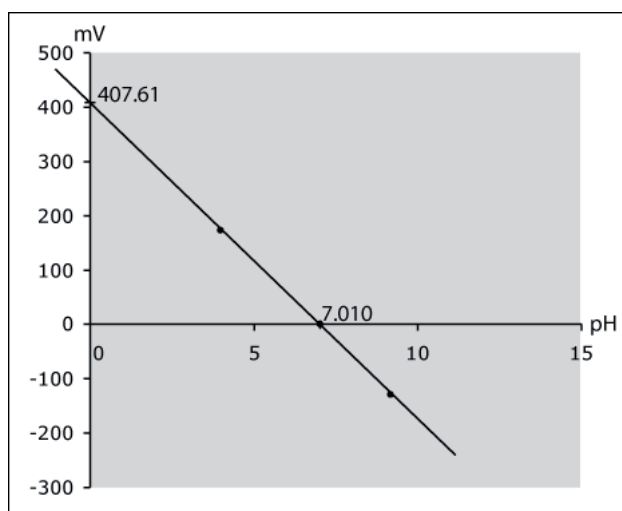
Two calibration modes are available for the calibrating pH and ISE sensors that can be selected under the "Probe (calibrate)" method function:

- linear calibration and segmented calibration (using the parameter "Calibration").

Both modes are briefly explained below.

Linear calibration

Linear calibration is explained below taking the example of pH sensor.



In linear calibration the 1st step is the capture of measurement data and the interpolation of the pH values with the buffer table to the effective values (the values used are only provided as an example):

	Selected buffer solutions	During the calibration of the recorded temperature	mV values measured during calibration	pH (effective) by interpolation according to the pH buffer table
1st Buffer	4.01 (at 25°C)	17 °C	172 mV	4.00
2nd Buffer	7.00 (at 25°C)	22 °C	0 mV	7.012
3rd Buffer	9.21 (at 25°C)	27 °C	-129 mV	9.19

In a second step, the mV measured values are converted to the averaged temperature " T_{Average} " ($17^{\circ}\text{C} + 22^{\circ}\text{C} + 27^{\circ}\text{C} / 3 = 22^{\circ}\text{C}$):

	Selected buffer solutions	mV values measured during calibration	Temperature-corrected measured values for $T_{\text{Mean}} = 22^{\circ}\text{C}$
1st Buffer	4.01 (at 25°C)	172 mV	174.96 mV
2nd Buffer	7.00 (at 25°C)	0 mV	0 mV
3rd Buffer	9.21 (at 25°C)	-129 mV	-126.85 mV

In the third stage, the gradient (T_{Mean}) and the mV value at pH 0 are determined by linear regression with the value pairs from mV (T_{Mean}) and pH (effective). The zero value is found from the mV value at pH 0, divided by the gradient (T_{Mean}):

- Slope (T_{Mean}) = -58.15
- mV value at pH 0 = 407.61 mV
- Zero point [pH] = mV value at 0 pH / Slope (T_{Mean}) = 7.010 [pH]

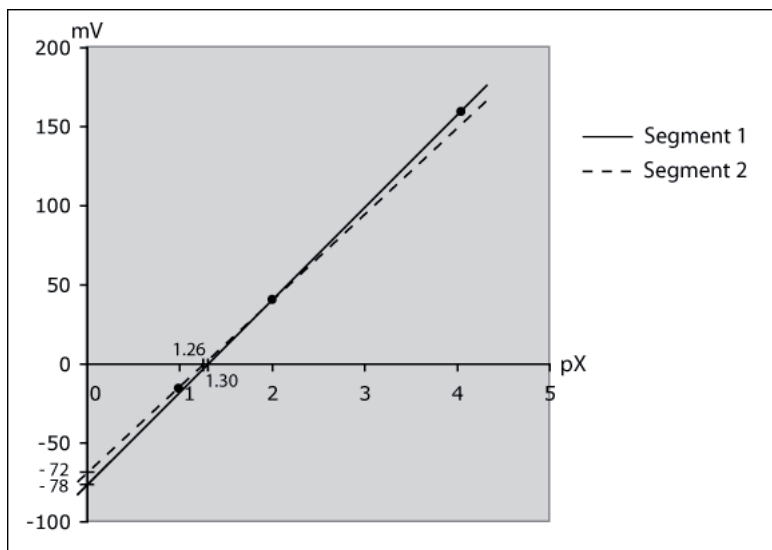
Lastly, the slope at (T_{Mean}) is back-calculated to the slope at (25°C).

- Slope (25°C) = -58.74 (=99.3% of the theoretical value)

Segmented calibration

With segmented calibration, no linear regression is performed across all measured points; instead, line segments that connect the individual calibration points are used. In this way allowance can be made for a non-linear performance of the sensor over a larger measurement range. For n standard solutions, $(n-1)$ segments are evaluated.

The segmented calibration is explained below taking the example of an ISE sensor (F-).



Just as in the case of linear segmentation initially the readings are recorded:

	During the calibration of the recorded temperature	Standard value (pX) at measuring temperature	mV values measured during calibration
Standard 1	25 °C	4.00 (at 25°C)	162.0 mV
Standard 2	25 °C	2.00 (at 25°C)	42.0 mV
Standard 3	25 °C	9.21 (at 25°C)	-15.0 mV

The mV measured values are then converted to the averaged temperature (not necessary in the example because the temperature is constantly 25°C) and a linear regression is conducted for each segment. Thus for each segment a gradient and the mV value at pH 0 are determined (both related to the mean temperature) and from both values the zero point is respectively calculated:

	During the calibration of the recorded temperature	mV value at 0 pH (based on T _{Mean})	Slope (T _{Mean})	Zero point [pX]
Segment 1	25 °C	-78.00 mV	60.00	1.30
Segment 2	25 °C	-72.00 mV	57.00	1.26

Afterward, the slope is converted to the reference temperature of 25°C (not necessary in this example, because (T_{Mean}) is already 25°C.

3.2.2 Pumps

Navigation: **Home > Setup > Hardware > Pumps**

You can configure a maximum of 20 pumps for use with the titrator. Starting from the pump list, you can add new pumps or select existing ones and change their settings. The list can also be printed and pumps can be deleted.

You can set up different pumps. For each pump, you can specify an explicit user-defined name and the pumping rate.

Editing pumps

- In **Pumps** choose [**New**] to add a new pump.
 - or –
 - Tap the entry of an existing pump to edit the corresponding parameters.
- ⇒ The windows to edit the parameters opens.

Parameters	Description	Values
Type	Defines the type of pump.	Membrane Peristaltic Solvent Manager
Name	Specify a descriptive name of your choice.	Arbitrary
Max. pump rate	Displays the pump rate in [mL/min] when the pump is operated at 100%. This is stated by the manufacturer or determined experimentally.	0.1...1000
Pump output	Information on the used pump output.	PUMP

3.2.3 Peripherals

Navigation: **Home > Setup > Hardware > Peripherals**

These settings encompass all input and output devices that belong to the titrator environment but that are not essential instruments for processing an analysis (peripherals cannot be accessed in methods). The computer also counts as a peripheral device. The list of all peripheral instruments defined in the titrator, together with the parameters of each individual instrument can be printed out by a printer.

3.2.3.1 Balance

Navigation: **Home > Setup > Hardware > Peripherals > Balance**

Before defining a balance, you need to select the balance type. The titrator supports the following types of balance:

Balance type	Supported balances
Mettler	AB PB PB-S AB-S PB-E AB-E College-S SB CB GB College-B HB AG PG PG-S SG HG XP XS XA XPE XSE XVE AX MX UMX PR SR HR AT MT UMT PM AM SM CM MS ML
Sartorius	Sartorius
More	--

METTLER TOLEDO Balances

These balances support Plug'n'Play and are automatically recognized and configured by the titrator.

For automatic balance recognition, you need to ensure the following:

1. The balance has been started up and is connected to the titrator by a suitable cable,
 2. The balance has been set to "Bidirectional" (if necessary, set the "Host" parameter accordingly),
 3. The parameters for the RS-232 interface on the balance correspond with those on the titrator.
- i** • As long as the balance is not connected to the titrator, the settings "Baud Rate", "Data Bit", "Stop Bit", "Parity" and "Handshake" can be entered manually. These are however automatically overwritten with the values identified by the PnP as soon as the user sets the same transmission parameters at the balance and the titrator.

Sartorius | Others

After you have selected this option and the system has recognized the balance, you can define the following parameters:

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Serial number	The serial number of the relevant device type.	Arbitrary
Connection	The serial port to which the device is connected. Possible connections are located on the mainboard, the analog board and the conductivity board.	MB/COM1 MB/COM2 AB1/COM1 More depending on configuration
Baud rate	The baud rate for data transmission via the RS-232 interface.	1200 2400 4800 9600 19200
Data bit	Defines the number of data bits.	7 8
Stop bit	Defines the number of stop bits. (2 stop bits can only be selected if 7 data bits are also selected at the same time.)	1 2
Parity	Defines the parity protocol.	Even Odd None
Handshake	Data transmission via the RS-232 interface. (Only the handshake option "Xon-Xoff" is available for serial connections on the analog and conductivity board in conjunction with a baud rate of 9600.)	None Xon-Xoff

- i** • The settings for the baud rate, data bit, stop bit, parity, and handshake must agree for the balance and titrator!
- If **None** is selected as balance type that means that no balance is to be connected to the titrator.

3.2.3.2 Barcode reader

Navigation: **Home > Setup > Hardware > Peripherals > Barcode reader**

When a barcode is imported, the system checks whether the imported barcode is suitable for starting the method. If so, the analysis start dialog is opened; all known data is entered there. If not, the barcode is ignored. If an analysis is already running with the same method ID, the sample is added to the end of the current analysis. An exception to this occurs if the **End series** barcode has previously been read. In this case, a new analysis is started (with the same method).

- i** • Only one barcode reader can be defined.

Define the following parameters for a barcode reader:

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary
Serial number	The serial number of the relevant device type.	Arbitrary
Transfer Smart-Codes to LabX	Transfer barcode to LabX.	Yes No

3.2.3.3 USB-Stick

Navigation: **Home > Setup > Hardware > Peripherals > USB-Stick**

Commercially available USB sticks from USB Version 1.1 are supported.

You can assign a relevant name to the USB stick.

3.2.3.4 Printer and USB data export

Navigation: **Home > Setup > Hardware > Peripherals > Printer**

The titrator supports the following types of printers and data export via the USB interface:

- USB printer with PCL record for Version 4 and higher.
- USB compact printer (stripe printer).
- USB data export.

i

- For data export, to an RS interface, you will need the USB RS232 adapter, the so-called **USB data export box**.
- Data export is not supported by the models "x20"

The USB compact printer prints out the following data:

Results	All except for curves and tables of measured values
Method function Record	Overview Results Raw results Resource data Sample data Method data
Setup	List printouts Parameter printouts
Methods	List printout Parameter printouts
Series	List printout Parameter printouts

i

- The compact printer does not generate the automatic printouts generated by the method functions **Instruction** and **Calculation** during the analysis. It also does not support all languages.
- For Karl Fischer determinations, manual concentration, drift and blank value analyses are printed out automatically.

Define the following parameters:

Parameters	Description	Values
Printer type	Selection of a printer, The USB compact printer does not support all languages. This printer can only print out a limited quantity of analysis data and results. For USB data export, the data is transmitted regardless of the selected language. Only a limited quantity of data and results are exported.	USB printer USB compact printer USB data export

Information on the USB data export

- In the method function **Record**, the parameter **Summary** must be activated (**Record** = outside loop) or **Per sample** or **Per series** (**Record** = inside loop). The other settings in **Record** have no effect.
 - If the method function **Record** is inserted outside the loop, the data from the preceding loop and the data between the **End of sample** and method functions **Record** are output.
- For a KF method in the method function **Record** (within the loop), the parameter **Summary** should be selected with the value **Per sample** or **Per series**.

If data export is activated, the following data is transmitted:

- The most important sample data and results, either per sample or per series, according to the parameter setting in **Summary** of the method function **Record**.
- Automatic reports for drift, blank value and concentration determination in a Karl Fischer water content determination if the global setting **Print autom. KF protocols** is also activated

Navigation: **Home > Setup > Global settings > Analysis and resources behavior > Analysis sequence settings**

Depending on the selected **printer** type, the following parameters appear in the printer dialog box:

- **USB printer and USB compact printer**

Parameters	Description	Values
Status	Indicates whether the selected printer type is installed.	Installed
Name	Specify a descriptive name of your choice.	Arbitrary
Serial number	The serial number of the relevant device type.	Arbitrary
Connection	Information on the USB port to which the printer is connected. PnP is displayed if the printer is not connected to the titrator.	MB1/USB1 PnP

- **USB data export**

The USB data export box is required for USB data export. If it is connected to the titrator using the USB interface, the box is automatically detected (PnP detection).

Parameters	Description	Values
USB data export box	Indicates whether the USB data export box is installed (info field).	Installed Not installed
Connection	The USB port to which the USB data export box is connected (info field). PnP is displayed if the box is not connected to the titrator.	USB PnP
Baud rate	The baud rate for data transmission via the USB interface.	1200 2400 4800 9600 19200
Data bit	Information on the number of data bits is displayed.	8
Stop bit	Information the number of stop bits is displayed.	1
Parity	Defines the parity protocol.	Even Odd None
Handshake	Data transmission via the USB interface.	None Xon-Xoff

The max. Xoff duration for outgoing data is around 30s.

3.2.3.5 PC settings

Navigation: **Home > Setup > Hardware > Peripherals > PC settings**

Configure these settings if you have your instrument connected to the PC software **LabX**.



- The PC with LabX installed must always be connected to the PC (USB) or Ethernet port on the rear panel.
- After the settings have been modified, it may be necessary to restart the instrument.

Parameters	Description	Values
Connect to LabX at start-up	If this parameter is activated, a connection to LabX will be established on startup.	Yes No
Connection type	Defines how the titrator is connected to the PC, either via the network connection or via the USB connection.	Network USB
Status	Information on the connection status from the instrument to LabX.	Connected Disconnected
Port number	Defines the port for a network connection of the titrator to LabX. Only appears for Connection type = Network .	1024...65535

3.2.3.6 Network settings

Navigation: **Home > Setup > Hardware > Peripherals > Network settings**

Configure these settings if you have your instrument connected to a network.

Parameters	Description	Values
Obtain IP address automatically	Indicates whether the IP address should be automatically obtained over the network.	Yes No
IP address	If the IP is not to be automatically obtained, you can enter it here.	000.000.000.000 ... 255.255.255.255
Subnet mask	If you want to run the titrator on a local subnetwork, you can define the subnet mask here that you want to use to link the subnet's IP address.	000.000.000.000 ... 255.255.255.255

Standard gateway	This is where you can enter the address of the standard gateway for communication between the various networks.	000.000.000.000 ... 255.255.255.255
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3.2.4 Titration stands

Navigation: **Setup > Hardware > Titration Stands**

In this window, you can add new titration stands or select existing stands that are connected to the titrator and change their parameters. You can also print the list of entered titration stands. You can also delete individual titration stands.

The following types of titration stand can be connected:

- **Auto stand**
 - **External stand**
 - **Manual stand**
 - **Rondolino TTL**
- In **Titration Stands** choose [**New**] to add a new titration stand.
 – or –
 Tap the entry of an existing titration stand to edit the corresponding parameters.
 ⇒ The windows to edit the parameters opens.

Parameters	Description	Values
Type	The type of the titration stand to be used.	Auto stand External stand Manual stand Rondolino TTL
Name	Specify a descriptive name of your choice.	Arbitrary
Stirrer output	Information on the used stirrer output.	STIRRER
Connection	Information on the connection type. Only for Type = Rondolino TTL .	TTL



- The Rondolino is connected to the TTL port.
- If you use an auto stand, the popup window that reminds the user to add the respective sample does not appear. Thus an interruption-free analysis sequence can be guaranteed for multiple determinations with a sample changer.

3.2.5 Auxiliary instruments

Navigation: **Home > Setup > Hardware > Auxiliary instrument**

Auxiliary instruments can be any instruments that access a titrator's TTL or 24 V output, stirrer or RS-232 connection and that are to be used in a method (e.g. valves, dispensers).

An auxiliary instrument is switched on for a predefined period or switched on and then switched off again via the corresponding command. The instruments are controlled via the method function **Auxiliary instrument**. Auxiliary instruments form part of a method, while peripherals are classified as input/output devices (printers, balances, barcode readers etc.), which do not have direct access to methods.

Starting from the auxiliary instrument list, you can add new auxiliary instruments or select existing ones or modify their parameters. Furthermore the list can be printed out at a printer or selected auxiliary instruments can be deleted.



- A maximum of 50 auxiliary instruments can be saved in the titrator.

Adding an auxiliary instrument

- 1 In **Auxiliary instrument** choose [**New**].
 ⇒ The windows to edit the parameters opens.
- 2 In **Control type** you must first select the manner in which the auxiliary instrument is to be controlled.
 ⇒ After you have selected the relevant type, you can determine the parameters.

Parameters	Description	Values
Name	Specify a descriptive name of your choice.	Arbitrary

Control type	The control type of the auxiliary instrument.	Output 24 V Stirrer Out TTL (Single pin) Input TTL (Single pin) RS-232
---------------------	---	---

Output 24 V/Stirrer (0-18V output)

Parameters	Description	Values
Output	Information on the used output.	STIRRER PUMP

TTL

Parameters	Description	Values
Output	Indicates which port and which pin on the titrator you want to use for the auxiliary instrument.	TTL-Out 1 TTL-Out 2 TTL-Out 3 TTL-Out 4
Input	The input where the auxiliary instrument should be queried.	TTL-In 1 TTL-In 2

RS-232

Parameters	Description	Values
Connection	Information on the serial port to which the device is connected.	COM
Baud rate	The baud rate for data transmission via the RS-232 interface.	1200 2400 4800 9600 19200
Data bit	Defines the number of data bits.	7 8
Stop bit	Defines the number of stop bits. (2 stop bits can only be selected if 7 data bits are also selected at the same time.)	1 2
Parity	Defines the parity protocol.	Even Odd None
Handshake	Data transfer via the RS-232 interface.	None Xon-Xoff

3.3 User settings

Navigation: **Home > Setup > User settings**

These settings contains the options that can be made specifically for each currently logged in user.

You can configure the language, the screen settings (for the touchscreen), the layout of the alphanumeric and numeric keyboard, the use of beeps, and shortcuts for each user.

3.3.1 Language

Navigation: **Home > Setup > User settings > Language**

Define the following parameters:

Parameters	Description	Values
Touchscreen	Defines the language for operation of the terminal.	German English French Italian Spanish Portuguese Chinese Russian Polish Korean
Record	Defines the language in which the reports are to be printed out.	German English French Italian Spanish Portuguese Chinese Russian Polish Korean



- For the Chinese and Korean language settings, it is not possible to print using the USB-P25 tape printer.
- For Polish, records can be printed on the USB-P25 tape printer without special characters.

3.3.2 Screen

Navigation: **Home > Setup > User settings > Screen**

Define the following parameters:

Parameters	Description	Values
Primary color	Here various color schemes for the user interface can be selected.	Gray Blue Green Red

Brightness	Specifies the display brightness in [%].	50 60 70 80 90 100 [%]
Button shape	Defines whether to display the buttons in the menus with square or rounded corners.	Rounded Square
Screen saver	Here you can define whether the screen saver should be used.	Yes No
Wait time	Defines how long in [min] the system should wait after the user's last action on the terminal before activating the screen saver.	1...1000

3.3.3 Beep

Navigation: **Home > Setup > User settings > Beep**

Define the following parameter:

Parameters	Description	Values
At push of a button	Enables a beep when tapping on the touch screen.	Yes No

3.3.4 Shortcuts

Navigation: **Home > Setup > User settings > Shortcuts**

Each user can manage the shortcuts that they have created. Individual shortcuts can be selected and deleted and the following parameters of a shortcut can be changed:

Parameters	Description	Values
Description	Any name for the shortcut.	Arbitrary
Immediate start	The method, series, or manual operation can be started immediately. This enables you to start the analysis without any interfering dialog.	Yes No
Homescreen position	You can select the free position for the shortcut on the Homescreen.	1...12

3.3.5 Keyboards

Navigation: **Home > Setup > User settings > Keyboards**

In this dialog, you can define the layout for the alphanumeric and the numeric input fields. The following settings are available:

Parameters	Description	Values
ABC keyboard	Determines the layout of the alphanumeric input field.	English French German
123 keyboard	Defines the organization of the keys for the numeric input field.	Calculator Phone

3.4 Global settings

Navigation: **Setup > Global settings**

In **Global settings**, you can make general settings on the titrator that apply for all users. The settings in this window can only be changed by users with the appropriate authorizations.

The settings include:

- **System settings** that apply for all users.
- **User management** for creating user accounts.
- The settings for **Analysis and resources behavior** determining the actions of the titrator before, during and after the performance of an analysis, and the response of the titrator when resources are deleted or when PnP resources are identified.

3.4.1 User Management

Navigation: **Home > Setup > Global settings > User management**

In the user management, you can add and delete users. A default user is already configured in the instrument. You can enter a maximum of 30 users.

- 1 In **User management** tap **[User]** to open the list of users.
- 2 To add a new user, tap **[New]**.
 - or -
 - Edit an existing user.

You can define the following parameters for each user account:

Parameters	Description	Values
User Name	The user's login ID.	Arbitrary
Full Name	The user's full name.	Arbitrary
User group	The user group to which the user is assigned.	Expert
Description	Any description for the user account or for the user.	Arbitrary

3.4.2 Analysis and resources behavior

The settings that you make here relate to the sequence of the analysis of samples or series with the aid of methods.

- You can define the actions of the titrator when started, during an analysis and afterward.
- You can also program the response of the titrator to the deletion of resources or when it identifies PnP resources.

Analysis sequence settings

The analysis sequence settings can only be modified if no tasks are currently being performed by the titrator.

You can make the following settings that influence the sequence of an analysis.

Parameters	Description	Values
Show required resources at start	When an analysis is started a screen appears displaying all resources required for the analysis and their status (available, not-available, locked or in use). If an individual entry is selected from this screen then the user receives additional information about the respective resource. However, if "no" is selected, then the required resources are still checked when the analysis is started and if necessary, an appropriate error message is issued.	Yes No
Show SOP	If an SOP (standard operating procedure) has been defined in the Title method function then this will be displayed before the method is started provided that "yes" has been selected.	Yes No
Show results after analysis	If a manual or external titration stand is being used, then the results for a sample are automatically displayed after they have been analyzed and must be acknowledged by the user before the analysis can be continued. With Auto stand the results are displayed for a certain period and are not to be confirmed. The activated parameter is valid for the following functions: Analysis: the results for a sample are shown Calibration/Loop: The results of the calibration are shown (slope, zero point) Sensor test: The results of the test are shown (slope, zero point, drift and sensor test OK / not OK)	Yes No
Check local printer connection and wait	When selected, the availability of a printer is checked at the beginning of the method. If not selected and no printer is connected, the method function Record is skipped. If a printer is connected, the method function Record is executed even if this parameter is not selected.	Yes No
Save results	Defines if date, time, user, Methods ID, sample ID, results, result unit per sample is saved in a file. If the USB-stick is not detected during the data writing, you can stop the process or you can plug in another stick for the data writing.	To USB-Stick No

Check USB-Stick connection and wait	If this parameter is activated, the presence of a USB - Stick is validated at the start of the analysis. Only for Save results = To USB-Stick .	Yes No
--	---	-----------------

Resources behavior

Use the following parameters to configure how the titrator responds to the deletion of resources and its response to the automatic identification of PnP resources.

Parameters	Description	Values
Information when deleting resources	Defines if a confirmation will be requested before a resource is deleted.	Yes No
Information when recognizing PnP resources	Defines if a confirmation will be requested every time a PnP resource is identified.	Yes No

Pump and stirrer detection

Parameters	Description	Values
Stirrer detection	Defines if the automatic stirrer detection is activated. This may be necessary, for example, if you connect additional devices via the stirrer outputs that are not automatically identified by the titrator.	Yes No
Pump detection	Defines if the automatic pump detection is activated. This may be necessary, for example, if you connect additional devices via the pump outputs that are not automatically identified by the titrator.	Yes No

3.5 Values

Navigation: **Home > Setup > Values**

There are three blank values and three auxiliary values which can be used in formulas for calculations. These values cannot be deleted or renamed and no additional values can be created.

Blank values

A blank value, which is assigned to a solvent, can be transferred to methods by using the method function **Blank**.

- 1 In **Values**, select [**Blank values**].
 - 2 Tap the entry of a blank value to edit the corresponding parameters.
- ⇒ The windows to edit the parameters opens.

Parameters	Description	Values
Unit	The units in which the blank is specified.	Arbitrary
Value	Here you can enter a numerical value.	$-10^8 \dots 10^8$



- When a blank is assigned with the method function **Blank**, this is updated in the settings immediately after completion of the method function.

Auxiliary values

The auxiliary value can be assigned to a result via the formula in the method function **Calculation**.

- 1 In **Values**, select [**Auxiliary values**].
 - 2 Tap the entry of an auxiliary value to edit the corresponding parameters.
- ⇒ The windows to edit the parameters opens.

Parameters	Description	Values
Comment	A brief comment (e.g. unit) to the auxiliary value can be entered.	Arbitrary
Value	Here you can enter a numerical value.	$-10^8 \dots 10^8$

3.6 Maintenance & Service

Navigation: **Home > Setup > Mainten. & Service**

3.6.1 MT service

Navigation: **Home > Setup > Mainten. & Service > MT-Service**

In this dialog, you can view and print out a list of the most recent (max. 10) METTLER TOLEDO services. Under each date, the user name of the METTLER TOLEDO service technicians and the date and time of the service appointment are displayed. The most recently performed service always appears at the top of the list.

You can change the service life (in days) of the last service date and configure the titrator to issue a warning at a defined time before the service life elapses (requires administrator rights).

– In **MT-Service** tap **[Settings]**.

⇒ The windows to edit the parameters opens.

Parameters	Description	Values
Service life	Defines the service life (in days) of the most recently performed service.	0...10 ⁴
Reminder	Determines whether the titrator should issue a warning before the service life or usable life of a resource elapses.	Yes No
Days before expiration	Determines the number of days before expiry of the service life that the titrator should issue a warning. The value entered here must be smaller than the service life. (Appears only if "Reminder" is activated.)	0...1000

3.6.2 Import/Export

Navigation: **Home > Setup > Mainten. & Service > Import / Export**

You can use this function to save titrator data on a USB stick (export) and reload the data back to a titrator later on (import).

Thus is it possible to create a backup of most data that has been changed from the titrator's default settings.

Uploading data from a backup copy results in the existing data in the titrator being overwritten. In this way you can immediately duplicate the status of one titrator in another one or restore titrator settings after repair.

The following two rules should be observed:

- Memory copies can only be imported from the same type.
- Memory copies can only be imported from the same or from a lower software version.

You can select whether you want to export or import a backup copy, an individual method or the user management.

A **backup copy** includes, for example:

- All parameters of methods, series and firmware updates
- Setup inclusive of all resources
- All shortcuts

The backup copy does **not** contain all saved results, data saved on a PnP component and the default parameters for manual operations.

When you import/export an **individual method** you can select which method is to be exported or imported. You require the right to edit methods.

When you import/export **user management settings** the entire user management settings with all users and their properties are exported or imported.

► In the **Maintenance & Service** dialog, open the **Import / Export** dialog window.

– In this dialog, you can define the following parameters:

Parameters	Description	Values
Action	Here you can select whether you wish to export the titrator data to a memory stick or to import it from a memory stick to a titrator.	Export Import
Data	In this box you can select the data that you wish to export or import. You can select whether you want to export or import a backup copy, an individual method or the user management.	Export Import
Method ID	Here you can select the Method ID for the relevant method.	Method list

3.6.3 Reset to factory settings

Navigation: **Home > Setup > Mainten. & Service > Reset to factory settings**



- In the process all data and changes to settings made by users of the titrator are lost.

3.6.4 Titrator firmware history

Navigation: **Home > Setup > Mainten. & Service > Titrator firmware history**

The **Titration firmware history** button displays a list of the firmware updates or model upgrades. The first entry in the list represents the initial operation of the titrator.

All list entries are stored with date, type, FW version and the user name of the user who performed the action.

3.6.5 Board firmware

Navigation: **Home > Setup > Mainten. & Service > Board firmware**

Display a list of all boards and burette drives available on the titrator along with the relevant firmware version. You can carry out an update.

3.6.6 Terminal

Navigation: **Home > Setup > Mainten. & Service > Terminal**

Display the chip ID of the terminal and adjust the touchscreen.

If the alignment of the touch-sensitive areas of the screen correspond not exactly with the position of the buttons e.g. after a software update was performed, then you can solve this error by executing this function.



- Do not touch the touch screen with pointed or sharp objects! This may damage the touch screen.
- 1 In **Terminal** tap **[Adjust touchscreen]**.
 - ⇒ The instrument will reboot and the adjustment screen appears.
 - 2 Touch and hold a touch screen stylus (resistive) on the center of the target until it moves to the next position on the screen.
 - 3 Repeat this procedure until a message appears.
 - 4 Tap the screen to confirm or wait for 30 seconds for canceling (timeout).
 - ⇒ The instrument will reboot.

Note

- Tap the center of the target as accurately as possible otherwise the process has to be repeated several times.
- Make sure not to touch any other locations on the screen and the fix key areas while doing this adjustment.
- Make sure not to touch the screen with your hand.
- Keep accurate angle for your usage.
- The adjustment process cannot be aborted.

3.6.7 Board data

Navigation: **Home > Setup > Mainten. & Service > Board data**

Display and print out a list of all the boards fitted in the titrator. Each board is listed by name and module location.

If a board is selected from the list, then its chip ID and all data on available inputs and outputs including the adjustment data will be displayed.

3.6.8 Drives

Navigation: **Home > Setup > Mainten. & Service > Drives**

Display and print a list of all connected drives. The list contains the position, serial number, chip-ID and status of each drive.

3.6.9 Burettes

Navigation: **Home > Setup > Mainten. & Service > Burettes**

Display and print out a list of connected PnP burettes. Each PnP burette is listed with its chip ID, serial number, volume and position of the attached drive.

3.6.10 Update

Navigation: **Home > Setup > Mainten. & Service > Update**

Use this function to update the titrator firmware using a USB stick.

4 Manual Operations

You can use manual operations to access various titrator functions that are not directly connected to the execution of an analysis, but that might be useful during the sample preparation, for example.

You can call up the following manual operations from here with the relevant titrator components:

Hardware components	Possible manual operations	Possible usages
Stirrer	Stir	Dissolve a solid sample
Sensor	Measure	Determine the pH or temperature of a solution
Burette	Rinse	Rinse burette before changing a titrant
	Rinse multiple burettes	Rinsing several burettes simultaneously
	Dispense	Dispense during sample preparation
	Manual titration	Manual titration using a color indicator
Pump	Pump	Pump auxiliary reagents in and out, fill and empty sample vessels, replace the solvent (for Karl Fischer water determination)
Auxiliary instrument	Control	Activating an external pump



- It is not possible to perform parallel execution of multiple manual operations.
- The resource parameters in all editable fields can be changed temporarily (only for the execution of the manual operation in question) and can vary from the setup settings. The changes made will not be copied over to the setup, however.

4.1 Stirrer

To switch a connected stirrer on or off for a definable time interval and at a definable stirring speed, select the following:

Navigation: **Home > Manual > Stirrer**

- 1 Make a selection in **Titration stand**.
- 2 Enter the stir time in [sec] or select "∞" for an infinite duration.
- 3 Tap [**Start**] to start the stirrer.

⇒ The stirrer starts. Tap [**Stop**] to stop the stirrer at any time (terminating the manual operation).

Define the following parameters:

Parameters	Description	Values
Titration stand	Defines which titration stand is to be used.	List of available titration stands
Stirrer output	Information on the used stirrer output.	STIRRER
Speed	Defines the stirring speed in [%].	0...100
Stir time	The stirring time, in [sec], during which the stirrer should be in operation. Select "∞" for unlimited stirring time.	0...10 ⁴ ∞



- Entries made here will only be applied to the manual operation and will have no effect on the instrument settings.

4.2 Pump

Navigation: **Home > Manual > Pump**

This manual operation will use a connected pump to pump in any volume of auxiliary reagent or - depending on the connection of the tubes - to drain it from the titration vessel.

Proceed as follows to start a pump process:

- 1 Select the pump and adjust the pump rate.
- 2 Enter the volume in [mL] to be added.
- 3 Tap [**Start**] to start the procedure.

⇒ The procedure starts. Tap [**Stop**] to stop the procedure at any time.

You can determine the following parameters:

Parameters	Description	Values
Action	Determines the actions for the pump process.	Fill Pump Drain
Auxiliary reagent	The auxiliary reagent to be added.	List of available auxiliary reagents
Pump	Use this setting to select a pump.	List of available pumps
Max. pump rate	Displays the defined pump rate in [mL/min] as defined in the settings. Changing this value does not change the rate of the pump, only the time calculated for the addition.	0.1 ... 1000
Pump output	Information on the used pump output.	PUMP
Volume	The volume to be dispensed, in [mL]. Select "∞" for unlimited pumping.	0 ... 1000 ∞
Drain time	Defines the pumping time for draining a fluid. The duration of the drain operation for the tubes should be as long as possible to ensure that the tubes are completely free of liquids following draining.	0 ... 1000 ∞
Fill time	Defines the pumping time for filling a liquid.	0 ... 1000 ∞
Stirrer	A stirrer can be switched on. Only for Action = Fill or Drain .	Yes No
Titration stand	The name of the titration stand. only if stirrer is activated.	List of titration stands
Stirrer output	Information on the used stirrer output.	STIRRER
Speed	Speed in [%]. Only if stirrer is activated.	0 ... 100



- Entries made here will only be applied to the manual operation and will have no effect on the instrument settings.

4.3 Sensor

To take a measurement using any connected sensor, select the following:

Navigation: **Home > Manual > Sensor**

- 1 Make a selection in **Sensor**.
 - 2 Select the desired stirrer and enter a speed.
 - 3 For polarized, potentiometric and conductivity sensors, specify whether the temperature should be entered manually or automatically.
 - 4 For manual temperature acquisition, enter the temperature.
- or -
For automatic temperature acquisition, select a connected temperature sensor and the temperature unit to be used.
 - 5 Enter the duration of the measurement in [sec] or select "∞" for an infinite duration.
 - 6 Select whether to output a record on the printer.
 - 7 To output a record on the printer, use dt [sec] to define the time interval between measurements.
 - 8 Tap [**Start**] to start the measurement.
- ⇒ The measurement starts. Tap [**Stop**] to stop the measurement at any time (terminating the manual operation).
- ⇒ During the measurement, the system will display the online curve (measured values in the selected unit versus time). Use [**Measured values**] to display a table of measured values instead of the curve.

4.3.1 Temperature sensor

You can define the following parameters for a manual operation:

Parameters	Description	Values
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Sensor input	Information on the used input.	PT1000
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	°C K °F
Titration stand	Defines which titration stand is to be used.	List of available titration stands
Stirrer output	Information on the used stirrer output.	STIRRER
Speed	Defines the stirring speed in [%].	0...100
Duration	The measurement and stirring time, in [sec]. Select "∞" for unlimited measurement time.	0...10 ⁴ ∞
Record	If activated, the measured values will be printed out.	Yes No
dt	Defines the time interval in [sec] for outputting measured values to the printer. Only appears if Record = Yes was selected.	1...6000



- Entries made here will only be applied to the manual operation and will have no effect on the instrument settings.

4.3.2 Potentiometric Sensor

Potentiometric sensors are potentiometric indicator electrode, such as glass electrodes for pH measurement, Redox electrode for measuring the redox potential or ion-selective electrodes (ISE) for determining of ion content in the solution. Below, the editable parameters are listed for both potentiometric sensors and photrodes used for turbidimetric and color induced titrations:

Parameters	Description	Values
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV pH pM A %T
Titration stand	Defines which titration stand is to be used.	List of available titration stands
Stirrer output	Information on the used stirrer output.	STIRRER
Speed	Defines the stirring speed in [%].	0...100
Temperature manual	Defines whether to enter the temperature manually (Yes) or via a temperature sensor (No).	Yes No
Temperature	If the temperature is entered manually, you can enter it here, in [°C]. Only appears if Temperature manual = Yes was selected.	-20...200
Temperature sensor	Here you can select the required temperature sensor. Only appears if Temperature manual = No is selected.	List of available sensors
Sensor input	Information on the used input.	PT1000
Temperature unit	The unit of measure for the temperature measurement. Only appears if Temperature manual = No was selected.	°C K °F
Duration	The measurement and stirring time, in [sec]. Select "∞" for unlimited measurement time.	0...10 ⁴ ∞
Record	If activated, the measured values will be printed out.	Yes No
dt	Defines the time interval in [sec] for outputting measured values to the printer. Only appears if Record = Yes was selected.	1...6000



- The parameters for temperature acquisition or entering the temperature, **Temperature manual**, **Temperature**, **Temperature sensor**, **Sensor input** and **Temperature unit** are omitted for mV sensors and the phototrode.
- Entries made here will only be applied to the manual operation and will have no effect on the instrument settings.

4.3.3 Polarized sensor

You can define the following parameters for a manual operation:

Parameters	Description	Values
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Sensor input	Information on the used input.	SENSOR
Indication	Defines how to do the indication. Depending on the unit of measure: [mV] = Voltametric , [μ A] = Amperometric .	Voltametric Amperometric
Ipol	Ipol is the polarization current, in [μ A], for the voltametric indication.	0.0...24.0
Upol	Defines the polarization voltage [mV], for an amperometric indication. Only for polarized sensors and Indication = Amperometric .	0...2000.0
Titration stand	Defines which titration stand is to be used.	List of available titration stands
Stirrer output	Information on the used stirrer output.	STIRRER
Speed	Defines the stirring speed in [%].	0...100
Temperature manual	Defines whether to enter the temperature manually (Yes) or via a temperature sensor (No).	Yes No
Temperature	If the temperature is entered manually, you can enter it here, in [$^{\circ}$ C]. Only appears if Temperature manual = Yes was selected.	-20...200
Temperature sensor	Here you can select the required temperature sensor. Only appears if Temperature manual = No is selected.	List of available sensors
Sensor input	Information on the used input.	PT1000
Temperature unit	The unit of measure for the temperature measurement. Only appears if Temperature manual = No was selected.	$^{\circ}$ C K $^{\circ}$ F
Duration	The measurement and stirring time, in [sec]. Select " ∞ " for unlimited measurement time.	0...10 ⁴ ∞
Record	If activated, the measured values will be printed out.	Yes No
dt	Defines the time interval in [sec] for outputting measured values to the printer. Only appears if Record = Yes was selected.	1...6000



- Entries made here will only be applied to the manual operation and will have no effect on the instrument settings.

4.4 Auxiliary Instrument

Navigation: **Home > Manual > Auxiliary instrument**

Selectively control here the titrator's inputs and outputs. You can transmit outgoing signals and query incoming signals. This lets you check whether the communication is functioning between the titrator and a connected auxiliary instrument. In this way, manually triggered auxiliary instrument functions can be used as support for a titration.

To activate an auxiliary instrument, proceed as follows:

- 1 In **Control type**, select the auxiliary instrument to be controlled.
 - 2 Enter the specific communication parameters for the control type.
 - 3 Tap [**Start**] to start the procedure.
- ⇒ The procedure starts. Tap [**Stop**] to stop the procedure at any time.

The following parameters are available, depending on the type:

Parameters	Description	Values
Control type	The control type of the auxiliary instrument.	Output 24 V Stirrer Out TTL (Single pin) Input TTL (Single pin) RS-232

For Control type = Output 24 V, the following parameters are available:

Parameters	Description	Values
Name	Select the auxiliary instrument to be controlled from the list.	Auxiliary instrument
Output	Information on the used output.	PUMP
Duration	The time, in [sec], the auxiliary instrument should be switched on. Select "∞" for unlimited time.	0...10 ⁴ ∞

i

- An auxiliary instrument controlled by the control type **Output 24 V** can be switched on and off or operated for a defined period of time.

For Control type = TTL, the following parameters are available:

Parameters	Description	Values
Name	Select the auxiliary instrument to be controlled from the list.	Auxiliary instrument
Output	Indicates which port and which pin on the titrator you want to use for the auxiliary instrument.	TTL-Out 1 TTL-Out 2 TTL-Out 3 TTL-Out 4
Mode	Determines the number and type of TTL signal issued. Fixed time: The control output is switched on for the defined time period. Input controlled: A signal received at the control inlet controls the control outlet. The Auxiliary Instrument function will be terminated as soon as the signal changes at the control inlet or after a defined maximum time has expired. Sequential: The control output runs through a defined sequence.	Fixed time Input controlled Sequential
Duration	The time, in [sec], the auxiliary instrument should be switched on. Select "∞" for unlimited time.	0...10 ⁴ ∞
Input aux. instr.	The name of the auxiliary instrument to serve as the signal input (control input). Only appears for Mode = Input controlled .	List of auxiliary instrument
Input	The input where the auxiliary instrument should be queried.	TTL-In 1 TTL-In 2
Input signal	Indicates whether an rising or a falling input signal should be detected.	Rising Falling
Max. wait time	The maximum waiting time for a signal change. After it expires, the method will be continued even if no input sequence was detected. Only appears for Mode = Input controlled .	0...10 ⁴ ∞
Output signal	Normal: The signal is transmitted without conversion. Inverted: The signal is transmitted in inverted form. Only if Mode = Input controlled .	Normal Inverted
Number of pulses	The number of impulses in the planned sequence. Only if Mode = Sequential .	0...10 ⁴
Pulse duration	The duration of a pulse, in [sec]. Only appears for Mode = Sequential .	0...10 ⁴
Interval	Defines the time span, in [sec], between two impulse starts. Only if Mode = Sequential .	0...10 ⁶ 0...10 ⁴

- If **Mode = Input controlled** was selected, the system checks the incoming input signal until the maximum time expires or a signal is received.

For Control type = Input TTL (Single pin), the following parameters are available:

Parameters	Description	Values
Name	Select the auxiliary instrument to be controlled from the list.	Auxiliary instrument
Input	The input where the auxiliary instrument should be queried.	TTL-In 1 TTL-In 2

Input signal	Indicates whether an rising or a falling input signal should be detected.	Rising Falling
Max. wait time	The maximum waiting time for a signal change. After it expires, the method will be continued even if no input sequence was detected. Only appears for Mode = Input controlled .	0...10 ⁴ ∞

- i**
- Use the control type **Input TTL (Single pin)** to wait for a rising or falling input signal. The manual operation will be ended as soon as an input signal is received or the maximum waiting time is exceeded.

For Control type = Stirrer, the following parameters are available:

Parameters	Description	Values
Name	Select the auxiliary instrument to be controlled from the list.	Auxiliary instrument
Speed	Defines the stirring speed in [%].	0...100
Duration	The time, in [sec], the auxiliary instrument should be switched on. Select "∞" for unlimited time.	0...10 ⁴ ∞

- i**
- An auxiliary instrument controlled by the control type **Stirrer** can be switched on and off or operated for a defined period of time.

For Control type = RS-232, the following parameters are available:

Parameters	Description	Values
Name	Select the auxiliary instrument to be controlled from the list.	Auxiliary instrument
Connection	The serial port to which the device is connected.	COM
Output sequence	Defines the output sequence to be transmitted by the titrator. ASCII control characters are generated with sequences started by the backslash character followed by three digits. For example: \013 for Carriage Return \010 for line feed.	ASCII characters
Wait for response	Defines whether the system should wait for a response sequence from the device.	Yes No
Input sequence	The response sequence from the external device. Only if Wait for response = Yes was selected.	Arbitrary
Max. wait time	The maximum waiting time for a signal change. After it expires, the method will be continued even if no input sequence was detected. Only appears for Mode = Input controlled .	0...10 ⁴ ∞

- i**
- Use the control type **RS-232** to transmit any signal and (if you so specify) to wait for a response.

4.5 Burette

4.5.1 Rinse burette

Navigation: **Home > Manual > Burette > Rinse**

This operation lets you rinse a burette and its connecting tubes and fill it with fresh titrant, for example if you want to remove air bubbles from the system.

- Select the titrant you want to rinse with.
- Select the drive on which the titrant is installed. (For PnP burettes, the system automatically selects the appropriate drive.)
- Enter the number of cycles you want to run.
- Enter the discharge volume in [%] to define the percentage of the burette's total volume that you want to discharge during each rinse passage.
- Enter the filling rate in [%] to define the speed at which you want to refill the burette. (100% is the maximum rate.)
- Tap [**Start**] to start the procedure.

⇒ The procedure starts. Tap [**Stop**] to stop the procedure at any time.



- Make sure that the dispensing tube is directed into a vessel which is a multiple of the volume of the burette.
- For reagents with a higher viscosity or volatile reagents, we recommend reducing the filling rate to prevent air from being drawn in and the titrant from outgassing.

You can determine the following parameters:

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list
Drive	Defines the drive on which you will use the burette containing the titrant.	1 2
Cycles	Defines the number of rinse cycles to be executed.	1...100
Discharge volume	The volume of titrant, in [mL], to be discharged during the rinsing process.	10...100
Fill rate	The filling rate of the burette in percent. 100% stands for maximum filling rate.	30...100

4.5.2 Rinse multiple burettes

Navigation: **Home > Manual > Burette > Rinse multiple burettes**

Two burettes can be rinsed at the same time using this manual operation.

- 1 Select the corresponding drives to rinse the burettes with titrant.
 - 2 Enter the number of cycles during which rinsing is to take place.
 - 3 Tap **[Start]** to start the procedure.
- ⇒ The procedure starts. Tap **[Stop]** to stop the procedure at any time.

You can determine the following parameters:

Parameters	Description	Values
Drive 1...Drive 8	Drives on which the burettes with titrant are installed.	Yes No
Cycles	Defines the number of rinse cycles to be executed.	1...100



- The drives can only be seen if they are connected.
- Drives that are equipped with a PnP burette are opened again at the specific fill rate of the titrant, whereas conventional drives are opened at 100% fill rate.

4.5.3 Dispense

Navigation: **Home > Manual > Burette > Dispense**

This manual operation lets you manually dispense a defined quantity of titrant.

- 1 Select the titrant you would like to dispense.
 - 2 Select the drive on which the titrant is installed. (For PnP burettes, the system automatically selects the appropriate drive.)
 - 3 Enter the volume to be dispensed in [mL].
 - 4 Enter the filling rate in [%] to define the speed at which you want to refill the burette. (100% is the maximum rate.)
 - 5 Tap **[Start]** to start the procedure.
- ⇒ The procedure starts. Tap **[Stop]** to stop the procedure at any time.

You can determine the following parameters:

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list
Drive	Defines the drive on which you will use the burette containing the titrant.	1 2
Volume	Defines the volume to be dispensed, in [mL].	0.001...100
Fill rate	The filling rate of the burette in percent. 100% stands for maximum filling rate.	30...100

4.5.4 Manual titration

Navigation: **Manual** > **Burette** > **Manual titration**

To perform a manually controlled titration, proceed as follows:

- 1 Select the titrant you would like to titrate with.
- 2 Select the drive on which the titrant is installed. (For PnP burettes, the system automatically selects the appropriate drive.)
- 3 Enter the filling rate in [%] to define the speed at which you want to refill the burette. (100% is the maximum rate.)
- 4 Select the sensors you would like to use for the measurement from the list of sensors defined in the setup.
- 5 Select the stirrer output for the stirrer and enter a speed.
- 6 Specify whether the temperature should be entered manually or automatically.
- 7 For manual temperature acquisition, enter the temperature.
- or -
For automatic temperature acquisition, select a connected temperature sensor and the temperature unit to be used.
- 8 Select whether the results should be given in the form of consumption (of the titrant) or content (in the sample).
- 9 Select the measurement unit and the number of decimal places for the results.
- 10 For results given as content, select the sample's entry type (**Volume** or **Weight**) and enter the sample quantity m , the density d (for entry types **Volume** or **Weight**), the molar mass M and the equivalent number z for the substance to be tested.
- 11 Specify whether a record should be output to the printer and select which elements should be contained in that record (**Results**, **Table of measured values** and **Curve**).
- 12 Tap [**Start**] to start the manual titration and move to the online dialog.
- 13 Tap [**Dispense**] once to add a minimum volume of titrant. If you touch and hold [**Dispense**], the system will continuously add titrant.
 - ⇒ The dispensing rate will increase as you hold down the button.
 - ⇒ After you release the button, the system will titrate at the minimum speed again the next time you tap the button.
- 14 Tap [**Exit**] to end the manual titration.

During the manual titration, the system will display the measured value, the titrant consumption, and a curve (measured value versus consumption) on the screen. After you finish, a record can automatically be output to the printer. You can also view the results, measured values and curve on the screen.



- For the results of the manual titration, the system takes as a basis the titrant consumption until the conclusion of the titration. The EQP is not calculated!

You can determine the following parameters:

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list
Drive	Defines the drive on which you will use the burette containing the titrant.	1 2
Fill rate	The filling rate of the burette in percent. 100% stands for maximum filling rate.	30...100
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Sensor input	The input to which you want to connect the sensor.	SENSOR PT1000
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV pH ppm pM pX %T A μ A $^{\circ}$ C K $^{\circ}$ F
Ipol	Ipol is the polarization current, in [μ A], for the voltametric indication.	0.0...24.0

Upol	Defines the polarization voltage [mV], for an amperometric indication. Only for polarized sensors and Indication = Amperometric .	0...2000.0
Titration stand	Defines which titration stand is to be used.	List of available titration stands
Speed	Defines the stirring speed in [%].	0...100
Temperature manual	Defines whether to enter the temperature manually (Yes) or via a temperature sensor (No).	Yes No
Temperature	If the temperature is entered manually, you can enter it here, in [°C]. Only appears if Temperature manual = Yes was selected.	-20...200
Temperature sensor	Here you can select the required temperature sensor. Only appears if Temperature manual = No is selected.	List of available sensors
Sensor input	The input to which you want to connect the sensor.	SENSOR PT1000
Temperature unit	The unit of measure for the temperature measurement. Only appears if Temperature manual = No was selected.	°C K °F
Result	Select whether to output the result of the manual titration as the amount of titrant consumed or as the content in the sample.	Consumption Content
Unit	The unit for stating the result in the form of the titrant consumption. Only for Result = Consumption .	mL mmol
Unit	The unit for stating the result as the sample content. Only for Result = Content .	mol/L mol/kg g/L g/kg % ppm
Decimal places	Specify the required number of decimal places for the results.	1...4
Entry type	The entry type for the sample size. Only for Result = Content	Weight Volume
Sample size	The sample size, in [mL] or in [g], depending on the entry type selected. Only for Result = Content .	0.0001...100
Density	The density of the sample substance to be determined, in [g/mL]. Only for Result = Content .	0.0001...100
M	Defines the molar mass of the substance [g/mol].	List of concentration/titer standards and substances
Record	Defines whether to output a record to the printer after the titration.	Yes No
Incl. result	Here you can specify whether the record should contain all the results. Only appears for Record = Yes .	Yes No
Incl. table of measured values	Here you can specify whether the record should contain a table of measured values. Only appears for Record = Yes .	Yes No
Incl. curve	Here you can specify whether the record should contain a curve. Only appears for Record = Yes .	Yes No



- The parameters for temperature acquisition or entering the temperature, **Temperature manual**, **Temperature**, **Temperature sensor**, **Sensor input** and **Temperature unit** are omitted for mV sensors and the phototrode.

5 Methods

To carry out an analysis with the titrator, you require a **method**. A method is an analysis program and consists of a sequence of method functions (some with method subfunctions), which are processed by the titrator in sequence.

In this chapter, you will learn how to access and define methods.

The basic building blocks of a titration method consist of sample preparation, stirring and wait times, the actual titration, result calculation and a record. The titrator defines these partial steps as functions that consist of parameters whose values can be changed.

Loops

Within a method you can define one loop, which can run the series analysis n-times. (see Method Syntax - Rules for Creating a Method (page 46)).

The beginning and end of a sample loop are defined by the method functions "Sample" and "End of Sample". The "End of Sample" method function is executed, and the sample loop stopped, only after the last sample in a series.

There are the following loop types:

- A **sample loop** is for analyzing a sample.
- A **calibration loop** is for calibrating a sensor.
- A **titer loop** is for determining the titer of a titrant.

Types of Methods

The titrator distinguishes between the following method types with different objectives:

- **GT**
GTMethod for general titration (contains only sample loops or mixed loops)
- **Calibration**
method for sensor calibration (contains only calibration loops).
- **Titer**
Method for titer determination, contains only titer loops

Predefined methods

- **Mettler method templates**
A number of methods have already been stored in the instrument. These methods were developed by METTLER TOLEDO for specific uses and can be used for the corresponding analysis.
- **Standard method templates**
When creating methods you can revert to method templates, which specify the structure of the method, and whose parameters already contain the most suitable default values.

Method ID

You can distinguish between different types of method and individual methods of the same type using their ID:

- Each method has its own unique method identification.
- The method ID of the Mettler methods is composed of the starting letter "M" followed by a sequential number (M001, M002, ...). However, the method ID can be freely chosen when you save a method.

5.1 METTLER TOLEDO Methods

A number of methods have already been stored in the instrument. These methods were developed by METTLER TOLEDO for specific uses and can be used for the corresponding analysis. These methods not only provide the sequence of the method functions, but they also define all of the method function settings. You create a new method by changing the parameters of a delivered method template and saving it under a new method ID.

ID	Title	Description	Titration	Sensor
M400	Acetic acid in vinegar	EQP-Titration	NaOH	DG115
M401	Ammonium chloride content	EQP-Titration	NaOH	DG115
M402	Free fatty acid content	EQP-Titration	KOH in Ethanol	DG113
M403	Blank solvent FFA	EQP-Titration	KOH in Ethanol	DG113

ID	Title	Description	Titrant	Sensor
M404	Chloride content in Ketchup	EQP-Titration	AgNO ₃	DM141
M405	Total hardness of tap water	EQP-Titration	EDTA	DP5
M406	Ca + Mg content of tap water	EQP-Titration	EDTA	Ca ISE
M409	Copper content	EQP-Titration	Na ₂ S ₂ O ₃	DM140
M410	Hydrogen peroxide content	EQP-Titration	KMnO ₄	DM140
M411	Vitamin C content voltametric	EQP-Titration	DPI	DM143
M415	m-Value of tap water (EP)	EP-Titration	HCl	DG115
M416	p-Value of tap water	EP-Titration	NaOH	DG115
M418	HCl content	EP-Titration	NaOH	DG115
M419	Free SO ₂ content in wine	EP-Titration	J ₂	DM143
M424	Bromine number ASTM D1159	EP-Titration	Bromide-Bromate	DM143
M425	Blank ASTM D1159	EP-Titration	Bromide-Bromate	DM143
M426	Acid number ASTM D664	EQP-Titration	KOH in 2 Propanol	DG113
M427	Acid number ASTM D664	EQP-Titration	KOH in 2 Propanol	DG113
M428	Base number ASTM D4739	EQP-Titration	HCl in 2 Propanol	DG113
M429	Blank ASTM D4739	EQP-Titration	HCl in 2 Propanol	DG113
M430	Base number ASTM D2896	EQP-Titration	HClO ₄ in acetic acid	DG113
M431	Blank ASTM D2896	EQP-Titration	HClO ₄ in acetic acid	DG113
M432	Chloride content in motor oil	EQP-Titration	AgNO ₃ in 2 Propanol	DM141
M435	Titer 0.1 mol/L NaOH	EQP-Titration	0.1M NaOH	DG115
M436	Calibration DG115-SC	Messung	pH Buffer: 4.01, 7.00, 9.21	DG115-SC
M449	Nitrogen Kjeldahl with K-360	EQP-Titration	1/2 H ₂ SO ₄	DG115-SC
M454	Nitrogen Kjeldahl TTL	EP-Titration	1/2 H ₂ SO ₄	DG115-SC
M455	Nitrogen Kjeldahl Manual	EP-Titration	1/2 H ₂ SO ₄	DG115-SC

5.2 Creating Methods

You create a new method by changing the parameters of a delivered method template and saving it under a new method ID.

Navigation: **Home > Methods**

- 1 Tap **[New]** to create a new method on the basis of a template.
- 2 From the available templates, in **Mettler method templates** or **Standard method templates**, choose the one that is most similar to the method you wish to create.
 - ⇒ You can now modify this method in line with your requirements by inserting or removing method functions or modifying its parameters.
- 3 In the method function **Title**, enter a new method ID. Afterwards, a new method will be stored under this method ID.
- 4 Assign a title to your new method.
- 5 Select available method functions to modify their parameters in line with your requirements.
- 6 Tap **[Insert]** to add additional method functions to the template.
- 7 Now use the arrow-shaped button to select the required position for the new method function in the method. (You will only be able to insert the method functions that are allowed in the corresponding location based on the method syntax.)
- 8 From the list, select the method function that you want to insert.
- 9 Modify the individual parameters of the method function in line with the resources.
 - ⇒ The new method function appears in the method.
- 10 To delete a method function, select the function in question and then tap **[Delete]**.
 - ⇒ The method function disappears from the method.
- 11 After inserting all required method functions, tap **[Save]**.

⇒ The method is saved under the method ID and appears in the list of available methods.



- When establishing a new method, follow the rules specified by the instrument.

See also

- Method Syntax – Rules for Establishing a Method (page 46)

5.2.1 Method Templates

When you create a new method, the method templates prescribe the sequence of the method functions. These method templates are not application-specific, but are dependent on the type of titrator. They allow the user to establish user methods quickly and easily. Most of the settings in the method functions that occur in a standard method already have default values.

To convert a method template into a user method, it has to be saved under a method ID.

Title	Description	Method type
EQP	Equivalence point titration	General titration
EP	End point titration	General titration
Measure	Is used for the controlled transfer of a sensor measuring value.	General titration
Lern-EQP	Is used to determine the best parameters for carrying out an EQP titration.	General titration
Titer with EQP	Titer determination by EQP titration	Titer determination
Titer with EP	Titer determination by EP titration	Titer determination
Calibration	Sensor calibration (linear regression for all measurement points)	Calibration
Segmented calibration	Sensor calibration, taking into account non-linear sensor behavior	Calibration
Blank with EQP	Blank value determination of a solvent using the equivalence point titration	General titration
Blank with EP	Blank value determination of a solvent using the end point titration	General titration
pH Sensor test	To check the slope, zero point and drift of pH-sensors.	Calibration

5.3 Modifying or Deleting Methods

You can change user methods or Mettler methods and store them under new method IDs.



- Once a Mettler method has been modified, you will only be able to save it as a copy (or as a user method) with a new method ID.

Navigation: **Home > Methods**

- 1 From the displayed list of methods, select the method that you want to modify.
 - 2 As soon as the methods functions of the selected method appear on the screen, you can modify the method.
 - 3 In the method function **Title**, enter a new method ID. Afterwards, a new method will be stored under this method ID. You can enter up to twenty alphanumeric characters.
 - 4 Select available method functions to modify their parameters in line with your requirements.
 - 5 Choose **[Insert]** to add additional method functions to the template.
 - 6 Now use the arrow-shaped **[Insert]** button to select the required position for the new method function in the method. (You will only be able to insert the method functions that are allowed in the corresponding location based on the method syntax.)
 - 7 From the list, select the method function that you want to insert.
 - 8 Modify the individual parameters of the method function.
- ⇒ The new method function appears in the method.
- 1 To delete a method function, select the function in question and then choose **[Delete]**.

- 2 After you have made all of the necessary adjustments, you can store the method in the titrator by choosing **[Save]**.

Deleting Methods

You can easily delete user-defined methods from the titrator. Select:

Navigation: **Home > Methods**

- 1 Select the method that you want to delete.
- 2 Choose **[Delete method]** to delete the method from the titrator's memory.

5.4 Starting Methods

The titrator offers various ways of starting a method:

- From the method editor
- By choosing **Start** from the Home dialog
- By using a shortcut on the Home screen
- Via the **Series** dialog
- By using the **"Setup"** dialog (to perform a calibration or titer determination)

You can use the method editor to start any method stored in the titrator.

- 1 From the displayed list in the **Methods** dialog, select the method that you wish to start (Home > Methods).
- 2 As soon as the method functions of the selected method appear on the screen, you can open the **Start analysis** screen by choosing **Start**.
- 3 Choose **Start** again to reach an overview screen on the resources required for the method. (Only if this was defined in the analysis sequence settings.)
- 4 To execute the method, confirm the screen by choosing **OK**.

5.5 Stopping Methods

Analyses or series of analyses that are in progress can be interrupted or terminated by the user in order to intervene in the analysis process or by the titrator itself.

The options available in the event of an interruption of the analysis procedure are listed below.

5.5.1 Suspending of ongoing analysis by the user

If you wish to make changes when an analysis or series is in progress, you can suspend the relevant method as follows:

- Tap **[Suspend]**.
⇒ The following options appear:

Save series data

The complete series assigned to the interrupted analysis is saved as a file in the form "SeriesXY".

- If the maximum permitted number of series has been reached, the series is not saved.
- Sample data from a method that is waiting in a queue can be saved by selecting **Suspend > Save series data**.

Skip sample

The analysis continues with the next sample. The current sample is marked in **Results** as **Excl.**.

Skip loop

The analysis omits the current sample loop and continues with the next one. The loop is marked in **Results** as **Excl.**.

- This method function is only available for selection if a sample from any given loop was being analyzed at the time of the interruption. If a **Calib.** loop is skipped, the analysis continues in accordance with the corresponding method function **Calibration**.
- The samples that have been skipped are automatically excluded from the statistics. This applies to all results for the sample; also those that were listed before the sample was skipped. If required, you can still use the **Results** dialog to include the sample in the statistics once the analysis is complete.

Further, you can decide whether you wish to stop or continue the analysis:

- To do so, choose **Continue** to continue the analysis or **Stop definitely** to stop the suspended analysis.

5.5.2 Suspending of ongoing analysis by the titrator

The titrator can interrupt an analysis that is in progress for the following reasons:

- Exceeding the specified termination parameter "Termination" for the methods "titration (EQP) and titration (EP)".
- Due to end or equivalent points not being found during learn titrations.
If no end or equivalent points are found during a learn titration an error message appears and the analysis is interrupted. You have the option of either canceling the titration or continuing after filling a new burette.

5.6 Method Syntax – Rules for Establishing a Method

A method consists of a sequence of method functions that are executed consecutively when a method is processed. When establishing a method, certain rules (method syntax) must be followed. These fundamental rules are described below:

5.6.1 Types and Possible Number of Loops

Nested loops are not permitted. Loops can only be inserted into or deleted from a method as a whole.

The number of loops allowed in a method differs depending on the method type and device type:

Method type	Permissible loop types	Maximum number of loops per method
GT	Sample loop Titer loop Calibration loop	1
Titer	Titer loop	1
Calib.	Calibration loop	1

5.6.2 Sample Loops

The following loop types are available for the various methods for general titration (GT):

Sample loop (GT):	Sample Titration stand (manual stand) Stir Titration (EQP) Calculation Record End of sample
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Titer loop:	Sample (Titer) Titration stand (manual stand) Stir Titration (EQP) Calculation Record End of sample Titer
Calibration loop:	Sample (calibration) Titration stand (manual stand) Stir Measure (normal) End of sample Calibration

5.6.3 Inserting and Deleting Loops

The following description applies particularly for the GT method type.

Only entire loops can be inserted into or deleted from a method.

When you insert a loop using the "Sample", "Sample (Titer)", and "Sample (Calib)" method functions, a regular, correct template that varies according to the loop type is inserted.



When deleting one of the stored method functions listed above in gray, the entire loop will be deleted from the method, including all of the method functions it contains.

5.7 Overview of Method functions

The number of method functions that can be used within a method is limited. The maximum number of method functions is **12**.

Functions	Explanation	Possible No. of MFs	Within loop	Outside loop
Title	Title and characteristics of the method.	1	No	Yes
Sample	Start of a sample loop.	total 1	Start of loop	
Sample (Titer)	Start of a loop for titer determination.			
Sample (Calibration)	Start of a loop for sensor calibration.			
Titration stand	Selects titration stand.	1	Yes	No
Pumps	Pumps a defined volume of a liquid.	2	Yes	Yes
Stir	Activates a stirrer.	2	Yes	No
Dispense (normal)	Dispenses a defined quantity of titrant.	1	Yes	Yes
Measure (normal)	Takes over monitoring a measured value from a sensor.	total 2	Yes	No
Titration (EQP)	Conducts an equivalence-point titration.		Yes	No
Titration (EP)	Conducts an end-point titration.		Yes	No
Titration (LearnEQP)	Conducts an equivalent-point-detection titration.		Yes	No
Calculation	Converts the analysis results.	3	Yes	Yes
End of sample	Concludes a sample loop.	1	End of loop	Yes

Functions	Explanation	Possible No. of MFs	Within loop	Outside loop
Titer	Assigns the result of a titer sample loop to a titer.	total 1	No	Yes
Calibration	Assigns the result of a calibration loop to a sensor.		No	Yes
Blank	Assigns a result or an arbitrary value to a blank and updates the value stored in Setup.	1	Yes	Yes
Auxiliary value	Assigns a value (Mean[R1], Mean[R2], or Mean[R3]) to an auxiliary value and updates the value stored in the settings.	1	Yes	Yes
Auxiliary instrument	Activates external auxiliary instruments.	2	Yes	Yes
Drain	Drains a volume from the sample vessel.	1	Yes	Yes
Record	Defines the record data to be output to the printer.	2	Yes	Yes

5.8 Method functions

All parameters that can be defined for the following method function are described below.

5.8.1 Title

Defines the title and type of a method and manages properties such as the creation and change date, the author, and whether or not the method is to be protected.

Parameters	Description	Values
ID	Unique ID of the method.	Arbitrary
Title	Title of the method.	Arbitrary
Protect	Protects the method against changes and deletion by any user other than the author or the administrator.	Yes No
SOP	Standard operating procedure.	None Text Link
SOP-Text	Text for a standard operating procedure Only if SOP = Text is selected.	Arbitrary
SOP-ID	ID for the link to a standard operating procedure. Only if SOP = Link is selected.)	Arbitrary

5.8.2 Sample

The "Sample" and "End of sample" method functions define the beginning and the end of a sample loop. All of the method functions contained in a loop are conducted for each sample in a series. The method functions are conducted in accordance with "End of Sample" only after processing the last sample.

Parameters	Description	Values
Number of IDs	Defines the number of sample IDs to be defined.	1...3
ID 1	The ID for the first or only sample of an analysis.	Arbitrary
ID 2...ID 3	The name defined here will be used as the default name for the respective sample on the sample loop. Only appears subject to the settings made for Number of IDs .	Arbitrary
Entry type	Defines whether the sample should be added with a defined mass, defined volume or defined number of pieces. The sample data query will then adjust according to the unit of measurement. Fixed volume or Fixed pieces : The sampling weight, sample volume or number of pieces will be entered as the parameter in this method function and will not be prompted when conducting the method.	Weight Fixed weight Volume Fixed volume Pieces Fixed pieces

Lower limit	Defines the lower limit for the variable entry data. The unit will depend on the setting for Entry type parameter. Only appears if none fixed values are selected in Entry type .	[g]: 0 ... 1000 [mL]: 0 ... 1000 [pcs.]: 0 ... 10 ⁶
Upper limit	Defines the upper limit for the variable entry of data. The unit will depend on the setting for Entry type parameter. Only appears if none fixed values are selected in Entry type .	[g]: 0 ... 1000 [mL]: 0 ... 1000 [St.]: 0 ... 10 ⁶
Weight	Weight in [g]. Appears only if Entry type = Fixed weight was selected.	0...1000
Volume	Volume in [mL]. Appears only if Entry type = Fixed volume was selected.	0...1000
Pieces	The number of sample(s). Appears only if Entry type = Fixed pieces was selected.	0...10 ⁶
Weight per piece	The weight in [g] per piece. Appears only if Entry type = Pieces or Fixed pieces was selected.	0 ... 1000
Density	The density of a liquid sample substance, in [g/mL]. Appears only if Entry type = Weight, Volume, Fixed weight or Fixed volume was selected.	0.0001...100
Correction factor	Any correction factor that can be used in calculations.	0.0001...10 ⁶
Temperature	The temperature in [°C] during the analysis. If temperature monitoring is activated in a titration function, the system will ignore the sample temperature given here.	-20...200
Entry	Determines the entry time for the sample size. Before: The sample size must be entered before the titration. Arbitrary: The sample size will have to be entered at any time during the titration (no later than when it is used during the calculations). Only appears if none fixed values are selected in Entry type .	Before Arbitrary

5.8.3 Sample (titer)

Start of a loop for titer determination Contains all of the necessary data regarding the titrant and the standard to be used.

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list
Standard	Select the name of the standard from the standards list.	Select from the standards defined in the set-up.
Entry type	Defines whether the quantity (weight or volume) of a liquid or solid standard should be entered when the analysis is started or whether a Fixed weight or a Fixed volume should be defined in the method function.	Weight Fixed weight Volume Fixed volume Pieces Fixed pieces
Lower limit	Defines the lower limit for the variable entry of sample data in [mL] or [g]. The unit will depend on the setting for Entry type parameter. Applies only for Entry type = Weight and Volume .	0...1000
Upper limit	Defines the upper limit for the variable entry of data. The unit will depend on the setting for Entry type parameter. Only appears if none fixed values are selected in Entry type .	[g]: 0 ... 1000 [mL]: 0 ... 1000 [St.]: 0 ... 10 ⁶
Weight	Weight in [g]. Appears only if Entry type = Fixed weight was selected.	0...1000
Volume	Volume in [mL]. Appears only if Entry type = Fixed volume was selected.	0...1000
Correction factor	Any correction factor that can be used in calculations.	0.0001...10 ⁶
Temperature	The temperature in [°C] during the analysis. If temperature monitoring is activated in a titration function, the system will ignore the sample temperature given here.	-20...200

Entry	Determines the entry time for the sample size. Before: The sample size must be entered before the titration. Arbitrary: The sample size will have to be entered at any time during the titration (no later than when it is used during the calculations). Only appears if none fixed values are selected in Entry type.	Before Arbitrary
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5.8.4 Sample (calibration)

Start of a loop for sensor calibration. Contains all of the necessary data regarding the sensor and the calibration standard.

Parameters	Description	Values
Sensor type	Specifies the type of sensor that is calibrated	pH ISE Temperature
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Action	Performing a calibration or a pH-sensor test.	Calibration Sensor test
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV pH ppm pM pX %T A μ A °C K °F
Automatic buffer recognition	Defines whether the titrator should automatically identify the buffers via the pH buffer list. Only possible for pH sensors.	Yes No
pH buffer list	Defines the pH buffer list to be used for the calibration of a pH sensor.	Select from the pH buffer lists (Auto pH buffer lists) defined in Setup.
List of standards	Defines the standards list to be used for the calibration of an ISE or conductivity sensor.	Select from the standards lists defined in Setup.
Calibration	Here you can define whether the calibration of a pH or ISE sensor should be done in a linear or segmented manner.	Linear Segmented
Number of buffers	The number of buffers to be used for the calibration of a pH sensor.	1...9
Number of standards	The number of standards to be used for the calibration of an ISE sensor.	1...9
Buffer 1-9	For the calibration of a pH sensor, up to nine buffers can be selected from the pH buffer list.	Select from the buffer list.
Standards 1-9	For the calibration of an ISE sensor, up to nine standards can be selected from the standards list.	Select from the standards list.
Standard	Select the name of the standard from the standards list.	Select from the standards defined in the setup.
Temperature	The temperature during the calibration in [°C] if temperature acquisition has not been selected in the "Measurement (normal)" method function. Does not appear for temperature sensors.	-20°C...200°C

5.8.4.1 pH sensor test

The sensor test is used to check the slope, zero point and drift of pH sensors.

The test can be started either by using a method or sample series via the "Calibration" method function or directly from the Setup of the sensor concerned (see also "Setup: Hardware > Sensors > Sensor Calibration and Sensor Test (page 19)").



- The calibration data of the pH sensor is not affected by the test.
- The results of the sensor test can be printed out.

Starting the sensor test via a method

Start the sensor test as follows:

- 1 Select a method of the "Calibration" type or create the appropriate method.

- 2 Select the "Sample (Calibration)" method function.
- 3 In the **Sample (Calibration)** dialog window, select the following parameters:
 - "Sensor type" = "pH"
 - "Action" = "Sensor test"
- 4 Specify the buffer parameters to be used (See "Methods: Method functions > Sample (Calibration)"). The sensor test is carried out using two buffer solutions.
- 5 Press **OK**.
- 6 Select the "Calibration" method function
- 7 Define the following parameters in the **Calibration** dialog:

Parameters	Description	Values
Interruption outside limits	Determines whether the method should be interrupted if a value lies outside the defined limits (only appears if the "Limits" parameter has been activated). A message (which must be acknowledged) appears advising that the process has been interrupted during the time that the message is displayed.	Yes No
Min. slope 1-8	The lower limit for the slope, in [%]. (100% refers to -59.16 mV/pH.)	10...200
Max. slope 1-8	The upper limit for the slope, in [%].	10...200
Min. zero point 1-8	The lower limit for the zero point.	-100...100
Max. zero point 1-8	The upper limit for the zero point.	-100...100
Min. drift	The minimum drift value in [mV/30s].	-100 to 100
Max. drift	The maximum drift value in [mV/30s].	-100 to 100

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- If the values are within the limits, the sensor test is regarded as having been passed.
- Slope and drift relate to 25°C.

To provide an overview, the relevant method functions have been summarized and listed in the following table:

Method functions for the pH sensor test

Method function	Description
Sample (Calibration)	This method function is used firstly in order to carry out a calibration and secondly for the sensor test. It is selected via the "Action" parameter. Only two buffers can be defined for the sensor test.
Measure (normal)	The measured values of both calibration solutions (pH buffers) are determined here. In addition, another drift determination is carried out for the second buffer.
Calibration	In the method, the "Calibration" method function for the sensor test is placed after the "End of sample" method function. Essentially, "Calibration" corresponds to a calculation function. In the process, it calculates the calibration parameters from the measured values of the calibration loop and the calibration standard values (pH buffer values). These are then compared with the inputted limit values for the zero point, slope and drift.
Record	The results of the sensor test are displayed in the "Overview" section of the record. The various selection parameters for titration curves (E – V, dE/dV – V, etc.) which are available during standard titration are invalid for the record.

See also

- Sample (calibration) (page 50)

5.8.5 Titration stand

You can use the following parameters to specify the relevant titration stand.

Parameters	Description	Values
Type	Defines the type of titration stand to be used.	Rondolino TTL Manual stand Auto stand External stand
Titration stand	Defines which titration stand is to be used.	List of available titration stands

5.8.6 Pump

You can use this method function to drain a reagent into a sample vessel.

Parameters	Description	Values
Auxiliary reagent	The auxiliary reagent to be added.	List of available auxiliary reagents
Volume	Defines the volume in [mL] to be pumped.	0...1000

5.8.7 Stir

Activates or deactivates (speed = "0") the stirrer of the current titration stand.

Parameters	Description	Values
Speed	Defines the stirring speed in [%].	0...100
Duration	The stirring time, in [sec]. After the stirring time has elapsed, the titrator will continue to the next method function without switching off the stirrer. The stirrer is switched off after the analysis is finished or the beaker is changed. The stirrer output is defined by the prior method function "Titration stand".	0 ... 10 ⁵

5.8.8 Dispense (normal)

You can use this method function to dispense a precisely defined quantity of titrant.

The smallest increment (dV(min)) is 1/20000 of the burette volume, i.e. for the following burettes:

1 mL burette: dV(min) = 0.05 µL

5 mL burette: dV(min) = 0.25 µL

10 mL burette: dV(min) = 0.50 µL

20 mL burette: dV(min) = 1 µL

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list
Volume	Volume in [mL].	0.0001...1000
Dosing rate	Defines the dosing rate (not including the filling time), in [mL/min]. You can also select a burette type-dependent maximum number.	0.01...60

5.8.9 Methods with subfunctions

The method functions described below have subfunctions with their own parameters:

5.8.9.1 Measure (normal)

For the controlled acquisition of a measured value from a sensor. If a temperature sensor is selected for the measurement, the subfunction "Temperature acquisition" is omitted.

Subfunction: Sensor

Parameters	Description	Values
Type	The type of sensor to be used to perform the measurement.	mV pH ISE Photrode
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors

Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV pH ppm pM pX %T A μ A °C K °F
Indication	Defines how to do the indication. Depending on the unit of measure: [mV] = Voltametric , [μ A] = Amperometric .	Voltametric Amperometric
Ipol	Ipol is the polarization current, in [μ A], for the voltametric indication.	0.0...24.0
Upol	Defines the polarization voltage [mV], for an amperometric indication. Only for polarized sensors and Indication = Amperometric .	0...2000.0

Subfunction: Temperature acquisition

Parameters	Description	Values
Temperature acquisition	Defines whether to record the temperature, with the aid of a temperature sensor, during the execution of the analysis function.	Yes No
Temperature sensor	Defines which temperature sensor to use for the temperature acquisition. Only for Temperature acquisition = Yes .	Sensor list
Unit	Defines the temperature unit to be used.	°C K °F

Subfunction: Stir

Parameters	Description	Values
Speed	Defines the stirring speed in [%].	0...100

Subfunction: Acquisition of Measured Values

Parameters	Description	Values
Acquisition	Defines how the measured value is acquired. Equilibrium controlled: The measured value is acquired as soon as it stabilizes. Fix: The measured value is acquired after a defined waiting period. Set value: The measured value is acquired as soon as it has exceeded, or fallen short of, a specific set value, or as soon as it is within a range defined by the lower and upper limits. (The Set Value option is not available if the method function is used within a Sample (Calib) loop.)	Equilibrium controlled Fix Set value

The following parameters are available for the sensor types: mV, pH, ISE, Phototrode, Polarized

Parameters	Description	Values
dE	Defines the measured value interval. As soon as the change in the measured value over the time period dt is less than dE, the measured value will be acquired. This occurs within the defined time interval of t(min) to t(max). dE is specified in the unchanged unit of the sensor per second: - mV for the mV sensor type, pH, ISE, phototrode and polarized voltametric sensor - μ A for polarized sensor.	0.1 ... 15
dt	Defines the time component, in [sec] for dE/dt. (For "acquisition" = "equilibrium-controlled" only.)	1...150
t(min)	Earliest possible time for the measured value acquisition, in [sec]. (For "acquisition" = "equilibrium-controlled" only.)	1...150
t(max)	Latest possible time for the measured value acquisition, in [sec]. (For "acquisition" = "equilibrium-controlled" only.)	1...10 ⁵
Time	Waiting time, in [sec], before acquisition of a measured value when "acquisition" = "Fixed".	1...10 ⁵

Mode	Mode for the measured value acquisition of the "set value". E > set value acquires the measured value as soon as the set value has been exceeded. E < set value acquires the measured value as soon as the measured value falls below the set value. Not available within a calibration loop. Only for Acquisition = Set value .	E > set value E < set value
Set value	Set value in the sensor unit. Measured values will be acquired after they exceed or fall below this value, depending on the mode setting. (For "acquisition" = "set value" only.) Not available within a calibration loop.	(See "Value Ranges of Sensor Measuring Units and Control Band")
t(max)	Latest time for the measured value acquisition, in [sec]. (For "acquisition" = "set value" only.) Not available within a calibration loop.	1...10 ⁵
Mean value	The system finds a mean value for the saved measured value, using a maximum of 10 measured values.	Yes No
No. of measured values	When you want to calculate a mean value, you can define the number of measured values used to find that mean value here.	1...10
dt	Defines the time interval, in [sec], for the measured value acquisition of the measured values to be averaged. (Appears only if "mean value" = "yes" is selected.)	1...60

You can define the following parameters for the temperature sensor:

Parameters	Description	Values
dT	Defines the measured value interval. As soon as the change in the measured value during the time period dt is less than dT, the measured value will be acquired. This occurs within the defined time interval of t(min) to t(max). This value is specified in the unchanged unit of the sensor, per second: °C K °F (Only for "Acquisition" = "Equilibrium controlled".)	0.1 ... 10 Unit: °C K °F
Mode	Mode for the measured value acquisition of the "set value". T > set value : acquires the measured value as soon as the set value has been exceeded. T < set value : value acquires the measured value as soon as the measured value falls below the set value. Not available within a calibration loop. T within range : acquires the measured value as soon as the measured temp. value is within the range including the limits. Only for Acquisition = Set value .	T > set value T < set value T within range T within range

5.8.9.2 Titration (EQP)

Carries out an equivalence-point titration. You can define the relevant parameters for the following subfunctions:

Subfunction: Titrant

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list

Subfunction: Sensor

Type	The type of sensor to be used to perform the measurement.	mV pH ISE Phototrode
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV pH ppm pM pX %T A µA °C K °F
Indication	Defines how to do the indication. Depending on the unit of measure: [mV] = Voltametric , [µA] = Amperometric .	Voltametric Amperometric

Ipol	Ipol is the polarization current, in [μA], for the voltametric indication.	0.0...24.0
Upol	Defines the polarization voltage [mV], for an amperometric indication. Only for polarized sensors and Indication = Amperometric .	0...2000.0
Frequency	Polarization frequency in [Hz]. The standard frequency is 4 Hz; other values should only be used for special applications. Only for Type = Polarized , and Unit = mV .	4 2 1 0.5

Subfunction: Temperature acquisition

Parameters	Description	Values
Temperature acquisition	Defines whether to record the temperature, with the aid of a temperature sensor, during the execution of the analysis function.	Yes No
Temperature sensor	Defines which temperature sensor to use for the temperature acquisition. Only for Temperature acquisition = Yes .	Sensor list
Unit	Defines the temperature unit to be used.	°C K °F

Subfunction: Stir

Speed	Defines the stirring speed in [%].	0...100
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Subfunction: Predispensing

Parameters	Description	Values
Mode	Specifies the type of addition: Volume : predispenses a specific volume. Potential : system predispenses a substance until a certain potential is reached. Factor : A multiple of the sample size is predispensed. None : does not predispense.	Volume Potential Factor None
Volume	Volume in [mL].	0.0001...1000
Potential	The potential at which predispensing is stopped. Only for Mode = Potential .	Depends on the sensor
Factor	The system calculates the predispensing volume by multiplying the factor by the sample size. (For "mode" = "factor" only.)	0 ... 10 ⁵
Wait time	Defines a waiting time, in [sec]. After predispensing or, if Mode = None , before the start of titration.	0...32000

Subfunction: Control

Parameters	Description	Values
Control	Here you can select from among three predefined control modes, or you can select User to define all the parameters as freely editable. If you change from Normal , Fast , Cautious to User , the system will copy over the predefined parameter settings and they will then be freely editable.	Normal Fast Cautious User
Mode	Select an application depending on the sensor type. The selected application will then provide its own specific parameter set. Not available for Control = User .	Application list
Show parameters	Here you can select whether to display the preset parameters of the control modes Normal , Fast or Cautious as non-editable info fields. Not for Control = User .	Yes No

Titrant addition	Defines whether to always dispense the same volume defined by dV (Incremental) or to adjust the volume to be titrated per step as the titration progresses (Dynamic). Only for Control = User .	Dynamic Incremental
dE(set value)	Defines the potential difference targeted per titrant addition. (For control mode "user" and dynamic titrant addition only)	0.1 ... 100
dT(set value)	Defines the temperature difference in the unit of the temperature sensor that is targeted for a temperature sensor per titrant addition. For Control = User and Titrant addition = Dynamic only.	0.1 ... 100
dV(min)	Defines the minimum amount for a titrant addition, in [mL]. For Control = User and Titrant addition = Dynamic only.	0.0001 ... 1
dV(max)	Defines the maximum amount for a titrant addition, in [mL]. For Control = User and Titrant addition = Dynamic only.	0.0001 ... 10
dV	Defines the volume increment, in [mL], for the incremental titrant addition. For Control = User and Titrant addition = Incremental only.	0.0001 ... 10
Meas. val. acquisition	Type of measuring value acquisition: Equilibrium controlled: The system acquires the measured value and makes the next titrant addition as soon as a stable measured value is established. Fixed time: The measured values acquisition and the titrant addition occur according to fixed time intervals. Only for Control = User .	Equilibrium controlled Fixed time
dE	As soon as the change in the measured value during the time period dt is less than dE, the measured value will be acquired. Acquisition takes place no earlier than after t(min) and no later than after t(max). Then the next titrant addition is conducted. (For control mode "user" and equilibrium-controlled measured value acquisition only)	0.1 ... 15
dt	Defines the time interval, in [sec], for calculating dE/dt (or dT/dt for a temperature sensor). For Control = User and Meas. val. acquisition = Equilibrium controlled only.	0.1 ... 15
t(min)	Earliest possible time for the measured value acquisition, in [sec]. Only for Control = User and Meas. val. acquisition = Equilibrium controlled .	0.5 ... 150
t(max)	Latest possible time for the measured value acquisition, in [sec]. Only for Control = User and Meas. val. acquisition = Equilibrium controlled .	1 ... 10 ⁵
dt	Defines the time interval, in [sec], for Fixed time . For Control = User and Meas. val. acquisition = Fixed time only.	0.5 ... 6000

Subfunction: Evaluation and recognition

Parameters	Description	Values
Procedure	Defines which evaluation procedure to use.	Standard Asymmetric Minimum Maximum Segmented

Threshold	Defines the threshold (absolute amount) that must be exceeded for the recognition of an EQP. Procedure = Minimum and Maximum: This threshold value refers to the original curve [UoM] Procedure = Standard and Asymmetric: It refers to the 1st derivative of the original curve [UoM*/mL]. Procedure = Segmented: It refers to the 2nd derivative of the original curve [UoM/mL].	Standard, Asymmetric and Segmented: 0 ... 10 ⁶ Minimum and Maximum: Depends on the sensor
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* UoM: Unit of Measurement

Tendency	Defines the tendency for which the EQP is to be detected. For Procedure = Standard, Asymmetric and Segmented.	Positive Negative None
Ranges	You can define up to three recognition ranges. Outside these ranges, the system will recognize neither EQP's nor EQP candidates. Depending on what is defined here, upper and lower limits are defined for each recognition range and also whether additional EQP criteria are to be used for each recognition range.	1 2 3 0
Lower limit 1-3	Defines the lower limit for the recognition range. The unit of measure will depend on the sensor used. Does not appear if Ranges = 0.	Depends on the sensor
Upper limit 1-3	Defines the upper limit for the recognition range. The unit of measure will depend on the sensor used. Does not appear if Ranges = 0.	Depends on the sensor
Add. EQP criteria	Defines whether to take additional EQP criteria into consideration. The available selection will depend on the evaluation procedure chosen. They can be defined individually for each recognition range or for the overall recognition range (Ranges = 0). Last EQP: The system only considers the quantity of EQPs defined. Steepest jump: The system only considers the number of steepest jumps defined. Lowest value: The system only considers the number of lowest values defined. Highest value: The system only considers the number of highest values defined.	Last EQP Steepest jump Lowest value Highest value No
Last jumps	The quantity of last jumps to be taken into consideration. Only for Add. EQP criteria = Last EQP.	1 ... 9
Steepest jumps	The quantity of steepest jumps to be taken into consideration. Only for Add. EQP criteria = Steepest jump.	1 ... 9
Lowest values	The quantity of lowest values to be taken into consideration. Only for Add. EQP criteria = Lowest value.	1 ... 9
Highest values	The quantity of highest values to be taken into consideration. Only for Add. EQP criteria = Highest value.	1 ... 9

Subfunction: Termination

Parameters	Description	Values
At Vmax	Defines the maximum volume, in [mL], at which the titration must be terminated if it has not been terminated already.	0.1 ... 1000
At potential	Defines whether to terminate the titration after reaching a defined potential (with the correct tendency!).	Yes No
Potential	The potential at which to terminate the titration. The unit of measure will depend on the sensor used. (For "at potential" = "yes" only.)	-100 ... 100 (See "Value Ranges of Sensor Measuring Units and Control Band")

Termination tendency	Defines for which tendency the titration should be terminated. Only for At potential = Yes .	Positive Negative None
At slope	Defines whether to terminate the titration after reaching a defined slope. This absolute value must be exceeded by one measured value and then be greater than two measured values to result in termination.	Yes No
Slope	The slope, in [unit of measure/mL], at which to terminate the titration. (For "at slope" = "yes" only.)	0 ... 10 ⁵
After number of recognized EQPs	Specifies whether the titration should be terminated after the recognition of a specific quantity of EQP candidates. The EQP candidates must fulfill the following conditions: - It lies within the recognition range defined in Ranges . - It is above the threshold defined in Threshold - It show the correct tendency as defined in Tendency . If no additional EQP criteria should be considered, then EQP candidate = EQP applies.	Yes No
Number of EQP's	Defines the quantity of EQP candidates after the recognition of which the system should terminate the titration. (For "after number of recognized EQPs" = "yes" only.)	1 ... 30
Combined termination criteria	No: Termination as soon as the first of the selected criteria from the (Potential Slope After number of recognized EQPs) group has been fulfilled. Yes: Termination as soon as all the selected criteria have been fulfilled. Termination of the titration in any case if the maximum volume is reached.	Yes No

5.8.9.3 Mode

An application mode can be selected in the "Control" subfunction for the EQP titration method functions if the "Control" setting is not set to "User". Application modes are available for various types of titration (acid/base, redox, argentometry, etc.). If an application mode is selected, the settings for the Control subfunction will be specified based on what is best for the primary uses for the corresponding type of titration. The user can choose between three different parameter sets for each application mode (Control "Normal", "Fast" and "Slow").

Sensor type	Unit	Unit for dE(set value) and dE	Mode
pH	pH	mV	Acid / Base
	mV		Acid / Base (non aqu.)
mV	mV	mV	Precipitation
			Precipitation (non aqu.)
			Redox
ISE	mV	mV	Precipitation
	ppm		
	pX		
	pM		
Phototrode	mV	mV	Precipitation
	%T		Complexation
	A		
Polarized	mV	mV	Redox
	μA	μA	Redox
Temperature	°C	°C, °F, K	Acid / Base
	°F		
	K		

5.8.9.4 Titration (EP)

Carries out an end-point titration. You can define the relevant parameters for the following subfunctions:

Subfunction: Titrant

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list

Subfunction: Sensor

Type	The type of sensor to be used to perform the measurement.	mV pH ISE Photrode
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV pH ppm pM pX %T A μ A °C K °F
Indication	Defines how to do the indication. Depending on the unit of measure: [mV] = Voltametric , [μ A] = Amperometric .	Voltametric Amperometric
Ipol	Ipol is the polarization current, in [μ A], for the voltametric indication.	0.0...24.0
Upol	Defines the polarization voltage [mV], for an amperometric indication. Only for polarized sensors and Indication = Amperometric .	0...2000.0

Subfunction: Temperature acquisition

Parameters	Description	Values
Temperature acquisition	Defines whether to record the temperature, with the aid of a temperature sensor, during the execution of the analysis function.	Yes No
Temperature sensor	Defines which temperature sensor to use for the temperature acquisition. Only for Temperature acquisition = Yes .	Sensor list
Unit	Defines the temperature unit to be used.	°C K °F

Subfunction: Stir

Speed	Defines the stirring speed in [%].	0...100
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Subfunction: Predispensing

Parameters	Description	Values
Mode	Specifies the type of addition: Volume : predispenses a specific volume. Potential : system predispenses a substance until a certain potential is reached. Factor : A multiple of the sample size is predispensed. None : does not predispense.	Volume Potential Factor None
Volume	Volume in [mL].	0.0001...1000
Potential	The potential at which predispensing is stopped. Only for Mode = Potential .	Depends on the sensor
Factor	The system calculates the predispensing volume by multiplying the factor by the sample size. (For "mode" = "factor" only.)	0 ... 10 ⁵
Wait time	Defines a waiting time, in [sec]. After predispensing or, if Mode = None , before the start of titration.	0...32000

Subfunction: Control

Parameters	Description	Values
End point type	Absolute: Titration is ended when the absolute measured value is reached. Relative: The system will take into consideration the difference between the desired end point and the measured value at the start of the titration.	Absolute Relative
End point value	The defined titration end point. The unit will depend on the sensor used.	(See "Value Ranges from Sensor Measuring Units and Control Band")
Control band	This number defines the width of the control band. Outside the control band, the system will titrate with the maximum dispensing rate. The smaller the control band, the faster the titrator will react to a deviation from the potential of the defined end point. When the measurement curve reaches the control band, the titrator will slow down the titrant addition to approach the end point in a cautious manner. The unit will depend on the sensor used.	(See "Value Ranges from Sensor Measuring Units and Control Band")
Dosing rate (max)	The maximum dosing rate in [mL/min].	0.001...60
Dosing rate (min)	The minimum dosing rate in [µL/min].	1...10 ⁴

Subfunction: Termination

Parameters	Description	Values
At EP	Defines whether to terminate the titration after reaching the end point. If No is selected, after reaching the end point the system will continue acquiring measured values without adding titrant until the maximum time period is reached.	Yes No
Termination delay	The termination delay which defines the time period, in [sec], between reaching the end point and terminating the titration. If during the termination delay the measured value drops below the end point, the system will add further increments and restart the termination delay. (Only if "at EP" = "yes" is selected.)	0...10 ⁸
At Vmax	Defines the maximum volume, in [mL], at which the titration must be terminated if it has not been terminated already.	0.1...1000
Max. time	Defines the maximum time of the titration, in [sec].	0...10 ⁸ ∞

5.8.9.5 Titration(LearnEQP)

Learn titration (EQP) is used to determine the best parameters for carrying out an EQP titration. As soon as the settings have been successfully recorded, the titration detection in the method is converted to a normal EQP titration with the recorded settings.

You can determine the relevant parameters for the following subfunctions:

Subfunction: Titrant

Parameters	Description	Values
Titrant	Select a titrant from the list of the defined titrants.	Titrant list

Subfunction: Sensor

Parameters	Description	Values
Type	The type of sensor to be used to perform the measurement.	mV pH ISE Phototrode
Sensor	Select a sensor from the list. The list depends on the sensor type selected in Type .	List of available sensors
Unit	The unit of measure to be used for the measurement; the unit will depend on the sensor type selected.	mV pH ppm pM pX %T A µA °C K °F

Subfunction: Temperature acquisition

Parameters	Description	Values
Temperature acquisition	Defines whether to record the temperature, with the aid of a temperature sensor, during the execution of the analysis function.	Yes No
Temperature sensor	Defines which temperature sensor to use for the temperature acquisition. Only for Temperature acquisition = Yes .	Sensor list
Unit	Defines the temperature unit to be used.	°C K °F

Subfunction: Stir

Parameters	Description	Values
Speed	Defines the stirring speed in [%].	0...100

5.8.10 Calculation

For converting the titration results.

Parameters	Description	Values
Result type	If you select the parameter "Result type" = "Predefined", the Results proposals button is available. With it you can select a predefined result from the proposal list. The parameters "Unit", "Formula", and "Constant" are adjusted automatically. If you select the parameter "Result type" = "User defined", the parameters "Result", "Result unit", and "Constant" is editable.	Predefined User defined
Calculation type	Using this parameter you can perform calculations for the listed categories. For the selection of the result from the proposal list, you have to consider the Parameter Entry type used in the method function Sample . If there is a difference between Calculation type and Entry type in Sample , an error message appears.	Direct titration Back titration autom. Back titration manual Blank comp. 2nd titration function Other
Formula, Result Result unit Constant C	These parameters are automatically set for results proposals if you have selected the parameter "Result type" = "Predefined" (these parameters depend on the selected "Calculation type" and the "Entry type" in the method function "Sample". If you have selected "Result type" = "User defined" you can edit the parameters "Result", "Result unit" and "Constant C". "Formula" is not editable.	Arbitrary "Constant C=" only a number is allowed
Auxiliary value	Defines which of the predefined auxiliary values shall be used in this calculation.	Aux. val. 1...3
Blank	Defines which of the predefined blank values shall be used in this calculation.	Blank 1...3
Selected EQP	You can enter equivalence points (EQP) which you want to consider for the calculation. This parameter is only available if "Titration (EQP)" is selected in a loop.	1 ... 10
M	Defines the molar mass of the substance [g/mol].	List of concentration/titer standards and substances
Decimal places	The number of decimal places for the result.	0...6
Result limits	Defines whether limits should be observed for the result. If this function is activated, there will be a message in the record if the result falls outside the defined limits.	Yes No
Lower limit	Defines the lower result limit. Appears only if "result limits" = "yes" was selected.	-10 ⁸ ... 10 ⁸
Upper limit	Defines the upper result limit. Appears only if "result limit" = "yes" was selected.	-10 ⁸ ...10 ⁸

Interruption outside limits	Determines whether the method should be interrupted if a value lies outside the defined limits (only appears if the "Limits" parameter has been activated). A message (which must be acknowledged) appears advising that the process has been interrupted during the time that the message is displayed.	Yes No
Record statistics	Specifies whether statistics should also be issued with the results in the report along with the result. The statistics are not printed, if in the method function "Protocol" the parameter "Results" = "No" is selected.	Yes No

5.8.11 Record

This method function defines the type and scope of the data to be output for a record using the printer (see "Peripherals" > "Printer").

If the method function "Record" is placed within a sample loop, the record will include all previous method functions within the current sample loop.

If the method function "Record" is placed outside of a sample loop, the record will include all previous method functions listed after the last sample loop in the method procedure. A few settings are not available outside of a loop.

Parameters	Description	Values
Summary	States whether or not a short summary of the results should appear at the top of the protocol.	No Per sample Per series out of loop: No Yes
Results	The results from the "Calculation" method functions. Any statistic selected will be recorded after the last sample of a series or multiple determination.	within loop: Per Sample Per Series No Out of Loop: No Yes
Raw results	The raw results produced during the determination	within loop: Per Sample Per Series No Out of Loop: No Yes
Measured value table	The table of measured values of the current sample (not available out of loop).	Last titration function All titration functions No
Sample data	The sample data of a sample loop. (Not available outside of loop)	Per sample Per series No
Resource data	All data in the setup regarding the resources used in the method.	Per Sample Per Series Non Per Sample Per Series No
E – V	Titration curve of the current sample. The potential is plotted against the volume (not available out of loop).	Last All No
dE/dV – V	The 1st derivation of the titration curve, potential against volume (with linear coordinate representation) (not available out of loop).	Last All No
log dE/dV – V	The 1st derivative of the titration curve for potential against volume. (With logarithmic ordinate display) (not available outside of loop)	Last All No
d ² E/dV ² – V	The 2nd derivative of the titration curve for potential against volume. (With linear coordinate display) (not available out of loop)	Last All No
E – t	Titration curve of the current sample. The potential is plotted versus the time. (Not available outside of loop)	Last All No
V – t	Titration curve of the current sample. The volume is plotted versus the time. (Not available outside of loop)	Last All No
dV/dt – t	The 1st Derivative of the titration curve volume against time" (not available out of loop).	Last All No
T – t	Titration curve of the current sample. The temperature is plotted versus the time. (Not available outside of loop)	Last All No

E – V & dE/dV – V	Two superposed titration curves E – V and dE/dV – V for the current sample. (Not available outside of loop)	Last All No
V – t & dV/dt – t	Two overlaid titration curves "V – t" and "dV/dt – V" of the current sample (not available out of loop).	Last All No
Method	Printout of the method used.	No Yes
Series data	All data from the series run.	No Yes
Calibration curve	Calibration curve. The sensor unit of measurement is plotted against the measured values of all samples (not available within loop).	No Yes

5.8.12 End of sample

The "End of Sample" method function closes a sample loop. A sample loop refers to the range of a method through which a sample series will pass for each sample. The commencement of a sample loop is specified using the "Sample" method function.

5.8.13 Titer

The "Titer" method function is only available outside a loop. This method function assigns the result of a sample loop to a titer and updates the value stored in Setup.

Parameters	Description	Values
Limits	Determines whether limits should be taken into account for acquisition of a value. If the value is outside these limits, the value is not transferred to Setup.	Yes No
Interruption outside limits	Determines whether the method should be interrupted if a value lies outside the defined limits (only appears if the "Limits" parameter has been activated). A message (which must be acknowledged) appears advising that the process has been interrupted during the time that the message is displayed.	Yes No
Lower limit	Defines the lower limit of a value. Appears only if the "limits" = "yes" setting was selected.	0...100
Upper limit	Defines the upper limit of the concentration limit.	0.1...100

5.8.14 Calibration

This method function assigns the result of a calibration loop to a sensor and updates the sensor setup. Calibration is only performed outside a loop. This method function can be applied both for "Calibration" and "pH-sensor test". The calibration can be performed for "Action" = Calibration" in the "Sample (Calib)" method function and the sensor test for "Action" = Sensor test".

Parameters	Description	Values
Limits	Determines whether limits should be taken into account for acquisition of a value. If the value is outside these limits, the value is not transferred to Setup.	Yes No

The "Limits" parameter is only available for "Action" = Calibration".



In cases of segmented calibration for pH and ISE sensors, the limits will be defined and observed for each segment.

Depending on the sensor type, if the "Limits" checkbox is activated, the following parameters can be determined (100% represents -59.16 mV/pH (sensor type: pH) or to -59.16 mV/[unit] /Ion charge (sensor type: ISE). The unit corresponds to the unit specified in the previous method function, "Sample (Calib)". (For temperature sensors, only the two info fields for the minimum and maximum zero point are displayed.)

For pH and ISE sensors:

Parameters	Description	Values
Interruption outside limits	Determines whether the method should be interrupted if a value lies outside the defined limits (only appears if the "Limits" parameter has been activated). A message (which must be acknowledged) appears advising that the process has been interrupted during the time that the message is displayed.	Yes No
Min. slope 1-8	The lower limit for the slope, in [%]. (100% refers to -59.16 mV/pH.)	10...200
Max. slope 1-8	The upper limit for the slope, in [%].	10...200
Min. zero point 1-8	The lower limit for the zero point.	-100...100
Max. zero point 1-8	The upper limit for the zero point.	-100...100



The determined slope is converted to 25°C and compared with the limits.

5.8.15 Blank

This method function assigns a result or arbitrary value to a blank value, including the unit.

Parameters	Description	Values
Name	Select a name from the list.	Blank 1...3
Value B=	Here you can enter a number or you can select a formula from the proposal list (via the Proposal button).	1 ... 120 Mean value [R1...R3]
Unit	The units in which the blank is specified.	Arbitrary
Limits	Determines whether limits should be taken into account for acquisition of a value. If the value is outside these limits, the value is not transferred to Setup.	Yes No
Interruption outside limits	Determines whether the method should be interrupted if a value lies outside the defined limits (only appears if the "Limits" parameter has been activated). A message (which must be acknowledged) appears advising that the process has been interrupted during the time that the message is displayed.	Yes No
Lower limit	Appears only if "limits" = "yes" was selected.	-10 ⁸ ... 10 ⁸
Upper limit	Appears only if "limits" = "yes" was selected.	-10 ⁸ ... 10 ⁸

5.8.16 Auxiliary value

This method function assigns a result or arbitrary value to an auxiliary value.

Parameters	Description	Values
Name	Select a name from the list.	Aux. val. 1...3
Formula H=	Here you can enter a formula that will be used to convert the result of the sample loop to the auxiliary value. You can also enter a number or an auxiliary value.	Formula Auxiliary value Number
Limits	Determines whether limits should be taken into account for acquisition of a value. If the value is outside these limits, the value is not transferred to Setup.	Yes No
Interruption outside limits	Determines whether the method should be interrupted if a value lies outside the defined limits (only appears if the "Limits" parameter has been activated). A message (which must be acknowledged) appears advising that the process has been interrupted during the time that the message is displayed.	Yes No
Lower limit	Appears only if "limits" = "yes" was selected.	-10 ⁸ ... 10 ⁸
Upper limit	Appears only if "limits" = "yes" was selected.	-10 ⁸ ... 10 ⁸

5.8.17 Auxiliary instrument

This method function activates external auxiliary instruments and enables the titrator to be controlled by such auxiliary instruments. The parameters described in the following can be defined for all control types. These are followed by parameters that can be defined explicitly for the relevant control type:

Parameters	Description	Values
Control type	The control type of the auxiliary instrument.	Output 24 V Stirrer Out TTL (Single pin) Input TTL (Single pin) RS-232
Name	Specify a descriptive name of your choice.	Arbitrary

5.8.17.1 Control type: 24V output

Parameters	Description	Values
Mode	Defines the mode for controlling the control output. Fixed time: The control output is switched on for the defined time interval. On Off: The control outlet is switched on or off. After a sample series the control outlet is automatically switched off.	On Off Fixed time
Time	A time span in [sec] can be defined here for which the control outlet should be switched on. Only if Mode = Fixed time .	0...10 ⁶

5.8.17.2 Control type: Stirrer

Parameters	Description	Values
Mode	Defines the mode for controlling the control output. Fixed time: The control output is switched on for the defined time interval. On Off: The control outlet is switched on or off. After a sample series the control outlet is automatically switched off.	On Off Fixed time
Time	A time span in [sec] can be defined here for which the control outlet should be switched on. Only if Mode = Fixed time .	0...10 ⁶
Speed	Defines the stirring speed in [%].	0...100

5.8.17.3 Control type: Out TTL (Single pin)

Parameters	Description	Values
Mode	Defines the mode for controlling the control output. For TTL signals, the number and type of the output signals is determined. Fixed time: The control output is switched on for the defined time period. On Off: The control output is switched on or off. Input controlled: A signal received at the control inlet controls the control outlet. The Auxiliary instrument function is terminated as soon as the signal changes at the control input or after a defined maximum time has expired. Sequential: The control output runs through a defined sequence.	On Off Fixed time Input controlled Sequential
Time	A time span in [sec] can be defined here for which the control outlet should be switched on. Only if Mode = Fixed time .	0...10 ⁶
Input	Select the auxiliary instrument to serve as the signal input (control input). Only if Mode = Input controlled .	Auxiliary instrument

Output signal	Normal: The signal is transmitted without conversion. Inverted: The signal is transmitted in inverted form. Only if Mode = Input controlled .	Normal Inverted
Max. time	The maximum waiting time for a signal change, in [sec]. After it expires, the method is continued even if no signal change was detected. Only for signal inputs.	0...10 ⁶
Number of pulses	The number of impulses in the planned sequence. Only if Mode = Sequential .	0...10 ⁴
Pulse duration	The duration of a pulse in [sec] (time switched on + time switched off). Only if Mode = Sequential .	0...10 ⁶
Interval	Defines the time span, in [sec], between two impulse starts. Only if Mode = Sequential .	0...10 ⁶ 0...10 ⁴

5.8.17.4 Control type: TTL input (single pin)

Parameters	Description	Values
Input signal	Indicates whether an rising or a falling input signal should be detected.	Rising Falling
Max. time	The maximum waiting time for a signal change, in [sec]. After it expires, the method is continued even if no signal change was detected. Only for signal inputs.	0...10 ⁶

5.8.17.5 Control type: RS-232

Parameters	Description	Values
Send output sequence	Defines whether an output sequence should be sent.	Yes No
Output sequence	The control sequence for the signal receiver - can also contain a formula enclosed in characters % or control characters in format \xxx where xxx is the decimal number of the control character. G20 supports only %R1% or %R2%. (Only if "Send output sequence" is activated).	%R%
Wait for response	Defines whether the system should wait for a response sequence from the device.	Yes No
Max. time	The maximum waiting time for an input sequence in [sec]. After it expires, the method will be continued even if no input sequence was detected. Only if Wait for input sequence = Yes .	0...10 ⁶ ∞
Input sequence	The response sequence from the external device. Only if Wait for response = Yes was selected.	Arbitrary

5.8.18 Drain

You use this method function to drain a specific volume from a sample vessel using a pump (membran -, peristaltic- or air pump (Solvent Manager)). You can specify the following parameters:

Parameters	Description	Values
Drain pump	Defines which pump is to be used for drainage.	List of available pumps
Drain volume	The volume to be drained, in [mL]. Not if Drain pump = Solvent Manager .	0...1000

Duration	The duration to drain the solvent , in [sec]. Only available if Drain pump = Solvent Manager .	0...10 ³
-----------------	--	---------------------

5.9 Method functions Within a Loop

The method functions that are permitted between the "Sample" and "End of sample" method functions are limited and depend on the loop type.

The options within a calibration loop are identical to those in the sample loop with the restriction that they cannot contain any titration method functions, and the method function "Measure (Normal)" must occur (only) once in the loop.

The same options that apply for the sample loop also apply for the titer loop, however the (titer) loop must contain at least one titration method function.

The following method functions are essentially permissible within a sample loop in arbitrary order.

- Drain
- Calculation
- Blank
- Dispense (Normal)
- Auxiliary instrument
- Measure
- Record
- Pump
- Stir
- Titration (EP, EQP, LearnEQP)
- Titration stand



For the method functions "Titration stand", "Calculation", and "Record", certain rules must be followed:

- The method function "Titration stand" must appear immediately after the loop-initializing functions "Sample", "Sample (Calib)" or "Sample (Titer)".
- A maximum of four "Titration Stand" method functions within a loop can be applied.
- It is best to insert the method function "Calculation" after the method function that determines the raw results for the calculation.
- The method function "Record" can be only inserted after the method function that generates the results the record should contain.

5.10 Method functions Outside of a Loop

In addition to the preset "Title" method function, which always appears at the start, additional method functions can be inserted outside a loop depending on the method type:

- Drain
- Calculation
- Blank
- Dispense (normal)
- Auxiliary instrument
- Calibration (position is fixed)
- Pump
- Record
- Titer (position is fixed)
- The method function "Calibration" must appear immediately after the "End of Sample" method function of a calibration loop.
- The method function "Titer" must appear immediately after the "End of Sample" method function of a titer loop.
- The same options are available for calibration and titer methods. In addition, when entering a loop, enter the method functions "Calibration" or "Titer", as appropriate after the "End of Sample" function.

6 Series Templates

You can use series templates to gather up to 120 individual samples to form a **sample series**. All samples in the series are analyzed one after the other with a defined method (analysis template for sequential processing of samples using the same method).



- You can create a shortcut on the Homescreen for all series templates.
- A maximum of 60 sample series can be stored in the titrator.

If you select a series template from this list by clicking on it, you can change its parameters or delete the entire template.

You can choose **New** to create a new series template. The following parameters will be available:

Parameters	Description	Values
Sample series ID	Here you can assign any ID to the sample series.	Arbitrary
Method ID	Here you can select the Method ID for the relevant method.	Method list
Comment	You can enter a brief comment about the series.	Arbitrary
Number of samples	Defines the number of samples to be analyzed.	1...120
Number of standards	The number of standards to be analyzed with a method or series.	1...120
Number of buffers	The number of buffers to be used for the calibration of a pH sensor.	1...9

During the creation of a sample series, you can choose "**Samples**" to display the loop list (method type: "GT") or to the standard list (method type "Titer" and "Calibration"). From these lists, you can change predefined sample or standard data or you can create new sample or standards.

6.1 Sample or Standard Parameters

The sample list, which can be opened by choosing **Samples** in the series parameter window, displays all samples of a loop with a number, the first ID, and the sample size (depending on entry type - see "Method functions: Sample" (page 48)). You can also edit the samples here.



- Series IDs must be unique, although sample IDs do not have to be.
- For titer loops, the standard name and the sample size are listed, and for calibration loops the name of the list of standards and the individual standards.

Select an entry from the list. You can define the following parameters for each sample, depending on the type of the loop (Sample, Titer, Calibration):

Parameters	Description	Values
Number	Defines the number of the sample.	1...120
ID	A user-defined name for the ID of the sample, in accordance with the "Sample" method function.	Arbitrary
Sample size	You can enter the sample size here. For fixed entry types, this field only appears as an info field.	0...1000 [g] [mL] 0...10 ⁶ [pcs.]

*The entered value of the sample size has to be valid within the range which is configured in the "Sample" method function of the relevant method.

Weight per piece	The weight in [g] per piece. Appears only if Entry type = Pieces or Fixed pieces was selected.	0 ... 1000
Density [g/mL]	The density of the sample for the entry types "Weight", "Fixed weight", "Volume" and "Fixed volume".	0.0001...100
Comment	You can enter a brief comment about the series.	Arbitrary
Correction factor	Any correction factor that can be used in calculations.	0.0001...10 ⁶
Temperature	The temperature in [°C] during the analysis. If temperature monitoring is activated in a titration function, the system will ignore the sample temperature given here.	-20...200



For entering the sample parameters, particularly for numerous samples, the titrator provides you with assistance in the entry windows of the "ID 1" and "Sample size" parameters:



These extra icons are a quick, direct way to jump to the entry window of the previous sample or next sample. You can also choose "**Sample ID 1**" and "**Sample size**" to switch directly between the entry windows for the sample parameters "ID 1" and "Sample size".

7 Analysis Sequences

7.1 Starting an Analysis

An analysis can be started on the titrator in several different ways:

1. By choosing one of the following buttons:
 - **Start** from the method editor
 - **Start** from Homescreeen
 - **Start** from the **Series** dialog
 - **Titer** to perform a titer determination in **Setup** (Navigation: Setup > Chemicals > Titrant > Titrant Parameters).
 - **Calibration / Sensor test** to calibrate or to test pH sensor in **Setup** (Navigation: Setup > Hardware > Sensors > Sensor Parameters), refer to section "Setup: Hardware > Sensors".
2. Using a user-specific shortcut or a direct shortcut from Homescreeen.

When you create a shortcut by choosing **AddToHome** (see "Description of Functions > The User Interface > Shortcuts and Direct Shortcuts"), the following parameters are available:

Parameters	Description	Values
Description	Any name for the shortcut.	Arbitrary
Immediate start	The method, series, or manual operation can be started immediately. This enables you to start the analysis without any interfering dialog.	Yes No
Homescreeen position	You can select the free position for the shortcut on the Homescreeen.	4

After you create the shortcut, it appears in the selected position in "Home", from where you can select it by tapping the touchscreen.

When you start an analysis, whether by using a button or with a shortcut, the system always opens the **Start analysis** dialog (see "Description of Functions > The User Interface > The Start Analysis Dialog"). The only exceptions are direct shortcuts ("Immediate start" = "Yes"), whose selected settings permit a direct start.

At the start of an analysis, you can still make changes to various settings in the **Start analysis** dialog. It is therefore possible, for example, to modify the sample size and define the number of samples to be determined.

If the analysis you want to start is a single determination, you can enter the sample size or sample ID directly as a parameter in the **Start analysis** dialog.

In general, the sample data can be entered for each individual sample using the **Samples** button in the **Start analysis** dialog. In the **Sample data** dialog that opens when you choose this button, a list of the individual samples is displayed.

In addition, the status is displayed for every sample (regardless of the loop type) in the **Sample data** dialog. The following status levels can be assigned to a sample:

- **Idle**: The sample is not yet running and the sample data can still be edited
- **Running**: The sample is running but the sample data can still be edited
- **Active**: The sample is running and the sample data can no longer be edited
- **Done**: Done – the sample has run and concluded and the sample data can no longer be edited

If you select a sample, you can define the following sample data.

To enter sample data, tap on "Sample" in the **Start analysis** dialog. The **Sample data** dialog opens. You can tap on an entry in the "Sample list" or you can tap on **New** to specify the sample data via the following parameters:

Parameters	Description	Values
Number	Defines the number of the sample.	1 ... 120
ID 1	The ID for the first or only sample of an analysis.	Arbitrary
Sample size	You can enter the sample size here. For fixed entry types, this field only appears as an info field.	0 ... 1000 [g] [mL] 0 ... 10 ⁶ [pcs.]
Weight per piece	The weight in [g] per piece. Appears only if Entry type = Pieces or Fixed pieces was selected.	0 ... 1000

Density	You can enter the sample's density, in [g/mL], here. Does not appear for the Entry type = Pieces and Fixed pieces .	0...100
Comment	You can enter a brief comment about the series.	Arbitrary
Correction factor	Any correction factor that can be used in calculations.	0.0001...10 ⁶
Temperature	The temperature in [°C] during the analysis. If temperature monitoring is activated in a titration function, the system will ignore the sample temperature given here.	-20...200

You can enter the following parameters in the **Start analysis** dialog, depending on the type of analysis to be started and the resources used:

Parameters	Description	Values
Type	The type of analysis to be started.	Method Series
Number of samples	Defines the number of samples to be analyzed.	1...120
Number of standards	The number of standards to be analyzed with a method or series.	1...120
ID 1	The ID for the first or only sample of an analysis.	Arbitrary
Sample size	You can enter the sample size here. For fixed entry types, this field only appears as an info field.	0...1000 [g] [mL] 0...10 ⁶ [pcs.]

- All the parameters that can be edited in the **Start analysis** dialog or the sample data dialog will overwrite the settings defined in the method for the same parameters.
- All non-editable parameters that are displayed as an info field are only shown for orientation purposes and list the settings from the method.
- If the sample size must be entered before the analysis but the user does not do so, the user will be required to enter it immediately before the start of the analysis.

7.2 Analysis Sequence Steps

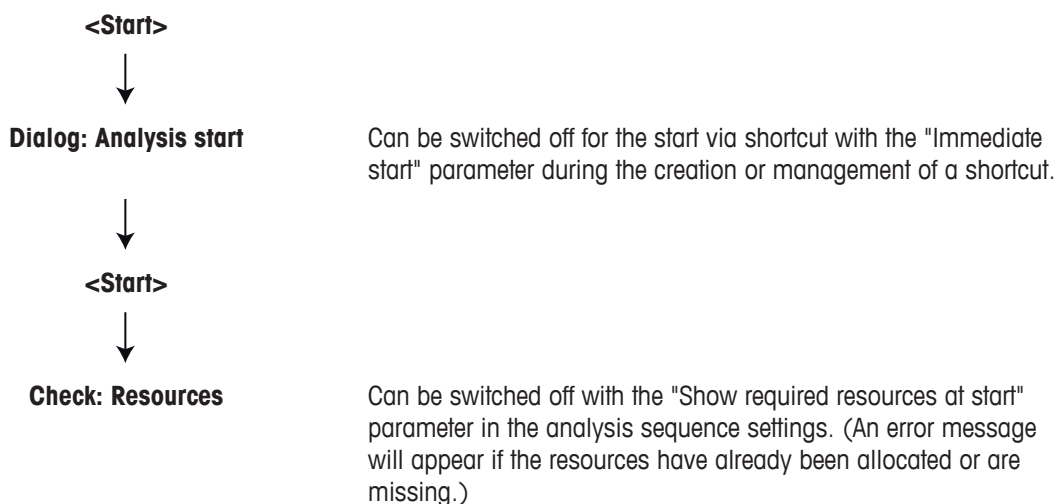
During the processing of an analysis, starting from the start of the analysis and sample addition through to the results display, the titrator displays a range of dialog windows, some of which the user has to confirm in order for the analysis to continue. These dialog windows are used to ensure faultless processing, and also to provide the user with information.

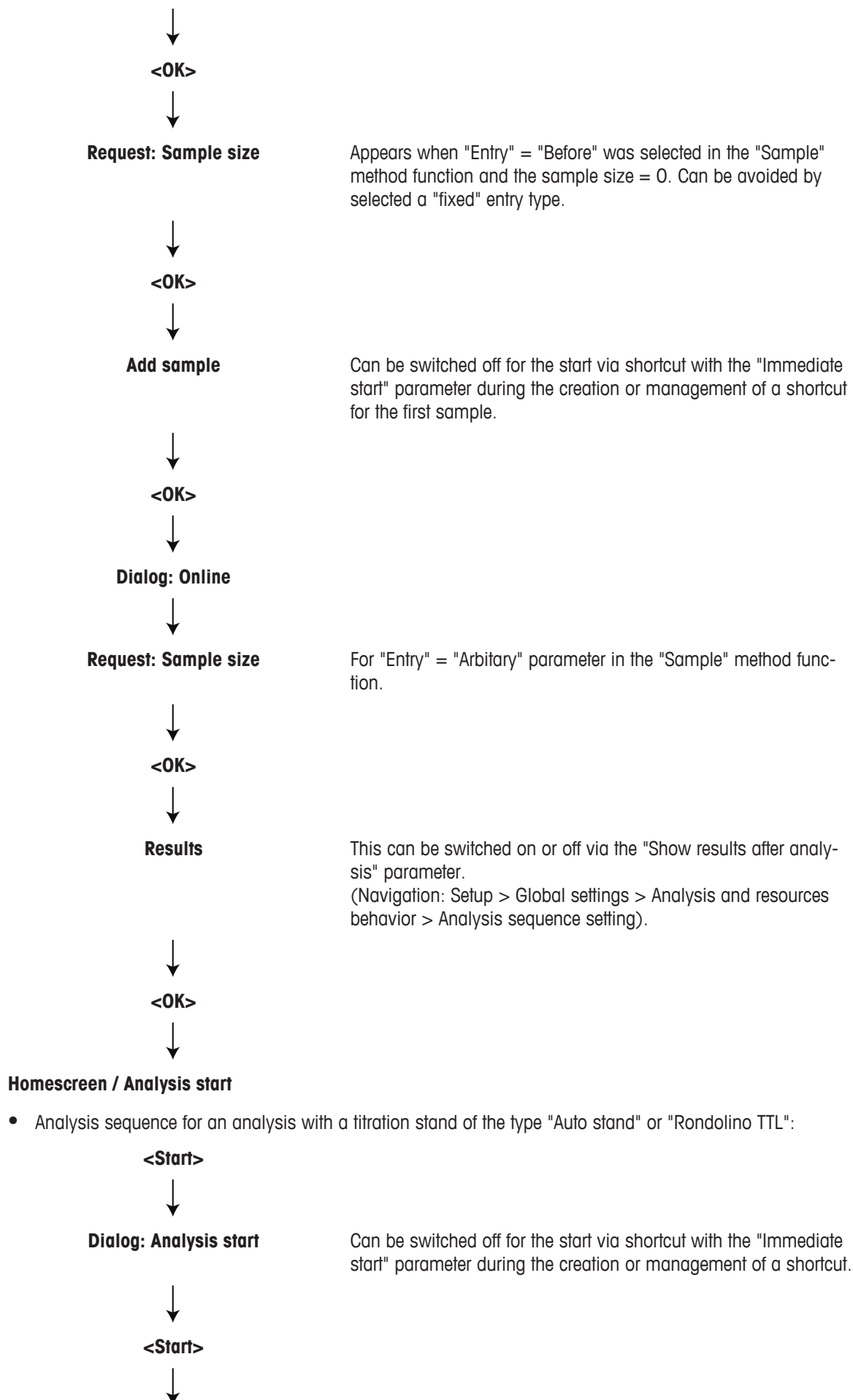
Depending on the required degree of automation for an analysis, it can, however, be useful and desirable to deactivate particular security questions or information dialogs to ensure that the sequence is processed without interruption. Below are some process flow examples.

7.2.1 Analysis sequence

For GT analyses, the sequence with the use of a manual or with the use of an automatic titration stand is shown. In each case, you are told where the individual screens can be switched off in the user interface.

- Analysis sequence for an analysis with a titration stand of the type "Manual stand":





Check: Resources

Can be switched off with the "Show required resources at start" parameter in the analysis sequence settings (Navigation: Setup > Global settings > Analysis and resources behavior > Analysis sequence settings).



<OK>



Online Dialog



Results

Can be switched off with the "Show results after analysis" parameter in the analysis sequence settings (Navigation: Setup > Global settings > Analysis and resources behavior > Analysis sequence settings).

Note:

At the end of a series, all results are listed. The display of this list can be switched on or off via the "Show results after analysis" parameter.



Homescreen / Analysis start

8 Titrator Evaluation Procedure

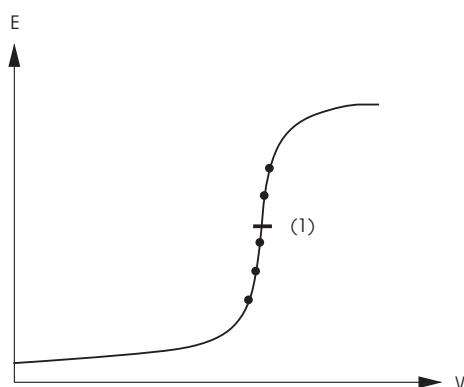
The identification of equivalence point candidates within a defined recognition range can be done using four different evaluation methods:

- Standard
- Minimum / Maximum
- Segmented
- Asymmetric

Which method you use for the evaluation will depend on the type of titration or the form of the resulting titration curve. The procedure to be used is defined in the "Evaluation and recognition" method subfunction of the "Titration (EQP)".

8.1 Standard Evaluation Procedure

The titrator's standard evaluation procedure is based on the chemical model of a classic acid-base titration. In this model, the equivalence point of such a titration will be at the point of inflection of the S-shaped titration curve and the curve will be symmetrical with regard to this inflection point.



For the recognition of an inflection point using the standard procedure, the titrator will always look at one group of measured values (a "measured value window"). It will examine whether an inflection point is detectable for that group of measured values. This window will then be shifted along the curve by one measured value and reexamined for points of inflection. The system repeats this procedure until it detects no inflection point twice in a row. It then uses the inflection points found to define the most suitable one as the final inflection point of the titration.

(1) Inflection point

The standard evaluation procedure initially only identifies points of inflection. Criteria defined by the user in the method can influence whether and when an inflection point is to be registered as an EQP candidate.

If so defined in the method, the following criteria will have to be fulfilled:

- The inflection point must lie within a recognition range.
- It must be above a threshold (refers to the first derivative).
- The titration curve must demonstrate a specified tendency in the area of the inflection point.

EQPs are only detected in the range of the measured curve which is specified by the "Tendency" parameter (Positive, Negative), refer to method function "Titration (EQP): Evaluation and Recognition".

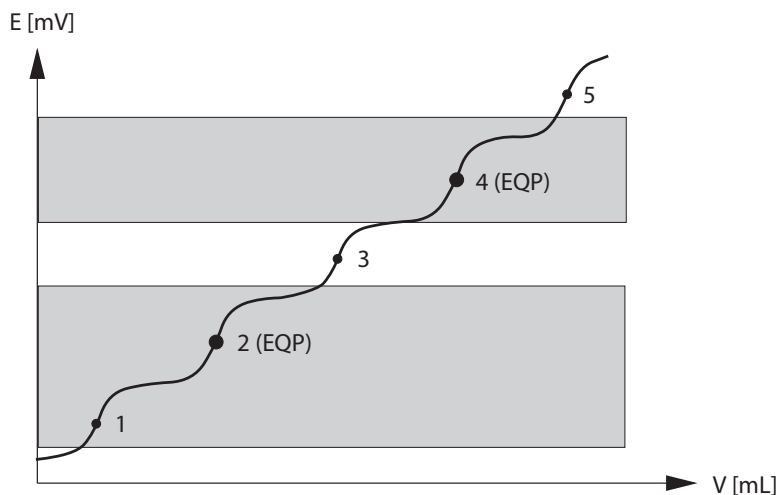
If these criteria are fulfilled, the inflection point becomes an EQP candidate.

The additional EQP criteria can now be used to influence which EQP candidates are ultimately recognized as equivalence points.

For the standard evaluation, the additional EQP criteria "Last EQP" and "Steepest jump" are available. They can be selected individually for each defined recognition range.



These criteria can be defined in the "Evaluation and recognition" subfunction of the "Titration EQP" method functions.



Theoretical example for the evaluation of a titration curve with five points of inflection

Explanation:

This titration curve shows five points of inflection (1 – 5).

Inflection points 1, 2 and 4 are recognized as EQP candidates, since only these points lie within the 2 recognition ranges while also fulfilling the "Tendency" and "Threshold" parameters.

The specified "Additional EQP criteria" then determine whether the EQP candidates are actually recognized as EQP. These additional EQP criteria can be defined for every recognition range.

In the example shown above, the following were specified as additional EQP criteria:

Recognition Range 1: "Last EQP"

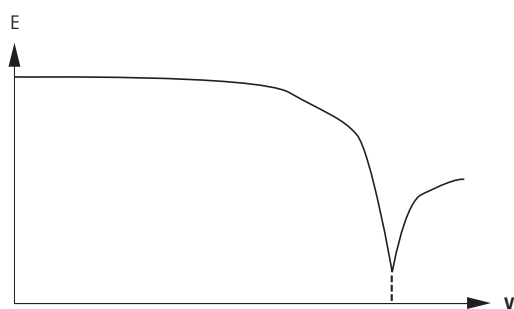
Recognition Range 2: "No"

Of the two EQP candidates found in Recognition Range 1, the system only identifies the second one as an EQP due to the "Final jump" criterion. The first one remains merely an EQP candidate.

The termination criterion defined was that the titration should be terminated after the recognition of three EQP candidates ("Termination after EQP" = "3"). In the above example the titration is terminated on identification of the 4th turning point (3rd EQP candidate).

8.2 Minimum / Maximum

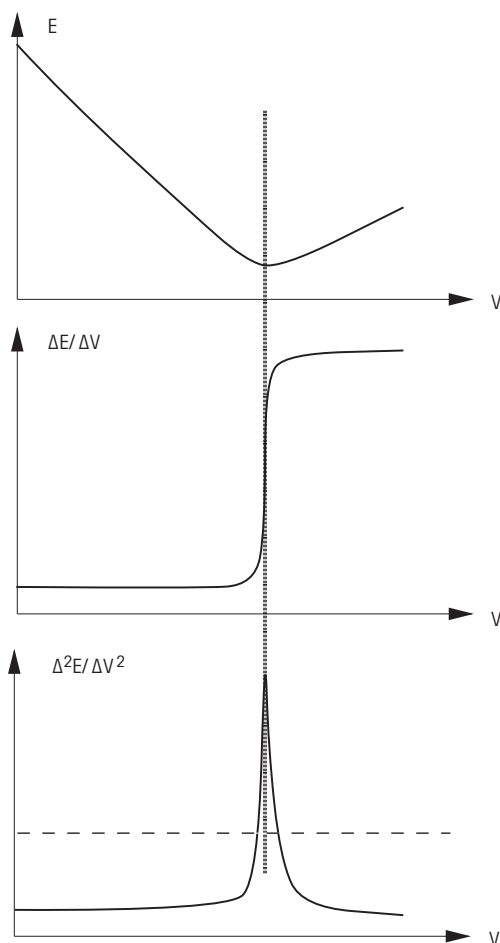
The result of this evaluation is the calculated minimum (maximum) of the measured titration points. The classic example of a titration curve with a minimum is the photometrically indexed surfactant determination.



The minimum (maximum) is calculated using a polynomial approximation of the titration curve in the range of the minimum (maximum). The equivalence point recognition is done directly from the titration curve data.

8.3 Segmented Evaluation

Various indication methods (including photometry, conductometry, and amperometry) generate titration curves with linear or approximately linear sections (segmented curves). The titrator uses individual procedures to evaluate these curves. For a precise determination of the equivalence point, it is very important that these curves have both linear segments and a clear bend.



Titration curve

The titration curve contains two more or less linear segments and a bend between these two segments. The evaluation of segmented curves is generally done with the aid of the standard procedure for S-shaped curves, with the system using as its evaluation basis not the titration curve's measured points but the data calculated from them in the first derivative.

1. Derivative

The first derivative of a segmented curve is the first to demonstrate the typical S shape. Its inflection point is the titration's equivalence point.

2. Derivative

The threshold references the second derivative of the titration curve. In other words, the equivalence point for a defined threshold must be above this threshold number.

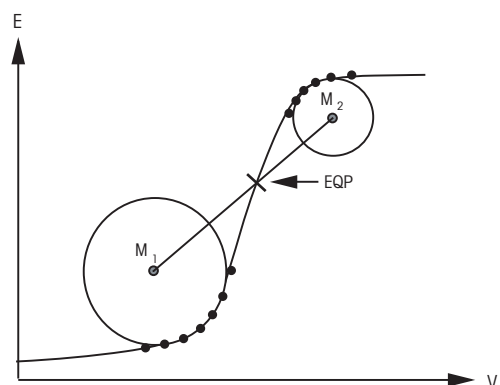
EQPs are only detected in the range of the measured curve which is specified by the "Tendency" parameter (Positive, Negative), refer to method function "Titration (EQP): Evaluation and Recognition". Within the segmented procedure the tendency refers to the 1. derivative.

8.4 Asymmetric

For markedly asymmetrical curves, the standard procedure can result in a systematic error. The difference between the true equivalence point and the point of inflection can be greater than the normally achievable precision. For these cases, the titrator uses an evaluation that uses the Tubbs method.

This empirical approximation method is a procedure for the evaluation of asymmetrical, analog-registered titration curves. It can also be used for digitally recorded titration curves. The Tubbs procedure result will be closer to the true equivalence point for some asymmetrical curves than the inflection point.

This evaluation procedure is based on the following considerations:



Each of the two branches of the titration curve will have a writable osculating circle with a minimal radius. The relationship between the two radii is determined by the curve's asymmetry. The intersection of the connecting lines between the circle center points M1 and M2 and the titration curve produces the desired equivalence point. Theoretical calculations show that the true equivalence point for asymmetrical titration curves will always lie between the inflection point and the branch of the titration curve with the greater degree of curvature (i.e. the smaller osculating circle).

The titrator uses a hyperbola to approximate those parts of the titration curve located in the area of the greatest curvature. For each approximated hyperbola, the system determines the peak (the point with the greatest curvature). The center points of the assigned smallest osculating circles are the focal points of both hyperbolas. The intersection of the connection lines from the two focal points and the titration curve produces the desired equivalence point, as shown above.

The evaluation requires at least six measured values in the area of the greatest curvature before and after the titration curve's inflection point. If the course of the titration curve does not permit the inclusion of the osculating circles, the titrator will use the standard procedure to calculate the equivalence point. You will be notified of this in the record of the "raw results".

EQPs are only detected in the range of the measured curve which is specified by the "Tendency" parameter (Positive, Negative), refer to method function "Titration (EQP): Evaluation and Recognition".

9 Analysis Data

The "Analysis data" include different types of data that can be used at various times during the planning and execution of an analysis.

The system differentiates between the following types of analysis data:

Raw data	Raw data are defined when you create a method or series. They are automatically generated and stored during the analyses. Raw data are always created for each analysis and cannot be influenced by the user.
Method data	All data for the method run.
Series data	All data from the series run, such as e.g. the series ID and the number of samples.
Sample data	All data from the analyzed samples, such as e.g. the sample size, sample density and sample ID.
Resource data	Data for all resources used during the execution of an analysis (for example, titrant, auxiliary instrument). The data for a resource are copied from the setup at the time when it is used in an analysis.
Table of measured values	Tables of measured values are created by some method functions during an analysis and can be output in the record.
Raw results	Raw results are data determined by the titrator during an analysis, such as used titrant volumes and measured values. The raw results can be converted into the actual analysis results in the "Calculate" method function using the appropriate symbols and formulas. Some of the raw results are always produced automatically and others are only generated when used within a calculation.
Results	Results are the results of the conversions of raw results run within the "Calculate" method function. The results of an analysis can be influenced by the user.

Of these, the following can be used in calculations:

- Sample data (such as the sample size or the sample density)
- Resource data (e.g. mole quantity and equivalence quantity for a substance)
- Raw results (e.g. blank)
- Results (the results of a calculation can then be used in a subsequent calculation).

10 Calculation and Results

The method functions "Titration (EP)" and "Titration (EP)", Measure (normal) and Dispense provide their own raw results within a method. These raw results are saved by the titrator in the order in which the generating method functions are processed within the method.

Example: Sequence of the calculations in the method, generating two results

Method function	Result
Title	
Sample	
Titration stand	
Stir	
Titration (EQP)	
Calculation	R1
Calculation*	R2
End of sample	

*: Allowed are a maximum of two "Calculation" method functions, which can either be inserted within a loop as well as outside of a loop.

The definitions to the parameters you can determine in the "Calculation" method function are available in "Methods: Method functions > Calculation"

10.1 Symbols for calculations

Inside the method function **Calculation**, you can access certain analysis data (**Raw results**, **Results**, **Resource data** and **Sample data**) via the different symbols. The following is a list of the symbols used for the G20. The list also contains additional symbols which are used in the records.

Symbol	Meaning
VEQ (=V)	Titration consumption in [mL] up to the end point or equivalence point. For multiple equivalence points, the consumption is calculated from the previous equivalence point.
Q	Substance quantity in [mmol] used up to the end point or equivalence point.
QEND	The total substance quantity in [mmol] used up to the end of a titration method function.
QENDDi	The total substance quantity in [mmol] used during a dispensing method function.
QE(H[AuxValue])	Consumption up to the auxiliary value in [mmol].
E	The measured potential of a method function Measure (normal) in [mV, pH...].
c	Gives the nominal concentration in [mol/L] of the titrant being used.
pw(-E)	The ionic concentration in [mol/L], [E=pH, pX, pM].
T	The measured temperature in a method function Measure (normal) (direct measurement with temperature sensor or concomitant temperature acquisition) in [°C], [K], [°F].
M	The molecular weight of a substance (as stored in the setup).
z	The equivalent number of a substance (as stored in the setup).
B[Blank]	A blank.
m	The sample size [g, ml, pcs].
H[AuxValue]	An auxiliary value.
d	The density of a sample or a standard [g/mL].
wp	The weight per piece (can be changed in method function Sample) [g].
p	The purity of a fixed titer standard [%].
cst	The concentration of a liquid titer standard [mol/L].
Rx	A result x.

Symbol	Meaning
C	A constant that uniquely belongs to the result Rx. This means it can not be used for the calculation of other results. For information on using Constant C= , refer to "Results: results proposal lists".
Mean[Rx]	The mean value of a result Rx.

10.2 Calculation formulas

Calculation formulas are used in the "Calculate" method function.

One typical example for a formula within the "Calculation" method function would be the expression $R=VEQ$. In this case, the consumed volume of titrant up to the point at which the end point is reached is assigned to R. All the symbols can be used for analysis data in relations like this. The analysis data to be used must be generated by the method before the "Calculate" method function.

Auxiliary values and blanks defined in the setup can generally be used in formulas in the same manner as symbols. The general form for an auxiliary value is: H[Name] (as defined in the setup).

10.3 Results

The **Results** dialog can be accessed directly from Homescreen using the relevant button.

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- The system only saves the results from the last analysis (series or individual sample).
- When you start a new analysis, you will lose the results from the previous analysis.
- You can see the results immediately after they are generated.

You can use the various buttons in the **"Results"** dialog to access different functions. You can, for example,

- view all results of the last analysis
- view statistics, perform an outlier test and if necessary, exclude samples from the statistics.
- perform recalculations for results in which certain raw data (e.g. sample sizes) have to be adapted retrospectively for a single sample or for all samples in a series.
- view and print the status and the calculated results of each individual sample.

Results are retained until new results are generated by methods. The results of the "older" of the two sample series are replaced.

All the changes performed on the saved results can be reversed with the **"Undo changes"** button.

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Changes to results are indicated by an asterisk in the record. Example: VEQ*.

All results

You can use the **All Results** button to view the results of the last analysis and print them if a printer is connected to the titrator (see "Printer").

From the **Results** dialog, you also have the following additional options:

- **Samples** View or print the results of an individual sample or exclude the entire sample (see "Results: Samples")
- **Statistics** Switch to the "Statistics" dialog (see "Results: Statistics")

Delete all results

You can use this button to delete all the data (raw data, raw results, and results) saved by the titrator in the results range.

Undo changes

If you make changes to the results saved by the titrator after the analysis, you can use **Undo changes** to discard them. Afterward, the system will reinstate the initial status directly after the conclusion of the analysis, in its original and unchanged state.

Statistics

For results within a sample loop, you can display and print out statistics.

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The statistics are only created if more than one sample was analyzed in the corresponding loop.

The following calculated values will be displayed as statistical components:

- Mean value $\bar{x}$ of a result R_x (Mean $[R_x]$)
- Standard deviation s
- Relative standard deviation s_{rel}
- Number of samples per loop n_{TOT}

If a result was excluded from the statistics, all the results from that sample will always be excluded as well. The system will then recalculate the statistics without the excluded sample and label them accordingly. If the sample's results are then put back into the statistical evaluation, the label will be removed from the statistics.

From the **Statistics** dialog, you also have the following additional options:

- **Samples** View, print, or exclude the results of an individual sample (see "Samples")
- **Results** View or print all results (see "All Results")
- **Outlier test** Perform a test for outliers in the statistical evaluation.

Samples

You can use the **Samples** button to display and print the status and calculated results for each individual sample. The same applies for a series of additional data sets that can be accessed via **"Data"**. This will let you view and print the sample, method and resource data for each sample and view and print the raw results and the measured values.

You can use the **Exclude** button in the Results: **Samples** dialog to exclude individual samples from the statistical evaluation. The system will not delete the results of the samples excluded in this way but merely label them as excluded. They will no longer be included in the statistics. Samples that have been excluded can be returned to the statistics at any time by choosing **"Include"**.

After a sample is excluded, all affected calculations (inside and outside of loops) are performed again.

Outlier test

If the results of individual samples in a measurement series deviate greatly from the calculated mean value, it may make sense to question the significance of these (few) results and treat them as "outliers".

Outliers will have the following effects on the overall result of an analysis:

- The mean value is significantly shifted higher or lower.
- The standard deviation is increased.
- The distribution of the individual values around the mean value is distorted and no longer follows a normal distribution.

The titrator has an automatic function for identifying and labeling outliers. You can call this function from the **Statistics dialog** using the **"Outlier test"** softkey.

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You can run an outlier test if you have the results from more than three samples.

The procedure used by the titrator is the Grubbs outlier test. For this procedure, the measured value $[x^*]$ that has the greatest deviation from the calculated mean value is analyzed. This number is used in the following equation, together with the mean value $[\bar{x}]$ and the standard deviation $[s]$:

$$PG = \frac{|x^* - \bar{x}|}{s}$$

The test variable $[PG]$ is then compared with the corresponding value in the Grubbs table $G(N, 90\%)$, which in turn depends on the number of measured values N :

N (number of samples)	1	2	3	4	5	6	7	8	9	10
90 %	-	-	1.15	1.46	1.67	1.82	1.94	2.03	2.11	2.18
N (number of samples)	11	12	13	14	15	16	17	18	19	20
90 %	2.23	2.29	2.33	2.37	2.41	2.44	2.48	2.5	2.53	2.56
N (number of samples)	21	22	23	24	25	26	27	28	29	30
90 %	2.58	2.6	2.61	2.63	2.65	2.67	2.69	2.7	2.72	2.74
N (number of samples)	31	32	33	34	35	36	37	38	39	40
90 %	2.75	2.77	2.78	2.79	2.81	2.82	2.83	2.84	2.86	2.87

N (number of samples)	41	42	43	44	45	46	47	48	49	50
90 %	2.88	2.89	2.9	2.91	2.92	2.92	2.93	2.94	2.95	2.96
N (number of samples)	51	52	53	54	55	56	57	58	59	60
90 %	2.97	2.97	2.98	2.99	3	3	3.01	3.02	3.02	3.03
N (number of samples)	61	62	63	64	65	66	67	68	69	70
90 %	3.03	3.04	3.04	3.05	3.05	3.06	3.06	3.07	3.07	3.08
N (number of samples)	71	72	73	74	75	76	77	78	79	80
90 %	3.08	3.08	3.09	3.09	3.1	3.1	3.11	3.11	3.12	3.12
N (number of samples)	81	82	83	84	85	86	87	88	89	90
90 %	3.12	3.13	3.13	3.14	3.14	3.15	3.15	3.16	3.16	3.17
N (number of samples)	91	92	93	94	95	96	97	98	99	100
90 %	3.17	3.17	3.18	3.18	3.19	3.19	3.2	3.2	3.21	3.21
N (number of samples)	101	102	103	104	105	106	107	108	109	110
90 %	3.21	3.22	3.22	3.22	3.23	3.23	3.23	3.23	3.24	3.24
N (number of samples)	111	112	113	114	115	116	117	118	119	120
90 %	3.24	3.22	3.25	3.25	3.26	3.26	3.26	3.26	3.27	3.27

If the calculated test variable PG is greater than the corresponding value taken from the table, the measured value x^* is identified as an outlier and marked accordingly.

After an outlier has been identified, the test is repeated with the remaining measured values (without the already identified outlier) using the newly calculated mean value and new standard deviation. This process is repeated continually until no further outlier can be identified.

It is then the user's responsibility to exclude any identified outliers from the statistics. After confirmation, the entire sample is excluded and the statistics are recalculated without the identified and excluded outliers.

10.4 Results proposal lists

Proposal list

In the "Calculation" dialog window (see "Methods: Method functions > Calculation"), using the **Results proposals** button, specified results with unit, formula and Constant can be selected.

Proposal lists for the "Sample" and "Sample (Titer)" method functions are dependent on the "Entry type" parameter. When the "Entry type" is modified, a validation is immediately carried out to determine whether the selected calculation exists in the corresponding entry type.

Result type: Predefined

After selecting a result from the proposal list, the "Result unit", "Formula" and "Constant" fields are automatically populated and can not be modified. Result, Result unit and the entry type selected in the "Sample" method function are used to determine the formula.

Result type: User defined

If the parameter "Result type=User defined" is selected, you can modify the "Result", "Result unit" and "Constant" fields; though not the formula.

The mode "User defined" only offers empty proposal lists. A result can only be selected in Predefined mode. If you switch this to "User defined", a number can be entered for "Constant C =".

The proposal lists inside and outside a loop are different. Inside a loop and for the "Result type=Predefined", the calculation type can also be selected ("Direct titration", "Back titration", "Blank-compensated", "Others").



An auxiliary value exists in the setup. This can not be deleted, nor can addition auxiliary values be created. The name of the auxiliary value is fixed.

The different proposal lists are displayed as follows:

10.4.1 Results proposal list inside loop

10.4.1.1 Proposal list for "Calculation type=Direct titration"

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Consumption	mL	--	VEQ	C = 1
	mL/g	g	VEQ/m	
	L	mL	VEQ/m	
	mmol	--	Q	
	mL	--	VEQ*f	
	mmol	--	Q*f	
Total consumption	mmol	--	QEND	
Consumption until pot.	mmol	--	QE(H[AuxValue])	
Content	mg/g	g mL: m*d pc: m*wp	Q*C/m	C = M/z
	mol/kg			C = 1/z
	mmol/g			
	mmol/kg			C = 1000/z
	ppm			C = M*1000/z
	%			C = M/(10*z)
	g/100g			
	mg/100g			C=100*M/z
	mL/g		VEQ*f/m	1
	mmol/g		Q*f/m	1
Content	g/L	g: m/d mL	Q*C/m	C = M/z
	mg/L			C = M*1000/z
	mol/L			C = 1/z
	eq/L			C = 1
	meq/L			C = 1,000
	mmol/L			C = 1000/z

10.4.1.2 Proposal list for "Calculation type=Automatic back titration"

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Consumption	mL	--	VEQ	C = 1
	mL/g	g	VEQ/m	
	mL/mL	mL	VEQ/m	
	mmol	--	Q	
Total consumption	mmol	--	QEND	
Consumption until pot.	mmol	--	QE(H[AuxValue])	
Content	mg/g	g mL: m*d pc: m*wp	R = (QENDDi-Q)*C/m	C = M/z
	mol/kg			C = 1/z
	mmol/g			
	mmol/kg			C = 1000/z
	ppm			C = M*1000/z
	%			C = M/(10*z)
	g/100g			
	mg/100g			C=100*M/z

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Content	g/L	g: m/d	R = (QENDDi-Q)*C/m	C = M/z
	mg/L	mL		C = M*1 000/z
	mol/L			C = 1/z
	eq/L			C = 1
	meq/L			C = 1,000
	mmol/L			C = 1000/z

10.4.1.3 Proposal list for "Calculation type=Manual back titration"

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Consumption	mL	--	VEQ	C = 1
	mL/g	g	VEQ/m	
	mL/mL	mL	VEQ/m	
	mmol	--	Q	
Total consumption	mmol	--	QEND	
Consumption until pot.	mmol	--	QE(H[AuxValue])	
Content	mg/g	g	R = (H[AuxValue] –Q) * C/m	C = M/z
	mol/kg	mL: m*d		C = 1/z
	mmol/g	pc: m*wp		C = 1000/z
	mmol/kg			C = M*1000/z
	ppm			C = M/(10*z)
	%			
	g/100g			
	mg/100g			C=100*M/z
Content	g/L	g: m/d	R = (H[AuxValue]–Q) * C/m	C = M/z
	mg/L	mL		C = M*1000/z
	mol/L			C = 1/z
	eq/L			C = 1
	meq/L			C = 1,000
	mmol/L			C = 1000/z

10.4.1.4 Proposal list for "Calculation type=Blank-compensated"

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Consumption	mL	--	VEQ	$C = 1$
	mL/g	g	VEQ/m	
	mL/mL	mL	VEQ/m	
	mmol	--	Q	
Total consumption	mmol	--	Q _{END}	$C = 1$
Consumption until pot.	mmol	--	$Q_{E(H[AuxValue])}$	

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Content	mg/g	g mL: m*d pc: m*wp	$R = (Q - B[\text{Blank}]) * C/m$	$C = M/z$
	mol/kg			$C = 1/z$
	mmol/g			$C = 1000/z$
	mmol/kg			$C = M * 1000/z$
	ppm			$C = M/(10 * z)$
	%			
	g/100g			$C = 100 * M/z$
	mg/100g			
	mg KOH/g		$R = (QE(H[AuxValue]) - B[\text{Blank}]) * C/m$	$C = M/z$
Bromine No.	g/100g		$R = (QEND - B[\text{Blank}]) * C/m$	$C = M/(10 * z)$
Content	g/L	g: m/d mL	$R = (Q - B[\text{Blank}]) * C/m$	$C = M/z$
	mg/L			$C = M * 1000/z$
	mol/L			$C = 1/z$
	eq/L			$C = 1$
	meq/L			$C = 1,000$
	mmol/L			$C = 1000/z$

10.4.1.5 Proposal list for "Calculation type=2nd titration function"

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Consumption	mL	--	$(VEQ[2] + VEX)$	$C = 1$
			$(VEQ[2] + VEND)$	
	mL/g	g	$(VEQ[2] + VEX)/m$	
			$(VEQ[2] + VEND)/m$	
	L	mL	$(VEQ[2] + VEX)/m$	
			$(VEQ[2] + VEND)/m$	
Total consumption	mmol	--	$(Q[2] + QEX)$	
			$(Q[2] + QEND)$	
Consumption until pot.	mmol	--	$QEND[2] + QEX$	
			$QEND[2] + QEND$	
	mmol	--	$QE(H[AuxValue])[2] + QEX$	
			$QE(H[AuxValue])[2] + QEND$	
Content	mg/g	g mL: m*d pc: m*wp	$(Q[2] + QEX) * C/m$ and $(Q[2] + QEND) * C/m$	$C = M/z$
	mol/kg			$C = 1/z$
	mmol/g			
	mmol/kg			$C = 1000/z$
	ppm			$C = M * 1000/z$
	%			$C = M/(10 * z)$
	g/100g			
	mg/100g			$C = 100 * M/z$

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Content	g/L	g: m/d	(Q[2] + QEX)*C/m and (Q[2] + QEND)*C/m	C = M/z
	mg/L	mL		C = M*1 000/z
	mol/L			C = 1/z
	eq/L			C = 1
	meq/L			C = 1,000
	mmol/L			C = 1000/z
	mL/g	g		(VEQ[2] + VEX)*f/m
		mL: m*d pc: m*wp	(VEQ[2] + VEND)*f/m	
	mmol/g	g	(Q[2] + QEX)*f/m	1
		mL: m*d pc: m*wp	(Q[2] + QEND)*f/m	

10.4.1.6 Proposal list for "Calculation type=Others"

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Potential	mV	--	E	C = 1
pH	pH			
Ion conc.	pX			
	pM			
	ppm			
Absorption	A			
Transmission	%T			
Current	μA			
Temperature	°C	--	T	C = 1
	K			
	°F			
Ion conc.	mmol/L	--	$pw(-E) \cdot 1000$	C = 1
	mol/L	--	$pw(-E)$	

i For **Calibration**, the results proposals for "Calculation type=Others" also apply.

10.4.1.7 Proposal List for the Method type "Titer"

Result	Unit	Replacing "m"	Formula R=	Constant C=
Titer	--	g	$m/(VEQ \cdot c \cdot C)$	$C = M/(10 \cdot p \cdot z)$
	--	mL		$C = 1/(cst \cdot z)$
	--	g		$C = d/(cst \cdot z)$

10.4.2 Results proposal list outside loop

Result	Unit	Replace "m" according to entry type	Formula R=	Constant C=
Mean value	--	--	Mean[R1]	C = 1
Mean value	--	--	Mean[R2]	C = 1
Mean value	--	--	Mean[R3]	C = 1

11 Appendix

11.1 Predefined calibration standards for pH sensors

METTLER TOLEDO EU (Ref. 25°C)	METTLER TOLEDO USA (Ref. 25°C)	DIN (19266) /NIST (Ref. 25°C)	DIN (19267) (Ref. 25°C)	MERCK (Ref. 20°C)
2.00	1.68	1.680	1.09	1.00
4.01	4.01	3.557	3.06	2.00
4.60	7.00	3.775	4.65	3.00
7.00	10.01	4.008	6.79	4.00
9.21		6.865	9.23	4.66
10.00		7.416	12.75	5.00
11.00		9.184		6.00
		10.014		6.88
		12.454		7.00
				8.00
				9.00
				9.22
				10.00
				11.00
				12.00
				13.00

Fluka (Ref. 20°C)	Novartis (Fluka) (Ref. 20°C)	FISHER (Ref. 25°C)	JIS Z 8802 (Ref. 25°C)	JJG119 (Ref. 25°C)
1.00	4.00	1.00	1.679	1.680
2.00	7.00	2.00	4.008	3.559
3.00	9.00	3.00	6.865	4.003
4.00		4.00	7.413	6.864
5.00		5.00	9.180	7.409
6.00		6.00	10.01	9.182
7.00		7.00		12.460
8.00		8.00		
9.00		8.991		
10.00		10.00		
11.00		11.00		
12.00				
13.00				

11.1.1 Temperature related values

11.1.1.1 METTLER TOLEDO

METTLER TOLEDO EU (Ref. 25°C)

Temp. [°C]	pH						
0	2.03	4.01	4.66	7.12	9.52	10.65	11.90
5	2.02	4.01	4.65	7.09	9.45	10.52	11.72
10	2.01	4.00	4.64	7.06	9.38	10.39	11.54
15	2.00	4.00	4.63	7.04	9.32	10.26	11.36
20	2.00	4.00	4.62	7.02	9.26	10.13	11.18
25	2.00	4.01	4.60	7.00	9.21	10.00	11.00
30	1.99	4.01	4.61	6.99	9.16	9.87	10.82
35	1.99	4.02	4.62	6.98	9.11	9.74	10.64
40	1.98	4.03	4.63	6.97	9.06	9.61	10.46
45	1.98	4.04	4.64	6.97	9.03	9.48	10.28
50	1.98	4.06	4.66	6.97	8.99	9.35	10.10
55	1.98	4.08	4.67	6.98	8.96	9.22	9.92
60	1.98	4.10	4.69	6.98	8.93	9.09	9.74
70	1.99	4.16	4.71	7.00	8.88	8.96	9.56
80	2.00	4.22	4.73	7.04	8.83	8.83	9.38
90	2.00	4.30	4.75	7.09	8.79	8.70	9.20
95	2.00	4.35	4.77	7.12	8.77	8.57	9.02

METTLER TOLEDO USA (Ref. 25°C)

Temp. [°C]	pH				
5	1.67	4.01	7.09	10.25	
10	1.67	4.00	7.06	10.18	
15	1.67	4.00	7.04	10.12	
20	1.68	4.00	7.02	10.06	
25	1.68	4.01	7.00	10.01	
30	1.68	4.01	6.99	9.97	
35	1.69	4.02	6.98	9.93	
40	1.69	4.03	6.97	9.89	
45	1.70	4.04	6.97	9.86	
50	1.71	4.06	6.97	9.83	

11.1.1.2 DIN / NIST
DIN (19266) / NIST (Ref. 25°C)

Temp. [°C]	pH									
0	1.666	3.577	3.863	4.010	6.984	7.534	9.464	10.317	13.423	
5	1.668	3.573	3.837	4.004	6.950	7.502	9.392	10.248	13.207	
10	1.670	3.569	3.819	4.001	6.922	7.474	9.331	10.180	13.003	
15	1.672	3.565	3.801	4.001	6.900	7.451	9.277	10.121	12.810	
20	1.676	3.561	3.787	4.003	6.880	7.432	9.228	10.066	12.627	
25	1.680	3.557	3.775	4.008	6.865	7.416	9.184	10.014	12.454	
30	1.685	3.553	3.766	4.015	6.853	7.405	9.144	9.970	12.289	
35	1.691	3.549	3.759	4.026	6.845	7.396	9.110	9.928	12.133	
40	1.697	3.549	3.754	4.036	6.837	7.389	9.076	9.892	11.984	
45	1.704	3.544	3.751	4.049	6.834	7.386	9.046	9.856	11.841	
50	1.712	3.548	3.748	4.064	6.833	7.384	9.018	9.830	11.705	
55	1.715	3.554	3.750	4.075	6.834	7.382	8.985	9.804	11.574	
60	1.723	3.560	3.753	4.091	6.836	7.380	8.962	9.778	11.449	
70	1.743	3.580	3.763	4.126	6.845	7.378	8.921	9.752	11.324	
80	1.766	3.609	3.780	4.164	6.859	7.376	8.885	9.726	11.199	
90	1.792	3.650	3.802	4.205	6.877	7.374	8.850	9.700	11.074	
95	1.806	3.674	3.815	4.227	6.886	7.372	8.833	9.674	10.949	

DIN (19267) (Ref. 25°C)

Temp. [°C]	pH					
0	1.08	3.12	4.67	6.89	9.48	13.89
5	1.08	3.11	4.67	6.87	9.43	13.63
10	1.09	3.10	4.66	6.84	9.37	13.37
15	1.09	3.09	4.66	6.82	9.32	13.16
20	1.09	3.07	4.65	6.80	9.27	12.96
25	1.09	3.06	4.65	6.79	9.23	12.75
30	1.10	3.05	4.65	6.78	9.18	12.61
35	1.10	3.05	4.65	6.77	9.13	12.45
40	1.10	3.04	4.66	6.76	9.09	12.29
45	1.10	3.04	4.67	6.76	9.04	12.09
50	1.11	3.04	4.68	6.76	9.00	11.98
60	1.11	3.04	4.70	6.76	8.92	11.69
70	1.11	3.04	4.72	6.76	8.88	11.43
80	1.12	3.05	4.75	6.78	8.85	11.19
90	1.13	3.07	4.79	6.80	8.82	10.99

11.1.1.3 MERCK
MERCK (Ref. 20°C)

Temp. [°C]	pH							
0	0.96	2.01	3.05	4.05	4.68	5.06	6.04	6.98
5	0.99	2.01	3.05	4.04	4.68	5.05	6.02	6.95
10	0.99	2.01	3.03	4.02	4.67	5.02	6.01	6.92
15	0.99	2.00	3.01	4.01	4.67	5.01	6.00	6.90
20	1.00	2.00	3.00	4.00	4.66	5.00	6.00	6.88
25	1.01	2.00	3.00	4.01	4.66	5.00	6.02	6.86

Temp. [°C]	pH							
30	1.01	2.00	3.00	4.01	4.66	5.00	6.03	6.86
35	1.01	2.00	3.00	4.01	4.66	5.00	6.03	6.85
40	1.01	2.00	2.98	4.01	4.67	5.00	6.04	6.84
45	1.01	2.00	2.98	4.01	4.67	5.01	6.05	6.84
50	1.01	2.00	2.97	4.00	4.68	5.01	6.06	6.84
60	1.02	2.00	2.97	4.00	4.69	5.04	6.10	6.84
70	1.02	2.01	2.97	4.00	4.70	5.05	6.12	6.84
80	1.02	2.01	2.97	4.00	4.71	5.10	6.17	6.86
90	1.02	2.01	2.96	4.00	4.72	5.14	6.24	6.88

MERCK (Ref. 20°C) (continued)

Temp. [°C]	pH							
0	7.13	8.15	9.24	9.46	10.26	11.45	12.58	13.80
5	7.07	8.10	9.16	9.40	10.17	11.32	12.41	13.59
10	7.05	8.07	9.11	9.33	10.11	11.20	12.26	13.37
15	7.02	8.04	9.05	9.28	10.05	11.10	12.10	13.18
20	7.00	8.00	9.00	9.22	10.00	11.00	12.00	13.00
25	6.98	7.96	8.95	9.18	9.94	10.90	11.88	12.83
30	6.98	7.94	8.91	9.14	9.89	10.81	11.72	12.67
35	6.96	7.92	8.88	9.10	9.84	10.72	11.67	12.59
40	6.95	7.90	8.85	9.07	9.83	10.64	11.54	12.41
45	6.95	7.88	8.82	9.04	9.79	10.56	11.44	12.28
50	6.95	7.85	8.79	9.01	9.74	10.48	11.33	12.15
60	6.96	7.83	8.73	8.96	9.67	10.33	11.04	11.75
70	6.96	7.80	8.70	8.93	9.62	10.19	10.90	11.61
80	6.97	7.78	8.66	8.89	9.55	10.06	10.70	11.39
90	7.00	7.75	8.64	8.85	9.49	9.93	10.48	11.15

11.1.1.4 FLUKA

FLUKA (Ref. 20°C)

Temp. [°C]	pH					
0	0.94	1.99	3.03	4.03	5.05	6.03
10	0.99	1.99	3.02	4.02	5.02	6.01
20	1.00	2.00	3.00	4.00	5.00	6.00
30	1.00	2.00	3.00	4.00	5.00	6.02
40	1.01	2.00	2.99	4.00	5.00	6.04
50	1.01	2.00	2.98	4.00	5.02	6.06
60	1.01	2.00	2.98	4.00	5.04	6.09
70	1.01	2.00	2.98	4.00	5.07	6.13
80	1.02	2.00	2.98	4.00	5.10	6.18
90	1.02	2.00	2.97	4.00	5.13	6.24

FLUKA (Ref. 20°C) (continued)

Temp. [°C]	pH						
0	7.13	8.18	9.24	10.24	11.45	12.58	13.71
10	7.05	8.09	9.11	10.10	11.20	12.26	13.35
20	7.00	8.00	9.00	10.00	11.00	12.00	13.00
30	6.98	7.94	8.93	9.90	10.81	11.75	12.66
40	6.97	7.90	8.86	9.82	10.64	11.53	12.37
50	6.96	7.86	8.80	9.75	10.48	11.31	12.10
60	6.96	7.82	8.75	9.68	10.33	11.09	11.84
70	6.97	7.80	8.71	9.62	10.19	10.88	11.61
80	6.98	7.77	8.67	9.55	10.06	10.68	11.40
90	7.00	7.75	8.64	9.49	9.93	10.48	11.20

NOVARTIS (FLUKA) (Ref. 20°C)

Temp. [°C]	pH		
0	4.01	7.11	9.20
5	4.00	7.08	9.15
10	4.00	7.05	9.10
15	4.00	7.02	9.05
20	4.00	7.00	9.00

Temp. [°C]	pH		
25	4.01	6.98	8.96
30	4.01	6.97	8.91
35	4.02	6.96	8.88
40	4.03	6.95	8.84
45	4.04	6.94	8.80
50	4.06	6.94	8.77
55	4.07	6.93	8.74
60	4.09	6.93	8.71
65	4.11	6.93	8.69
70	4.13	6.94	8.67
75	4.14	6.94	8.65
80	4.16	6.95	8.63
85	4.18	6.96	8.61
90	4.21	6.97	8.60
95	4.23	6.98	8.59

11.1.1.5 FISHER

FISHER (Ref. 25°C)

Temp. [°C]	pH										
0				4.01	5.05	6.07	7.13	8.15	9.166	10.34	11.80
5	0.95	1.98	2.98	3.99	5.04	6.05	7.10	8.13	9.126	10.26	11.69
10	0.98	1.98	2.97	4.00	5.03	6.06	7.07	8.08	9.089	10.19	11.46
15	1.01	2.02	3.00	3.99	4.99	6.05	7.05	8.01	9.055	10.12	11.31
20	1.01	2.00	3.00	4.00	5.00	6.00	7.02	8.00	9.022	10.06	11.17
25	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	8.991	10.00	11.00
30	1.02	2.00	3.02	4.01	5.01	5.99	6.99	8.00	8.961	9.94	10.88
35	1.03	2.02	3.03	4.02	5.01	5.98	6.98	7.95	8.930	9.90	10.76
40	1.02	2.01	3.03	4.03	5.04	5.97	6.97	7.94	8.902	9.85	10.62
45	1.03	2.01	3.04	4.04	5.06	5.97	6.97	7.94	8.874	9.81	10.52
50	1.03	2.01	3.04	4.06	5.08	5.96	6.97	7.93	8.845	9.78	10.41
55				4.07			6.97		8.815	9.74	
60				4.09			6.98		8.784	9.70	
65				4.11			6.99			9.68	
70				4.13			7.00			9.65	
75				4.14			7.02			9.63	
80				4.16			7.03			9.62	
85				4.18			7.06			9.61	
90				4.21			7.08			9.60	
95				4.23			7.11			9.60	

11.1.1.6 JIS / JJG

JIS Z 8802 (Ref. 25°C)

Temp. [°C]	pH					
0	1.666	4.003	6.984	7.534	9.464	10.32
5	1.668	3.999	6.951	7.500	9.395	10.24
10	1.670	3.998	6.923	7.472	9.332	10.18
15	1.672	3.999	6.900	7.448	9.276	10.12
20	1.675	4.002	6.881	7.429	9.225	10.06
25	1.679	4.008	6.865	7.413	9.180	10.01
30	1.683	4.015	6.853	7.400	9.139	9.97
35	1.688	4.024	6.844	7.389	9.102	9.92
40	1.694	4.035	6.838	7.380	9.068	9.89
45	1.700	4.047	6.834	7.373	9.038	9.86
50	1.707	4.060	6.833	7.367	9.011	9.83
55	1.715	4.075	6.834	7.361	8.985	9.80
60	1.723	4.091	6.836	7.355	8.962	9.77
70	1.743	4.126	6.845	7.349	8.921	9.74
80	1.766	4.164	6.859	7.343	8.885	9.71
90	1.792	4.205	6.877	7.337	8.850	9.68
95	1.806	4.227	6.886	7.331	8.833	9.65

JJG119 (Ref. 25°C)

Temp. [°C]	pH						
0	1.668	3.599	4.006	6.981	7.515	9.458	13.416
5	1.669	3.591	3.999	6.949	7.490	9.391	13.210
10	1.671	3.583	3.996	6.921	7.467	9.330	13.011
15	1.673	3.575	3.996	6.898	7.445	9.276	12.820
20	1.676	3.567	3.998	6.879	7.426	9.226	12.637
25	1.680	3.559	4.003	6.864	7.409	9.182	12.460
30	1.684	3.551	4.010	6.852	7.395	9.142	12.292
35	1.688	3.547	4.019	6.844	7.386	9.105	12.130
40	1.694	3.547	4.029	6.838	7.380	9.072	11.975
45	1.700	3.550	4.042	6.834	7.379	9.042	11.828
50	1.706	3.555	4.055	6.833	7.383	9.015	11.697
55	1.713	3.563	4.070	6.834	7.387	8.990	11.553
60	1.721	3.573	4.087	6.837	7.391	8.968	11.426
70	1.739	3.596	4.122	6.847	7.399	8.926	11.172
80	1.759	3.622	4.161	6.862	7.407	8.890	10.918
90	1.782	3.648	4.203	6.881	7.415	8.856	10.664
95	1.795	3.660	4.224	6.891	7.419	8.839	10.537

Index

A

Adjustment	
Touch screen	31
All Results	80
Analysis and Resources Behavior	
Analysis Sequence Settings	28
Resource Behavior	29
Analysis data	78
Analysis Sequence	71
Analysis, starting	70
Application Modes	58
Asymmetric evaluation procedure	76
Auxiliary instruments	25
Auxiliary reagents	13

B

Balance	21
Barcode reader	22
Beep	27
Blank value	29
Board data	31
Board firmware	31
Burettes	32

C

Calculations	
Results	79
Calibration	
starting	70
Calibration standards	14
Chemicals	12
Auxiliary reagents	13
Calibration standards	14
Substances	15
Titer standards	15
Titrants	13
Configure barcode reader	22
Configure USB stick	22
Configuring a balance	21
Control band	18
Control Type	
24V Output	65
Input TTL (Single Pin)	66
Out TTL (Single Pin)	65
RS-232	66
Stirrer	65
Curve progression	
Minimum / Maximum	75

D

Deleting results	80
Drives	31

E

Emergency stop (reset)	8
End-Point Titration	59
Equivalence-Point Titration	54

Evaluation and Calculation	78
Evaluation procedure	
asymmetric	76
Introduction	74

F

Firmware History	31
------------------	----

G

Global settings	
Analysis and Resources Behavior	28
User Management	27

H

Hardware	16
Balance	21
Barcode reader	22
Network settings	24
PC settings	24
Peripherals	21, 21
Printer	23
Sensors	16
Titration stands	25
USB-Stick	22
Homescreen	8

I

Import/Export, data	30
Info button	8
Interrupt Analysis	
User	46
Ion Selective Sensors	18
ISE Sensors	18

K

Keyboard layout	
Define	27

L

Language, setting	26
Layout of terminal	8
Learn Titration (EQP)	60
Linear Calibration	19
Loop	
Insertion and Deletion	47
Types and numbers	46

M

Manual operation	
Auxiliary instruments	36
Dispense	39
Manual titration	40
Pump	33
Manual operations	
Sensor	34
Stirrer	33
Measure (Normal)	52
Method	
Delete	45
Start	45
Method editor	42
Method functions	

Maximum number	47	Plug and Play Sensors	
Parameters	48	Setup	16
Within Loop	67	Polarized Sensor	
Method functions, parameters		Measure With	36
Auxiliary Instrument	65	Polarized Sensors	18
Auxiliary value	64	Predefined methods	42
Blank Value	64	Printer	23
Calculation	61	Setup	23
Calibration	63	USB data export	23, 23
Dispense (Normal)	52	Pump and Stirrer Detection	29
Drain	66	Pumps	21
End of Sample	63		
Measure (Normal)	52	R	
Pump	52	Reset button	8
Record	62	Reset to factory settings	31
Sample	48	Result type	
Sample (Calibration)	50	Predefined	82
Sample (Titer)	49	User defined	82
Stir	52	Results proposals	82
Titer	63	Results, deleting	80
Titration (EP)	59	Rinse Burette	38
Titration (EQP)	54	Rinse Multiple Burettes	39
Titration (LearnEQP)	60		
Titration Stand	51	S	
Method ID	42	Sample	48
Method syntax	46	Sample Loops	46
Method Templates	44	Sample parameters	68
Method Types	42	Sample Results	81
Methods		Sample, Titer, Calibration	
Creating	43	Loops	42
Modify	44	Screen, setting	26
Subfunctions	52	Segmented	
Suspend	45	Evaluation procedure	75
Mettler methods	42	Segmented evaluation procedure	75
METTLER TOLEDO balances	22	Sensor	
Minimum / Maximum		Potentiometric	35
Curve progression	75	Sensor Calibration	
mV Sensors	17	Linear Calibration	19
		Segmented Calibration	20
N		Setup	19
Network settings	24	Sensor test	
		Method function: Calibra-	50
O		tion	
Online Dialog	10	Method functions	50
Operation of the touchscreen	8	MF Calibration	64
Outlier test	81	Setup	19
Overview		starting	70
Method functions	47	Sensors	
		Configure	16
P		Sensors, manual operations	34
PC settings	24	Series templates	68
Peripherals	21, 21	Service & Maintenance	
Balance	21	Board data	31
Balances	22	Board firmware	31
Barcode reader	22	Burettes	32
Printer	23	Data Import/Export	30
USB data export	23	Drives	31
USB stick	22	Reset to factory settings	31
pH Sensor	17	Titrator Firmware History	31
pH sensor test	50	Update	32
starting	70	Settings	
Phototrode	17	global	27

Setup	
Chemicals	12
Setup menu	12
Shortcuts	9
Manage	27
Sorting lists	9
Standard evaluation procedure	74
Start analysis	10
Starting analysis	71
Statistics	80
Stirrer	33
Subfunctions	
Methods	52
Substances	15
Suspending analysis	
Titrator	45
Suspending options	10
Symbols for calculations	79
T	
Tape printer	23
Temperature Sensor	18
Measure With	34
Template	
Methods	47
Title, parameters	48
Titrants	13
Titration	
Network settings	24
PC settings	24
Titration (EP)	59
Titration (LearnEQP)	60
Titration stand	
Setting up	25
Touch screen adjustment	31
U	
Undo Changes	80
Updating	32
USB compact printer	23
USB data export	23, 23
USB data export box	23
USB-Stick	22
User Interface	8
Input Fields	9
User settings	
Keyboards	27
Language	26
Screen	26
Shortcuts	27
V	
Value ranges	
Control band	18
Sensors	18
Values	
Blank	29

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