Eco Titrator

Manual

8.1008.8001EN / v9 / 2026-03-31

Metrohm

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Eco Titrator

Firmware version 57.1008.0024 or higher

Manual

8.1008.8001EN / v9 /
2026-03-31

Technical Communication
Metrohm AG
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1 Overview

1.1 Product description

The Eco Titrator is a titrator for volumetric titrations for universal applications.

1.2 Product versions

The product is available in the following versions:

Table 1 Product versions

Art. no.	Designation	Version feature
2.1008.0010	Eco Titrator	with magnetic stirrer
2.1008.1010	Eco Titrator Acid/Base	with magnetic stirrer
2.1008.2010	Eco Titrator Salt	with magnetic stirrer
2.1008.3010	Eco Titrator Oil	with magnetic stirrer
2.1008.4010	Eco Titrator Redox	with magnetic stirrer

The article number and serial number for identification of the product can be found on the type label:

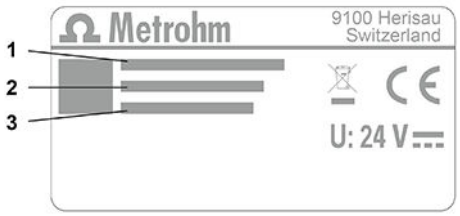


Figure 1 Type label (example)

1 **(01) = External article number**

2 **(21) = Serial number**

3 **(240) = Metrohm article number**

1.3 Displaying the accessories

Up-to-date information on the scope of delivery and on optional accessories can be found on the Metrohm website.

1 Searching for a product on the website

- Go to *https://www.metrohm.com*.
- Click on .
- Enter the article number of the product into the search field and press **[Enter]**.
  - Obtain the article number from the list *(see "Product versions", chapter 1.2, page 1)*.
- In the result list, click on the desired product.

Detailed information regarding the product is displayed.

2 Displaying the accessories

- Scroll down (accessories subject to availability):
  - Included parts
  - Optional parts

3 Downloading the accessories list (included and optional parts)

- Click on to download the accessories list as a PDF.

Metrohm recommends keeping the downloaded PDF for reference purposes.

1.4 Further information

Additional information on the product is available on the following pages:

- Metrohm website *https://www.metrohm.com* – Documents as PDF, overview of product family, information on applications, and details of accessories.

1.5 About the documentation

Possible depictions in the documentation:

Depiction	Meaning
*(5-**12**)*	Cross-reference to figure legend (Figure number - ***Element in the figure***)
1	Instruction step
Method	Parameters, menu items, tabs, and dialogs
File ▶ **New**	Menu path
[Continue]	Button or key
	Supplementary information to the descriptive text
	Note In graphics, orange arrows or frames indicate the reference to the descriptive text. The relevant elements may also be colored orange.
	Movement In graphics, blue arrows indicate the movement direction. The elements to be moved may also be colored blue.

2 Safety

2.1 Intended use

The Eco Titrator is equipped with the following functional units:

- Built-in magnetic stirrer
- Exchangeable cylinder unit

Method templates are available which are already configured except for a few parameters. The methods can be modified and saved under a new name or exported to a connected USB flash drive. This function makes it possible to copy methods quickly and easily from one instrument to another.

Titration modes

The following titration modes are supported:

- DET
- MET
- SET

Calibration mode

The CAL calibration mode is used to calibrate the electrode.

2.2 Responsibility of the operator

The operator must ensure that basic regulations on occupational safety and accident prevention in chemical laboratories are observed. The operator has the following responsibilities:

- Instruct personnel in the safe handling of the product.
- Train personnel in the use of the product according to the user documentation (e.g. install, operate, clean, eliminate faults).
- Train staff on basic occupational safety and accident prevention regulations.
- Provide personal protective equipment (e.g. protective glasses, gloves).
- Provide suitable tools and equipment to carry out the work safely.

The product may be used only when it is in perfect condition. The following measures are required to ensure the safe operation of the product:

- Check the condition of the product before use.
- Remedy defects and malfunctions immediately.
- Maintain and clean the product regularly.

2.3 Requirements for operating personnel

Only qualified personnel may operate the product. Qualified personnel are persons who meet the following requirements:

- Basic regulations on occupational safety and accident prevention for chemical laboratories are known and complied with.
- Knowledge of handling hazardous chemicals is present. Personnel have the ability to recognize and avoid potential dangers.
- Knowledge regarding the application of fire prevention measures for laboratories is available.
- Safety-relevant information is communicated and understood. The personnel can operate the product safely.
- The user documentation has been read and understood. The personnel operate the product according to the instructions in the user documentation.

2.4 Safety instructions

2.4.1 Danger from electrical potential

Contact with electrical potential can cause serious injuries or death. To avoid danger from electrical potential, observe the following:

- Operate the product only if it is in perfect condition. The housing must also be intact.
- Only use the product with the covers fitted. If covers are damaged or missing, disconnect the product from the energy supply and contact the regional Metrohm service representative.
- Protect live components (e.g. power supply unit, power cord, connection sockets) against moisture.
- Always have maintenance work and repairs on electrical components carried out by a regional Metrohm service representative.
- Disconnect the product from the energy supply immediately if at least one of the following cases occurs:
  - The housing is damaged or open.
  - Live parts are damaged.
  - Moisture penetrates.

2.4.2 Danger from biological and chemical hazardous substances

Contact with biological hazardous substances may cause poisoning from toxins or infections from microorganisms. Contact with aggressive chemical substances may cause poisoning or chemical burns. To avoid danger from biological or chemical hazardous substances, observe the following:

- Label the product according to regulations if it is used for substances that have a potential for chemical hazards and are generally subject to the Hazardous Substances Ordinance.
- Wear personal protective equipment (e.g. protective glasses, gloves).
- Use exhaust equipment when working with vaporizing hazardous substances.
- Dispose of hazardous substances in accordance with regulations.
- Clean and disinfect contaminated surfaces.
- Only use detergents that do not cause any unwanted side reactions with the materials to be cleaned.
- Dispose of chemically contaminated materials (e.g. cleaning material) in accordance with regulations.
- Proceed as follows in case of a return shipment to Metrohm AG or a regional Metrohm representative:
  - Decontaminate the product or product component.
  - Remove the labeling for hazardous substances.
  - Create a declaration of decontamination and enclose it with the product.

2.4.3 Danger from highly flammable substances

Using highly flammable substances or gases may cause fires or explosions. To avoid danger from highly flammable substances, observe the following:

- Avoid ignition sources.
- Use protective grounding.
- Use exhaust equipment.

2.4.4 Danger from leaking liquids

Leaking liquids may cause injuries and may damage the product. To avoid danger from leaking liquids, observe the following:

- Check the product and its accessories for leakages and loose connections.
- Replace leaking components and connecting elements without delay.
- Only use stirring bars that are the right length for the vessel size.
- Tighten loose connecting elements.
- Do not loosen tubing connections under pressure.
- Do not remove aspiration tubing under pressure.
- Carefully pull the tubing ends out of the vessels.
- Carefully allow liquids from the tubing to drain into suitable vessels.
- Insert the tubing tips completely into the vessels.
- Remove and dispose of escaping liquids in accordance with regulations.
- If you suspect that liquid has penetrated the instrument, disconnect the instrument from the energy supply. Then have the instrument checked by a regional Metrohm service representative.

2.4.5 Danger during transport of the product

Chemical or biological substances may be spilled during the transport of the product. Parts of the product may fall down or may be damaged. There is a risk of injury from chemical or biological substances and pieces of broken glass. To ensure safe transport, observe the following:

- Remove loose parts (e.g. sample racks, sample vessels, bottles) before transport.
- Remove liquids.
- Lift and transport the product with both hands on the base plate.
- Lift and transport heavy products only according to instructions.

2.5 Design of warning messages

The present documentation uses warning messages as follows.

Structure

1. Severity of the danger (signal word)
2. Type and source of danger
3. Consequences of disregarding the danger
4. Measures for averting the danger

Hazard levels

Signal color and signal word designate the hazard level.

DANGER

Indicates an immediate danger. It will result in serious injuries or death if not avoided.

WARNING

Indicates a potential danger. Failure to avoid the danger may result in death or serious injury.

CAUTION

Indicates a potential danger. If not avoided, it may result in light or minor injuries.

NOTICE

Indicates a potentially damaging situation. If not avoided, the product or something in the surrounding area could be damaged.

2.6 Meaning of warning signs

Warning signs on the product or in the documentation indicate potential dangers or draw attention to certain behaviors in order to avoid accidents or damage.

Depending on the application purpose, the operating company attaches additional warning signs to the product. The corresponding instructions of the operator must be followed.

Table 2 Warning signs according to ISO 7010 (examples)

Warning signs / meaning		Warning signs / meaning	
	General warning sign		Warning of hot surface
	Warning of sharp object (cut/ puncture)		Warning of hand injuries (crushing)
	Warning of electrical voltage		Warning of corrosive substances
	Warning of optical radiation		Warning of a laser beam
	Warning of flammable materials		Warning of biological hazard
	Warning of toxic materials		

3 Functional description

3.1 Eco Titrator – Overview

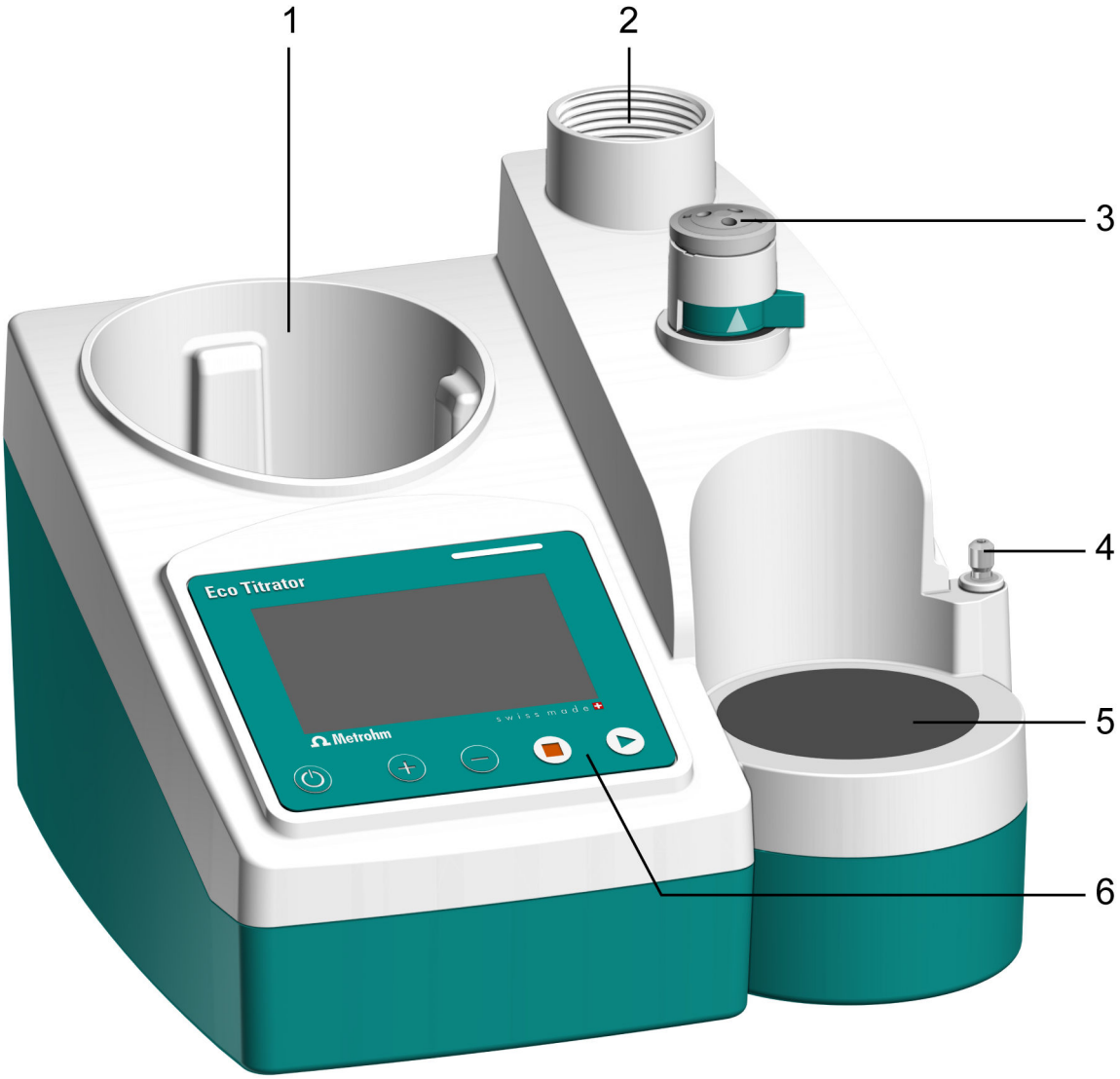


Figure 2 Eco Titrator – Front

1	**Bottle holder**	**2**	**Space for cylinder unit**
3	**Flat stopcock**	**4**	**Stand attachment**
5	**Magnetic stirrer**	**6**	**Status display, touch screen and control bar**

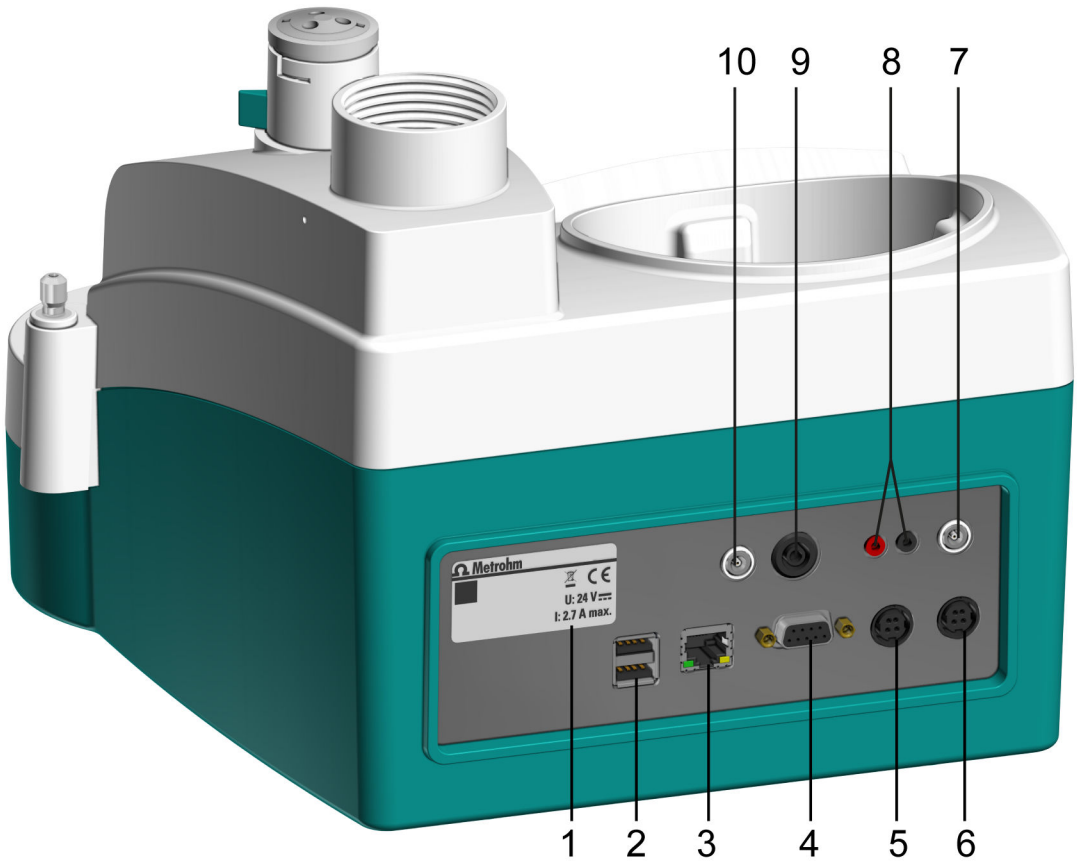


Figure 3 Eco Titrator – Rear

1	**Type label**	**2**	**USB (USB 1 and USB 2)** Connect USB flash drive, printer, balance, etc.
3	**Ethernet (RJ-45)** Remote control via local network	**4**	**Remote** Connect the instrument with a remote interface
5	**Power OUT** Energy supply for additional instrument possible	**6**	**Power IN** Connecting the power supply unit
7	**Pol** Connect a polarizable electrode	**8**	**Temp** Connect a temperature sensor (Pt1000 or NTC) or an electrode with integrated temperature sensor
9	**Ref** Connect a reference electrode	**10**	**Ind** Connect a non-polarizable electrode (e.g. ion-selective, pH, redox or other electrode)

Always use both Temp connectors *(3-**8**)* for the temperature measurement. Otherwise the measurement is not possible.

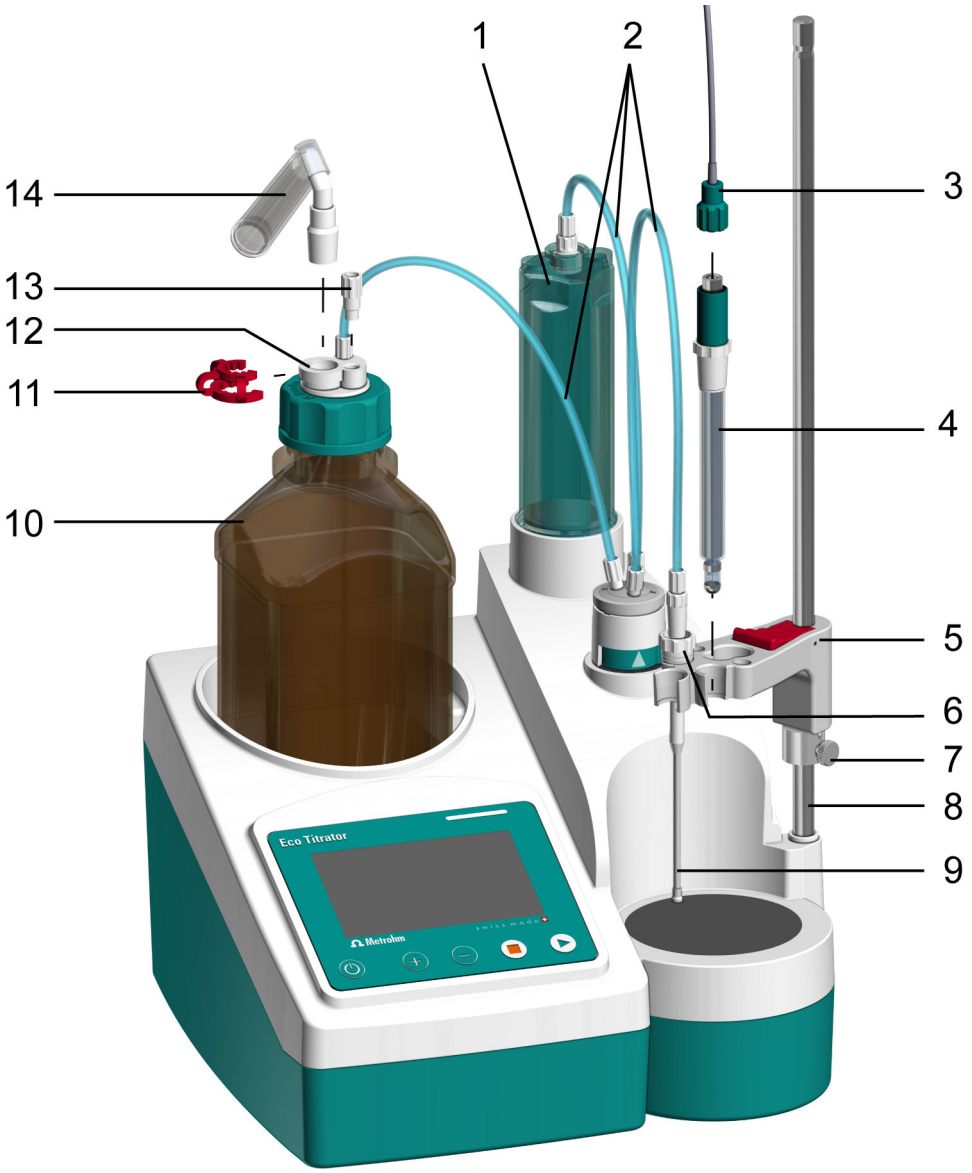


Figure 4 Eco Titrator – Accessories

1	**Cylinder unit**	**2**	**Tubing connections**
3	**Electrode cable**	**4**	**Electrode**
5	**Electrode holder**	**6**	**Guide sleeve**
7	**Clamping ring**	**8**	**Support rod**
9	**Tubing tip**	**10**	**Amber glass bottle with GL 45 thread**
11	**Ground-joint clip SGJ 14/15**	**12**	**Bottle cap**
13	**Threaded stopper**	**14**	**Adsorber tube**

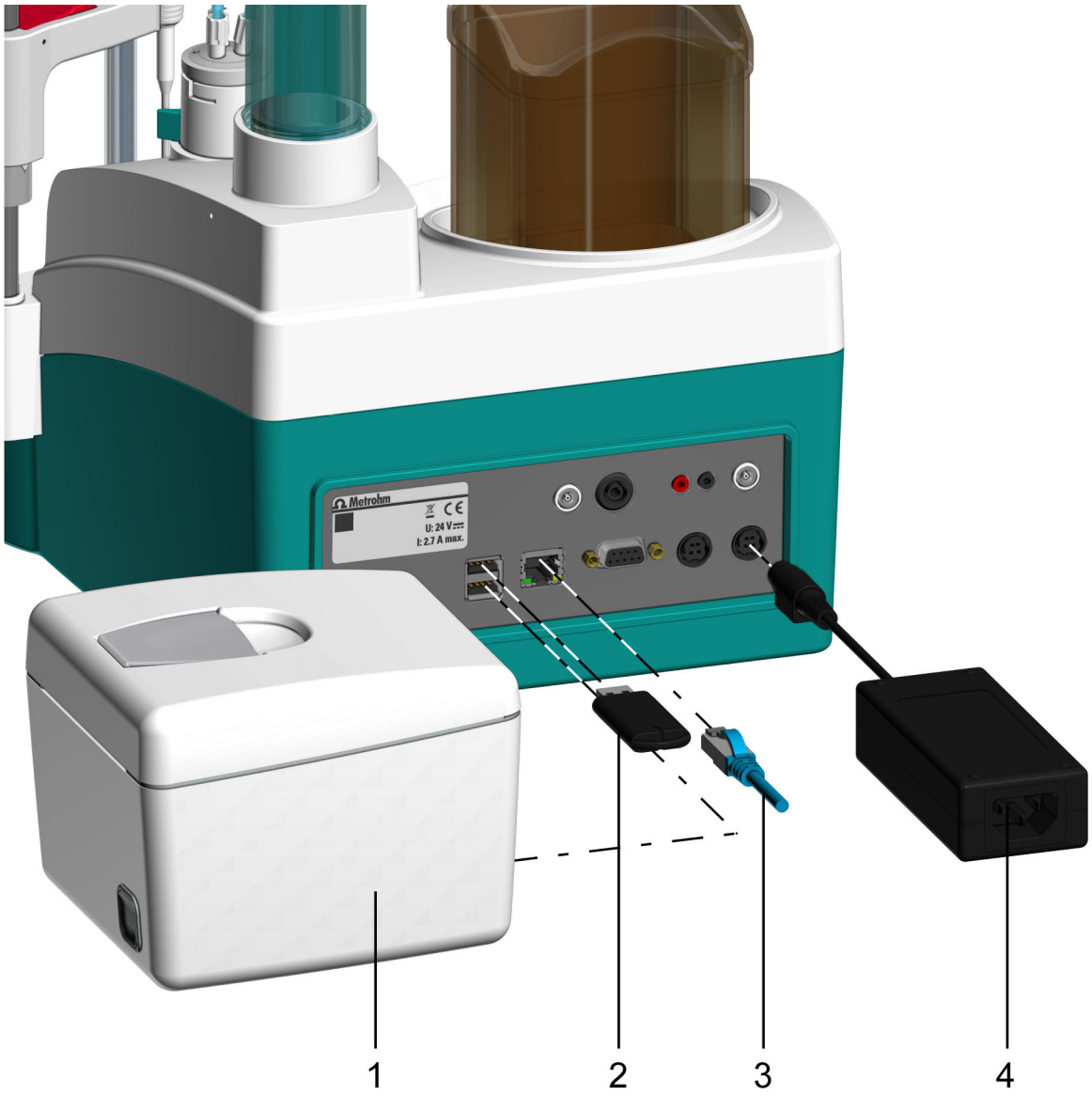


Figure 5 Eco Titrator – Peripherals

1	**Printer Q3X (optional)**	**2**	**USB flash drive**
3	**Ethernet cable (optional)**	**4**	**Power supply unit**

3.2 Function of the components

3.2.1 Magnetic stirrer

The magnetic stirrer ensures that the sample is well mixed. In order to do so, a suitable stirring bar *(see "Lengths of stirring bar", page 172)* must be placed in the sample vessel.

Adjust the stirring rate and the stirring bar to the amount and viscosity of the sample.

The stand attachment, to which the support rod, the clamping ring, and the electrode holder are attached, is located directly at the magnetic stirrer.

3.2.2 Cylinder unit and dosing drive

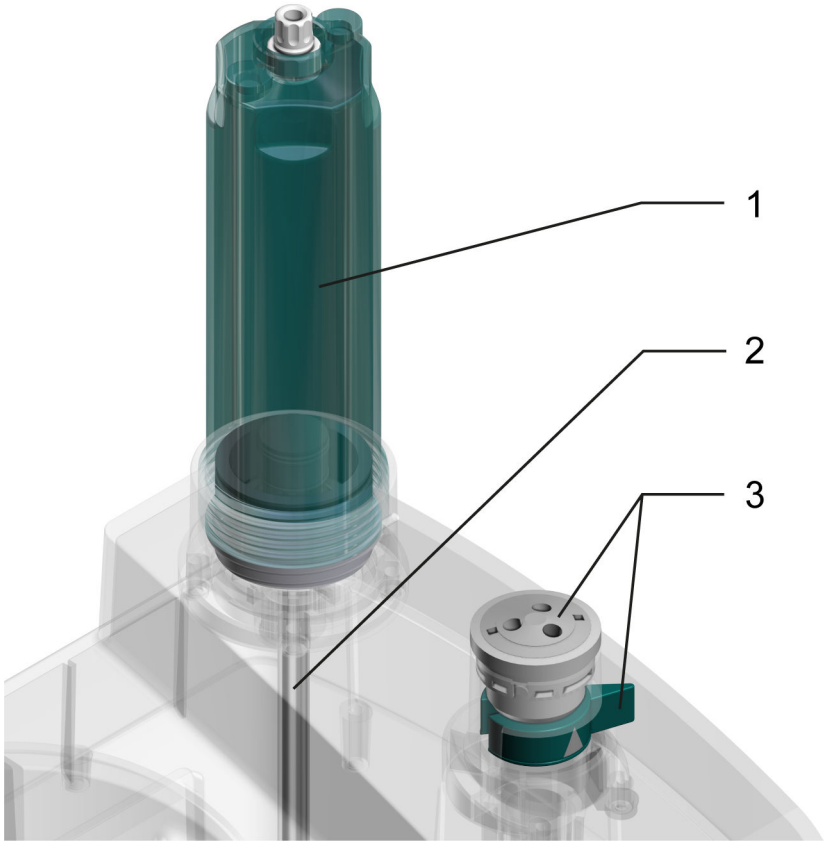


Figure 6 Cylinder unit and dosing drive – Overview

1	**Cylinder unit**	**2**	**Push rod (dosing drive)**
3	**Flat stopcock**		

The dosing drive and connected cylinder unit can be used to accurately dose liquid volumes.

The dosing drive is permanently installed in the housing of the device and moves the push rod to raise and lower the cylinder in the cylinder unit and is responsible for accurate dosing of the solution.

The flat stopcock switches between filling and emptying the cylinder unit.

Once the cylinder unit is put into place, the dosing drive and the flat stopcock assume responsibility for the following functions:

- **Raising and lowering the piston:**
  Solution is aspirated while the piston is being lowered. The cylinder fills up.
  Solution is dosed while the piston is being raised. The cylinder empties.
- **Rotate the flat stopcock:**
  The position of the flat stopcock determines which connectors the solution flows through.

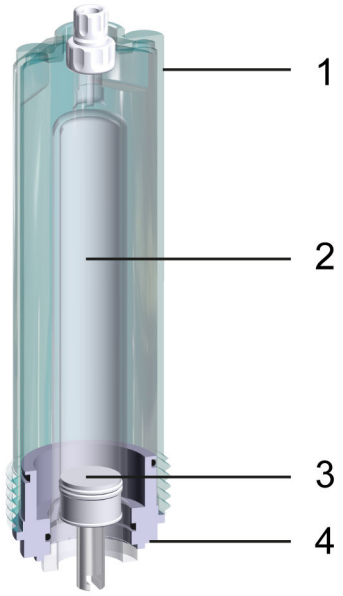


Figure 7 Cylinder unit – Overview

1	**Light protection**	**2**	**Cylinder**
3	**Piston with sealing lips and piston rod**	**4**	**Mounting ring**

3.2.3 Flat stopcock

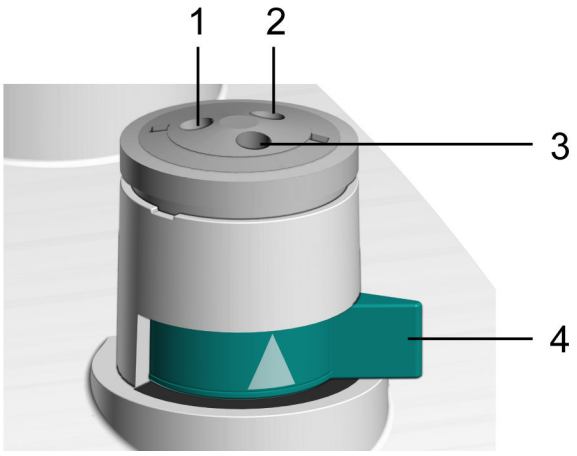


Figure 8 Flat stopcock – Overview

1	**Connector for the tubing connection to the bottle**	**2**	**Connector for the tubing connection to the tubing tip**
3	**Connector for the tubing connection to the cylinder unit**	**4**	**Switching lever**

3.2.4 Bottle unit

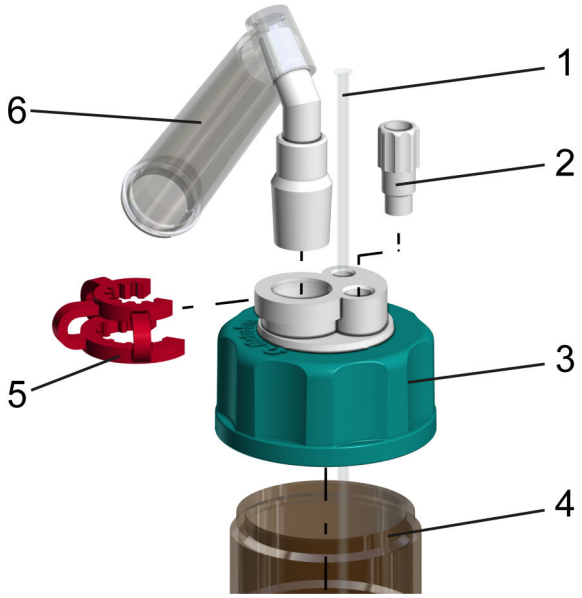


Figure 9 Bottle unit – Overview

1	**Cannula**	**2**	**Threaded stopper**
3	**Bottle cap**	**4**	**Amber glass bottle with GL 45 thread**
5	**Clip for SGJ 14/15**	**6**	**Adsorber tube**

3.3 Indicators and controls

Indicators – Status display and status indicator

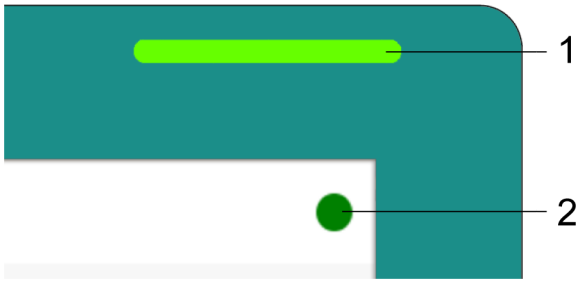


Figure 10 Indicators

1	**Status display**	**2**	**Status indicator**

The status indicator is only displayed if the touch screen is switched on.

Controls – Control bar

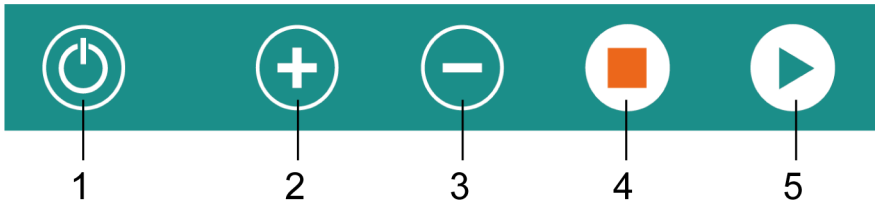


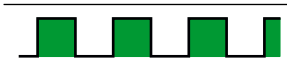
Figure 11 Control bar keys

1	**On/Off**	**2**	**Increase stirring rate**
3	**Reduce stirring rate**	**4**	**Stop**
5	**Start**		

3.4 Signals

The status display uses flashing patterns to display the operating status of the instrument.

Table 3 Status display

Signal	Flashing pattern	Meaning
	LED lights up green	Ready for operation
	LED flashes green (slowly)	In operation / Waiting
	LED flashes green (fast)	Malfunction or error

The status indicator uses colors to display the operating status of the instrument.

Table 4 Status indicator

Signal	Color	Meaning
	Green	Ready for operation
	Orange	In operation
	Yellow	Waiting
	Red	Malfunction or error

3.5 Remote interface

Pin assignment of the remote interface

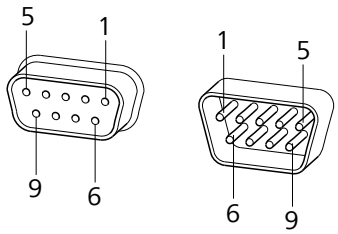


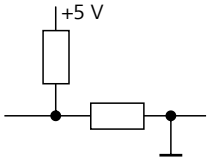
Figure 12 Pin assignment of remote socket and remote plug

The above figure of the pin assignment applies to all Metrohm instruments with 9-pin D-Sub remote connector.

Table 5 Inputs and outputs of the remote interface

Pin no.	Assignment	Function
1	Output 0	Ready/EOD
2	Output 1	Activate/Dosimat
3	Output 2	Titration/Determination
4	Output 3	Cond. OK
5	Output 4	Error
6	0 volt (GND)	
7	+5 Volt	
8	Input 0	Start
9	Input 1	Stop

Inputs

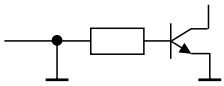


approx. 5 kΩ Pull-up

t_p > 100 ms

active = low, inactive = high

Outputs



Open Collector

t_p > 200 ms

active = low, inactive = high

I_C = 20 mA, V_{CEO} = 40 V

+5 V: maximum load = 20 mA

Status diagrams of the remote interface

EOD = End of Determination

Titration modes MET, DET, SET

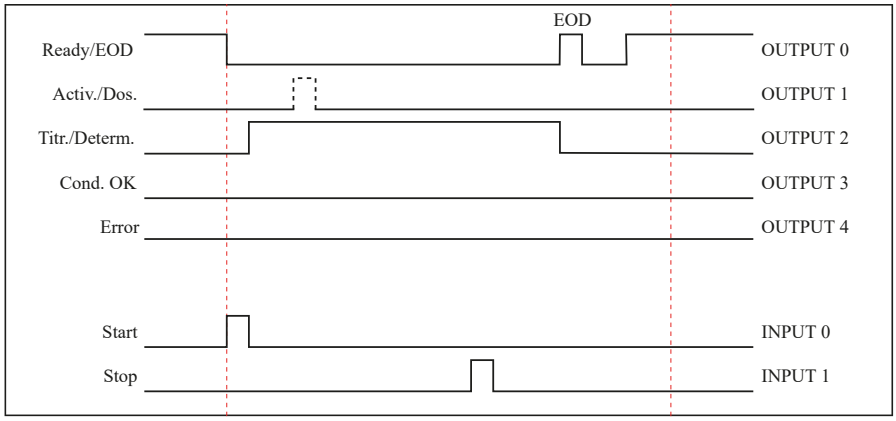


Figure 13 Remote status diagram titration mode, without error event

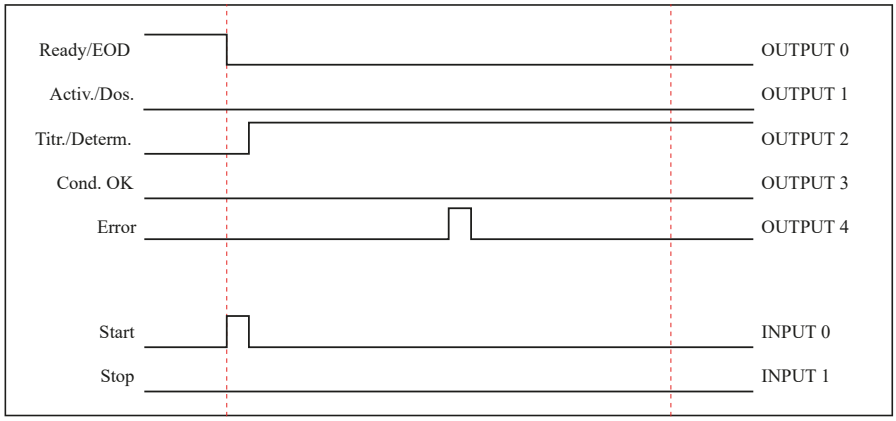


Figure 14 Remote status diagram titration mode, with error event

CAL calibration mode

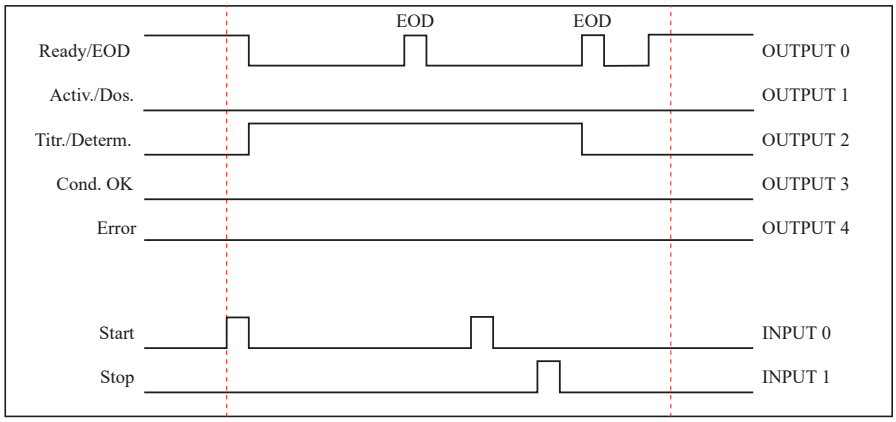


Figure 15 Remote status diagram CAL, without error event

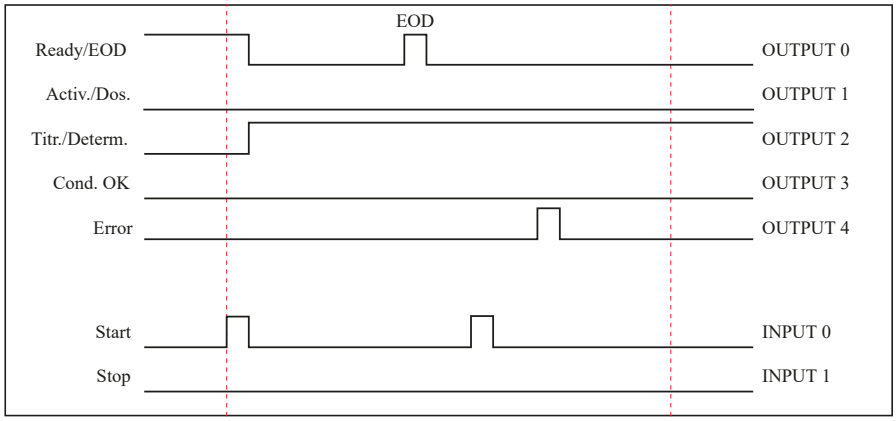


Figure 16 Remote status diagram CAL, with error event

3.6 Remote control

The instrument can be remotely controlled via an Ethernet/RS-232 connection. An RJ-45 plug with Local Area Network (LAN) is required for this. Connect the Ethernet cable to the Ethernet connector on the rear of the instrument *(see "Eco Titrator – Overview", chapter 3.1, page 9)*.

The connection can be established only if the instrument and the computer are part of the same local network (LAN) and communicate via port 8005. The IP address of the instrument is defined under: **System ▶ Ethernet settings**

Transfer protocol

The data communication is synchronous. On each command there is an acknowledgement by the instrument.

A command must be sent to the instrument with the control characters **CR LF** as terminator. The responses of the instrument will also be transferred with **CR LF** as terminator.

The instrument does not send spontaneous messages.

Commands and variables

Command	Function	Comment
$G	Start/Continue	Corresponds to the **[START]** or **[Continue]** key.
$S	Stop	Corresponds to the **[STOP]** key.
$H	Hold	Hold the method run.
$D	Scan instrument status	Responses: *Ready;0*, *Busy;0* or *Hold;0* (0 = no message). If a message on the instrument requires the interaction of the user, the acknowledgement of the status scan displays the corresponding message number. Example: Busy;010-119 = "Check buret unit" The message can be acknowledged with **[OK]** or **[Cancel]**, see below.
$A	Confirm message	Confirm the message on the instrument with **[OK]**. A mandatory status scan providing the message number must take place immediately before confirming the message, see above.
$A(CONTINUE), **$A(CANCEL)**	Confirm message	Confirm the message with **[CONTINUE]** or **[CANCEL]**.
$A(DELETE), **$A(CANCEL)**	Confirm message	Confirm the message with **[DELETE]** or **[CANCEL]**.
$A(YES), **$A(CANCEL)**	Confirm message	Confirm the message with **[YES]** or **[CANCEL]**.
$A(RECONNECT)	Confirm message	Confirm the message with **[RECONNECT]**.
$L(*method name*)	Load method	The method name must be known and unique.

Command	Function	Comment
$Q(*variable*)	Request variable value	Examples for variables: *EP1*, *R1*, *C00*. Complete list of the variables: see chapter *Formula editor*.

The values of the variables are only available after the end of a determination (in the status 'ready').

Acknowledgement of the instrument	Comment
OK	Command executed
E1	Method not found
E2	Invalid variable
E3	Invalid command

3.7 Arithmetic algorithms

Numerical format

The device software calculates in accordance with the widespread standard IEEE 754 (IEEE Standard for Binary Floating-Point Arithmetic for Microprocessor Systems). The numbers are used in calculations in "double precision" (64 bit). Decimal numbers are converted into binary numbers in the computer and used in this form for calculations. The output on the display and in reports once again contains decimal numbers; the binary numbers are thus converted back into decimal numbers. In order to check the internal calculations performed by the computer yourself in accordance with IEEE 754, the numbers are reproduced in the calculation report in complete accuracy. A minimal difference may arise between an originally entered decimal number and the internal computer representation in complete accuracy in the range of the rear decimal places. This difference results from the fact that an exact binary equivalent does not exist for every decimal number. If, for example, you enter the sample size 50.3 mg, then this will be depicted in the calculation report in "double precision" with 5.02999999999999E+01.

Rounding-off process

Measured values and results are rounded to the defined number of decimal places (commercial rounding, in accordance with the US Pharmacopeia USP). If the digit at the first dropped decimal place is **1, 2, 3 or 4**, then it will be rounded down. If this digit is **5, 6, 7, 8 or 9**, then it will

be rounded up. Negative digits will be rounded in accordance with their amount (away from zero).

Statistics

The arithmetic mean value and the absolute and relative standard deviations of results are calculated:

A maximum of five results ($1 \le k \le 5$) calculated in a determination can be statistically evaluated. A statistical series can contain a maximum of 20 determinations ($1 \le n \le 20$).

The following convention applies to the subsequent formulas:

$1 \le n \le 20$ and $1 \le k \le 5$.

Mean value:	$\bar{x}_k = \frac{1}{n} \cdot \sum_{i=1}^{n} R_{k,i}$
Absolute standard deviation:	$Sabs_k = +\sqrt{\frac{\sum_{i=1}^{n} \left(R_{k,i} - \bar{x}_k\right)^2}{n-1}}$
Relative standard deviation (in %):	$Srel_k = 100 \cdot \frac{Sabs_k}{\bar{x}_k}$

Explanations

The individual values are incorporated in the statistics with full accuracy.

15 significant places are yielded when the 64 bit numerical format is applied for the floating-point number in decimal presentation.

The accuracy can be controlled by the selection of the prefix of the unit (milli, micro) and the number of decimal places.

Example

The result displayed, **1234.56789158763 mg/L**, has 15 significant places. It should be rounded off to 3 decimal places according to the above rounding-off process:

- **1234.568 mg/L**.

If the same result is expressed in **g/L** (**1.23456789158,763 g/L**), and is also rounded off to 3 decimal places, then this will yield:

- **1.235 g/L**.

This means you obtain the lowest losses of accuracy with rounding if you select the application and the numerical format in such a way that the numbers displayed have as many places **before** the decimal point as possible.

A complete recalculation of the statistics using a pocket calculator or a computer calculation program may exhibit deviations. This can be explained by the different binary numerical formats used by these computers.

The above losses of accuracy by rounding off in the range of significant places are only theoretically relevant. They are generally several orders of magnitude less than measurement technique uncertainties (balance errors, dosing errors, measuring errors).

4 Delivery and transport

4.1 Delivery

Inspect the delivery immediately upon receipt:

- Check the delivery against the delivery note to ensure completeness.
- Check the product for damage.
- If the delivery is incomplete or damaged, contact your regional Metrohm representative.

4.2 Packaging

The product and accessories are supplied in protective special packaging. Keep this packaging to ensure safe transportation of the product. If a transport locking device is present, keep this as well for future reuse.

5 Installation

5.1 Setup location

The product is only suitable for operation indoors and may not be used in explosive environments.

The following requirements apply to the setup location:

- The room is well-ventilated and protected against both direct sunlight and excessive temperature fluctuations.
- The setup space is stable and free of vibrations. The setup space must be suitable for the dimensions and weight of the components (see technical specifications).
- All cables and connectors are accessible during operation. The cables are safely installed (no tripping hazards).
- The workplace is ergonomically designed and ensures trouble-free operation of the product.

5.2 Connecting the power cord

WARNING

Health hazards from electrical potential.

Severe injuries with possibly fatal consequences.

- Operate the product only if it is in perfect condition. The housing must also be intact.
- Only use the product with the covers fitted.
- Protect live components (e.g. power supply unit, power cord, connection sockets) against moisture.
- Always have maintenance work and repairs on electrical components carried out by a regional Metrohm service representative.

Connecting the power cord

Required accessories:

- Power supply unit (6.2164.010)

Use only this power supply unit. Other products are not permitted.

- Power cord:
  - Length: max. 2 m
  - Number of conductors: 3, with protective ground
  - Conductor cross-section: 3 × min. 1.0 mm^2 / 18 AWG
  - Coupling: IEC 60320, type C13, 10 A
  - Power plug: 6.2122.XX0 (according to customer requirement), min. 10 A

1

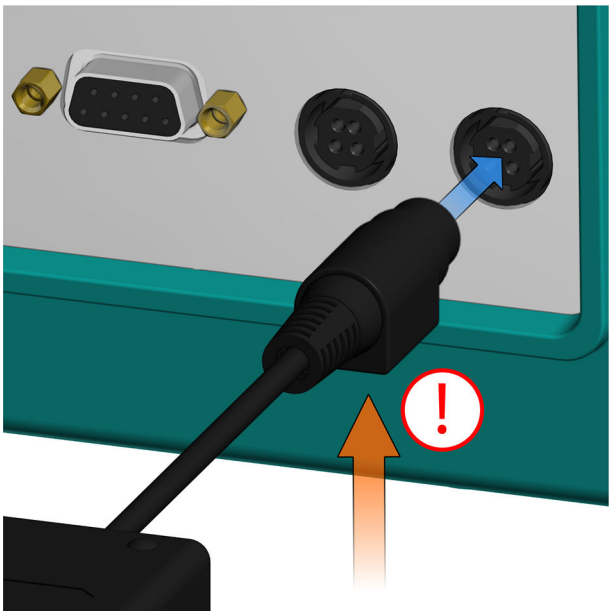


Figure 17 Rear of the instrument – Connecting the power cord

Connect the power supply unit to the **Power IN** connector.

Note the alignment (see figure).

2 Connect the power cord to the power supply unit.

3 Connect the cable to the energy supply.

The instrument can now be switched on and off: *(see "Switching the device on and off", chapter 6.1, page 33)*

5.3 Initial assembly of the cylinder unit

The initial assembly of the cylinder unit is carried out with an **installation wizard**.

The installation wizard not only supports the assembly of the cylinder unit but also the assembly of the remaining accessories:

- Support rod and clamping ring
- Electrode holder
- Bottle unit
- Tubing connections
- Beaker and stirring bar
- Link stopper and tubing tip
- Electrode

If the instrument has already been set up, the cylinder unit is disassembled and assembled with the **Manual control** ▶ **Exchange cylinder unit** function.

Executing the installation wizard

Prerequisite:

- The instrument is switched on. The push rod is in the lowest position.

1 The installation wizard starts automatically if the instrument is switched on for the first time.

The installation wizard can also be opened manually via **Manual control** ▶ **Installation wizard**.

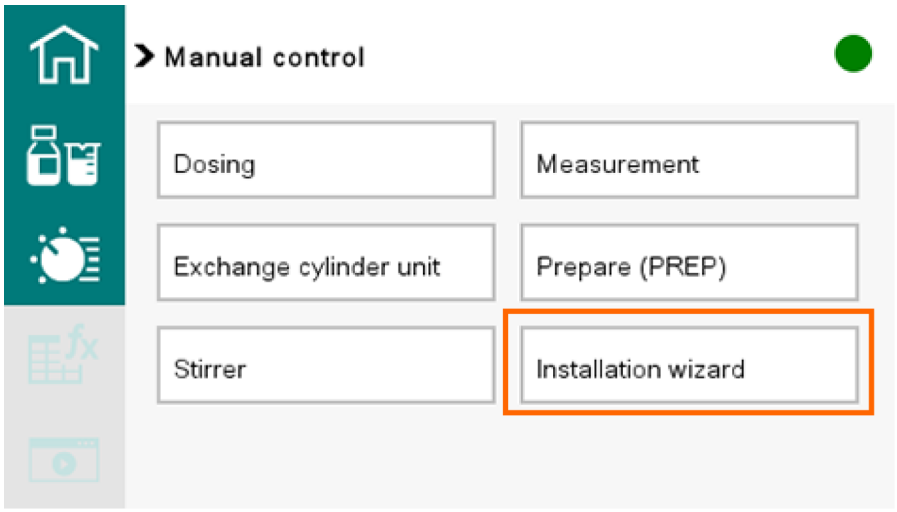


Figure 18 Opening the installation wizard manually

2 Mount the cylinder unit according to the instructions on the screen.

After having executed a step, move to the next step with .

The cylinder unit has been mounted.

3 Continue with the **installation wizard** to mount the remaining accessories.

The last picture shows the instrument with all the accessories mounted. Click to exit the installation wizard.

Further accessories can also be assembled without the installation wizard.

5.4 Mounting the support rod

Mounting the support rod, clamping ring and electrode holder

Required accessories:

- Support rod (6.2016.070)
- Clamping ring (6.2013.010)
- Electrode holder (6.2021.020)

1 Mounting the support rod

- Screw the support rod onto the stand attachment.

The clamping ring and the electrode holder can now be mounted to the support rod.

2 Mounting the clamping ring

- Push the clamping ring over the support rod with the groove facing upward.
- Push the clamping ring down as far as possible.

3 Mounting the electrode holder

- Press the locking lever on the electrode holder.
- Push the electrode holder over the support rod.
- To secure the electrode holder in place, release the locking lever at the desired height.

4 Securing the electrode holder in place

- Push the clamping ring under the electrode holder.
- Rotate the clamping ring in such a way that the wedge on the electrode holder fits in the groove in the clamping ring.
- Tighten the knurled screw on the clamping ring.

The clamping ring serves as a lower stop for the electrode holder and prevents the electrode holder with the mounted electrode from being lowered too far.

The electrode holder can now be equipped with the other accessories.

5.5 Mounting the bottle unit

Preparing the bottle cap

Required accessories:

- Bottle cap (6.1602.105)
- Cannula (6.1819.020)
- Threaded stopper (6.1446.080)
- Adsorber tube (6.1619.010)
- Ground-joint clip SGJ 14/15 (6.2023.020)
- Cotton
- Suitable sorbent
  - Molecular sieve for water-sensitive samples.
  - Soda lime for CO_2-sensitive samples.

1 Insert the cannula into the bottle cap.

2 Screw the threaded stopper into the bottle cap.

3 Fill the adsorber tube with a suitable sorbent.

If no special sorbent is required, then the adsorber tube can be filled with cotton and used as a dust filter.

4 Place the filled adsorber tube on the bottle cap.

5 Secure the adsorber tube in place with the ground-joint clip for SGJ 14/15.

The bottle cap is prepared.

Mounting the bottle unit

Prerequisite:

- The bottle cap is prepared.

Required accessories:

- Amber glass bottle (6.1608.023)

1 Set the bottle in the bottle holder.

2 Screw the prepared bottle cap onto the bottle and tighten it by hand.

The bottle unit is mounted

5.6 Mounting the tubing connections

The tubing connections connect the flat stopcock with the bottle unit, the cylinder unit, and the tubing tip.

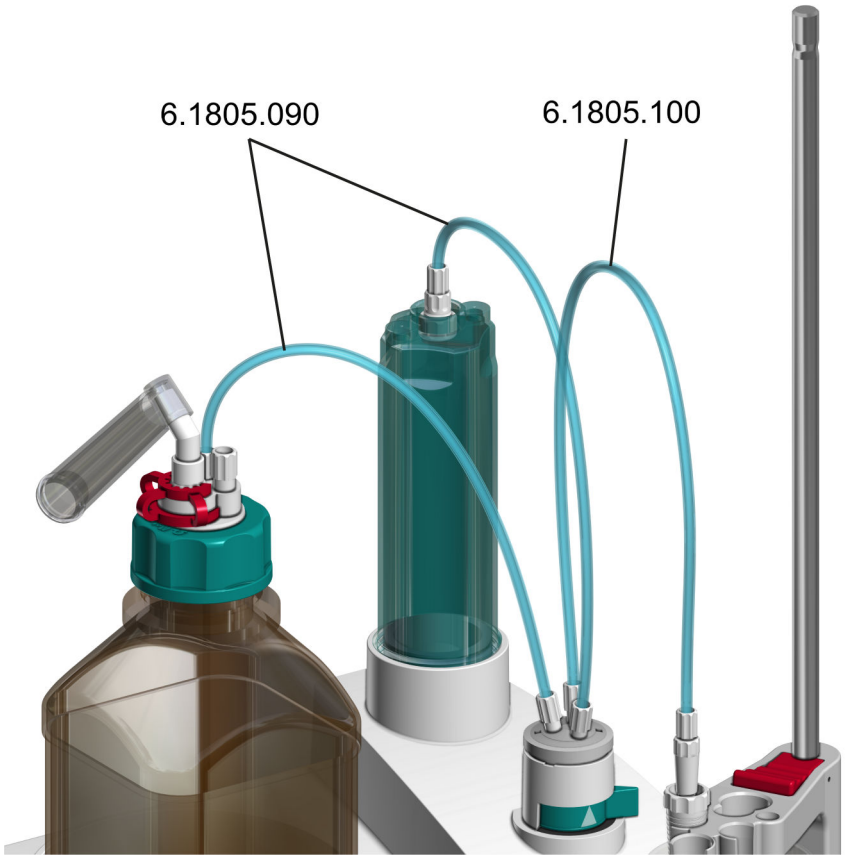


Figure 19 Tubing connections

Mounting the tubing connections and tubing tip

NOTICE

Deformation of the screw nipple of the tubing connections.

The tubing connections are unusable and must be replaced, otherwise liquids may leak out.

Measures to be avoided:

- Carefully screw in and tighten all tubing connections.
- Use no other investigative tools or other tools.

Prerequisite:

- The cylinder unit, electrode holder and bottle unit are mounted.

Required accessories:

- 2x FEP tubing 31 cm (6.1805.090)
- 1x FEP tubing 40 cm (6.1805.100)
- Required tubing tip:
  - Tip M6 (6.1543.060)
  - Antidiffusion tip M6 (6.1543.200)

  Suitable holder for tubing tip:
  - Link stopper (6.1446.030)
  - Guide sleeve (6.2709.070)

1. Screw the 6.1805.090 tubing securely to the cylinder unit and to the flat stopcock.
2. Screw the 6.1805.090 tubing securely to the bottle unit and to the flat stopcock.
3. Screw the 6.1805.100 tubing securely to the flat stopcock.
4. Screw the tubing tip securely to the 6.1805.100 tubing.
5. Mount a suitable holder for the tubing tip on the electrode holder and insert the tubing tip into the holder.

   The tubing connections and tubing tip are mounted.

5.7 Mounting the electrode

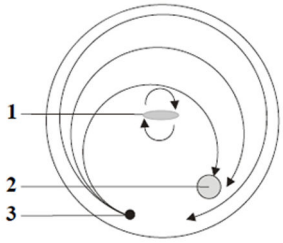


Figure 20 Schematic arrangement during a titration

1	**Stirring bar**	**2**	**Electrode**
3	**Tubing tip**		

Mounting the electrode

During the titration, it is important that the solution is mixed well. In order for the measurement to be taken in a well-mixed solution after the addition of the titrant, mount the electrode according to the following criteria (tubing tip may need to be repositioned):

1. Mount the tubing tip *(20-**3**)* in a place where turbulence is high.
2. Mount the electrode in such a way that the path from the addition of the titrant (tubing tip) to the electrode *(20-**2**)* is as long as possible.

   Always observe the stirring direction *(20-**1**)*.

6 Operation and control

6.1 Switching the device on and off

Switching on the device

Prerequisite:

- The power cord is connected.
- The instrument is switched off.

1 Press the key.

The instrument is initialized and a system test is performed.

If enabled in **System** ▶ **Settings**, then the following can occur after switching on:

- A **beep** sounds.
- **PREP warning** appears and indicates that the cylinder unit needs to be prepared *(see "Preparing (PREP)", chapter 6.4.4, page 50)*.

The instrument is switched on and the **start page** is displayed.

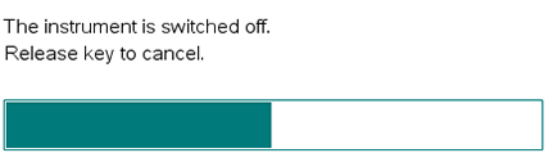
Switching off the device

Prerequisite:

- The device is switched on.

1 **Key combination**

- Press and hold down the key.
- Also press the key and hold down both keys until the progress bar is full.



If the keys are released during this time, then the device will remain switched on. This is to prevent accidental switch-off.

The device is switched off.

Instant Up

The **Instant Up** function locks the indicators and controls, but ensures that the device is immediately available again at the touch of a button.

Activating and deactivating Instant Up

Prerequisite:

- The device is switched on.

1 Activating Instant Up

- Press and hold down the key until the progress bar is full.

If the key is released during this time, then the indicators and controls will remain active.

Instant Up is activated. Indicators and controls are inactive.

2 Deactivating Instant Up

- To deactivate **Instant Up**, press the key.

The indicators and controls are available again.

6.2 Indicators and controls

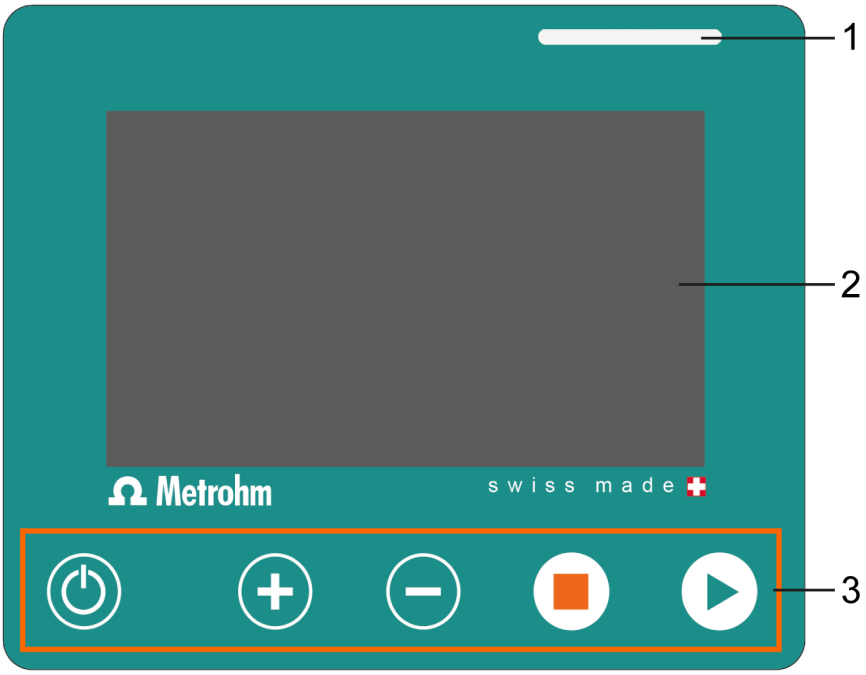


Figure 21 Status display, touch screen and control bar

1 Status display
Indicates the operating status of the instrument.

2 Touch screen
Used to set and control the instrument as well as to display results and additional information.

3 Control bar
Used to switch the instrument on and off, to control the dosing rate, and to start and stop the dosing process.

6.3 User interface

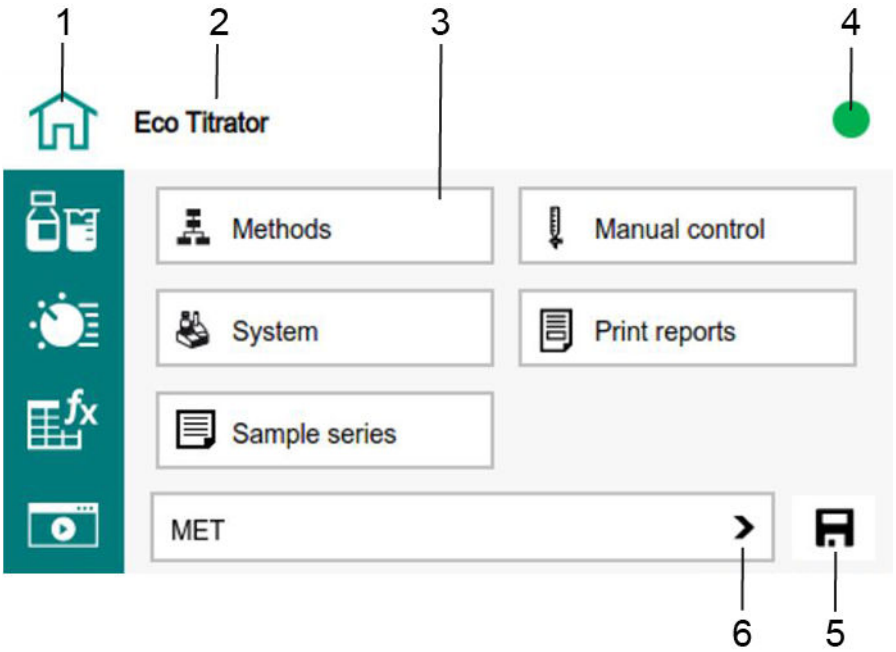


Figure 22 Start page with access to the functions

1	**Work areas**	**2**	**Menu path**
3	**Button**	**4**	**Status indicator**
5	**Icon**	**6**	**Method selection bar**

Work areas

Once the instrument is ready for operation, the work areas can be selected. Work areas that cannot be selected are grayed out.

If necessary, click the button so that the piston moves to the basic position, the status display lights up and the status indicator is green.

The following work areas can be selected:

Eco Titrator start page

The start page with access to the functions:

- Methods
- Manual control
- System
- Print reports

Sample data

Access to the sample data: sample size, unit, ID1 and ID2

Parameters

Access to the parameters, grouped into the following categories:

- Start conditions
- Titration parameters
- Stop conditions
- Evaluation
- Calculation
- Statistics
- Reports

Results

Access to the calculated results and the stop criterion.

Live status

Access to the graphic display of the ongoing determination.

Menu path

In the menu path, clicking one of the elements of the menu path can be used to call up the respective menu.

Buttons, input fields, keyboards and help texts

The menu provides the following possible inputs and information:

- **Buttons**
  The respective menu is called up by clicking the button.
- **On/off switch**
  The corresponding function is activated or deactivated by clicking on **[ON]** or **[OFF]**.
- **Input fields**
  The respective keyboard is called up by clicking the button of the input field.
- **Keyboards**
  Input of text, numbers or characters. An appropriate keyboard is called up, depending on the type of input.

Help texts

Help texts (in English) are available for the input fields. The respective help text is called up by long pressing (for at least 3 seconds) on an input field. Default values and possible inputs are displayed.

Status indicator

The status indicator on the touch screen uses colors to display the operating status of the instrument.

Icon

The following functions can be called up with the different icons - depending on the context:

- Save
- Delete
- Export
- etc.

Method selection bar

The list of saved methods opens by clicking on the method selection bar.

The list can be searched with the scroll bar and the requested method can be loaded by clicking on it.

Brightness of the display

The brightness of the display can be adjusted on the start page in the **System** ▶ **Diagnosis** ▶ **Display test** menu.

The most recently set brightness appears when the instrument is switched on.

Brightness

Input range	**1** to **10**
Default value = 7	

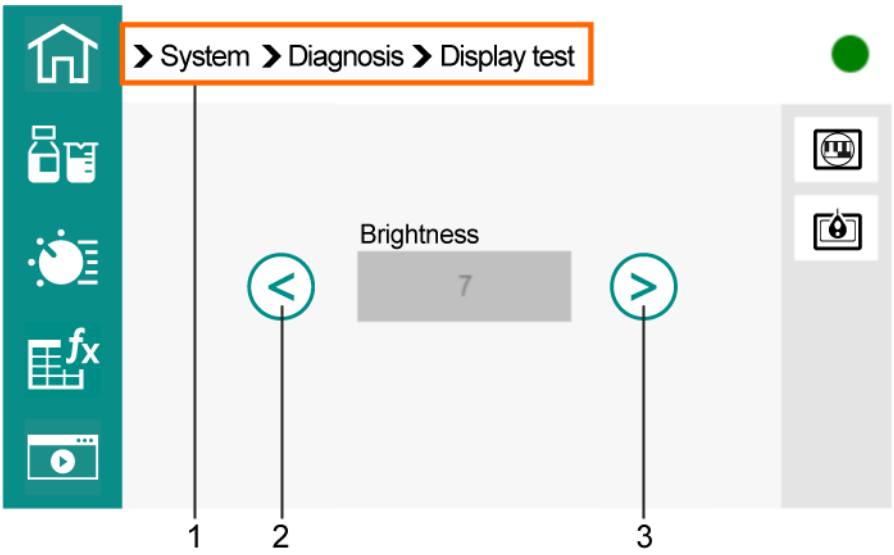


Figure 23 Display – Controls

1	**Menu path**	**2**	**Reduce brightness**
3	**Increase brightness**		

Keyboards

Different keyboard types are available.

Figure 24 Keyboard (example: lower-case characters)

1	**Input field**	**2**	**Delete entry**
3	**Backspace**	**4**	**Cancel input (close window)**
5	**Apply entry**	**6**	**Forwards in the input field**
7	**Backwards in the input field**	**8**	**Space**
9	**Switch keyboard**		

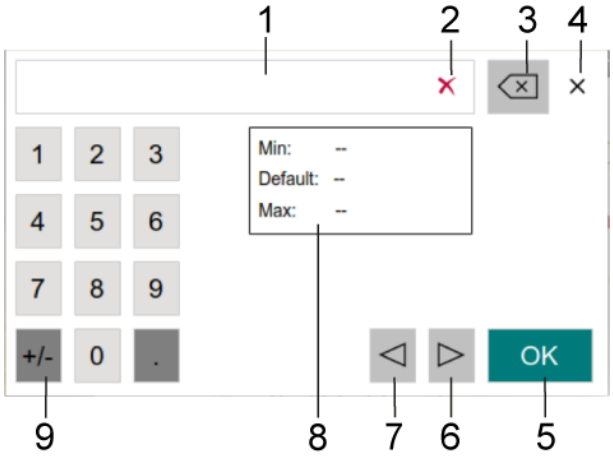


Figure 25 Keyboard (example: numbers)

1	**Input field**	**2**	**Delete entry**
3	**Backspace**	**4**	**Cancel input (close window)**
5	**Apply entry**	**6**	**Forwards in the input field**
7	**Backwards in the input field**	**8**	**Specifications**
9	**Algebraic sign change**		

6.3.1 Formula editor

Figure 26 Formula editor

1	**Input field**	**2**	**Delete entry**
3	**Backspace**	**4**	**Cancel input (close window)**
5	**Apply entry**	**6**	**Forwards in the input field**
7	**Backwards in the input field**		

The formula editor allows for the entry of formulas. The formula editor is equipped with an automatic syntax check. This is triggered as soon as

a formula is applied. The generally valid rules of priority apply for the calculation operations.

Variable	Description
C00	Sample size
EP#	Volume of endpoint EP# (# = 1–9)
CI#	Sample identification (# = 1–2)
R#	Result (# = 1–5)
FP#	Volume of fixed point FP# (# = 1–2)
CV0#	Common variable (# = 1–5)
SMN#	Mean value of result R# (# = 1–5)
TITER	Titer of selected solution
CONC	Concentration of selected solution
Var	List of additional variables
Templates	List of predefined calculation formulas

"#" stands for a sequential number that you must enter manually. Example: If you apply the variable **EP#** in the formula, only **EP** is entered. In order to define the EP to be used, the corresponding number has to be added manually after "EP". Example: EP**5**

Variables

Clicking on **[Var]** displays a list with additional variables. You can enter these variables either directly into the formula or also by selecting them from the list and applying them with **[OK]**.

Variable	Description
MIM	Initial measured value, i.e. measured value prior to the processing of the start conditions
MSM	Start measured value, i.e. measured value after the processing of the start conditions
MCV	End volume, i.e. total dosed volume at the end of the titration
ET#	Temperature at endpoint EP# (# = 1–9)
EM#	Measured value of endpoint EP# (# = 1–9)
ED#	Time at endpoint EP# (# = 1–9)
MSV	Start volume
MEN	Electrode zero point pH(0)

Variable	Description
MSL	Electrode slope
DD	Duration of the entire determination
MST	Start temperature
MCT	End temperature
FT#	Temperature at fixed point FP# (# = 1–2)
FM#	Measured value of fixed point FP# (# = 1–2)
FD#	Time at fixed point FP# (# = 1–2)

For information on the meaning of the placeholder **Molw**, see the following note.

Calculation templates

Pressing **[Templates]** displays a list with calculation templates. You can apply these templates directly with ✓.

Some templates contain the placeholder **Molw**, which stands for the molar mass of the sample. You must replace this placeholder with the correct value in the calculation formula.

Template	Description
Content %	Content in % Unit of the sample size = g
Content mmol/L	Content in mmol/L Unit of the sample size = mL
Content mol/L	Content in mol/L Unit of the sample size = mL
Content g/L	Content in g/L Unit of the sample size = mL
Content ppm	Content in ppm Unit of the sample size = g
Titer	Titer calculation Unit of the sample size = g
Blank mean value	Blank value as mean value of single results
Blank single value	Blank value as single value

6.4 Manual control

The **[Manual control]** button on the start page provides the following functions:

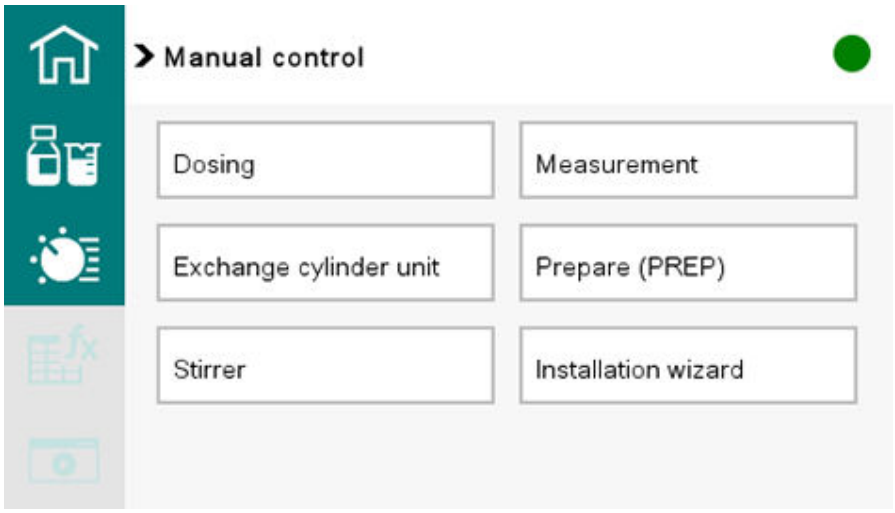


Figure 27 Manual control – Functions

- Dosing – Dose a specified volume or dose continuously.
- Measurement – pH measurement or potentiometric potential measurement.
- Exchange cylinder unit – Empty and safely exchange the cylinder unit.
- Prepare – Rinses and fills the cylinder unit and the tubings.
- Stirrer – Switch the stirrer on and off and set the stirring rate.
- Installation wizard – Initial installation of the cylinder unit.

6.4.1 Manual control – Dosing

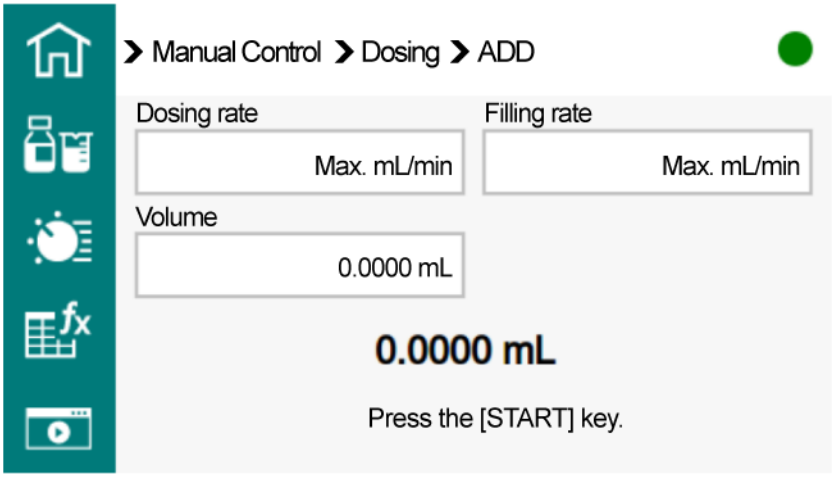
The following manual dosing functions are available with the Eco Titrator:

- **Dosing a fixed volume (ADD)** – Dosing a specified volume.
- **Continuous dosing (DOS)** – Dosing as long as the ▶ key is being pressed.

Dosing a specified volume (ADD)

1 Selecting the dosing function

Click on **Start page** ▶ **Manual control** ▶ **Dosing** ▶ **ADD**.



2 Configuring the dosing function

- The dosing and filling rates should be decreased for viscous and highly volatile liquids.
- The maximum dosing rate and maximum filling rate depend on the cylinder volume.
- In manual control, the instrument doses in steps of 1/20,000 of the cylinder volume. The entered dosing volume is rounded accordingly.

- Enter the dosing rate.
- Enter the filling rate (filling the cylinder).
- Enter the required dosing volume.

3 Starting the dosing

Press the ▶ key.

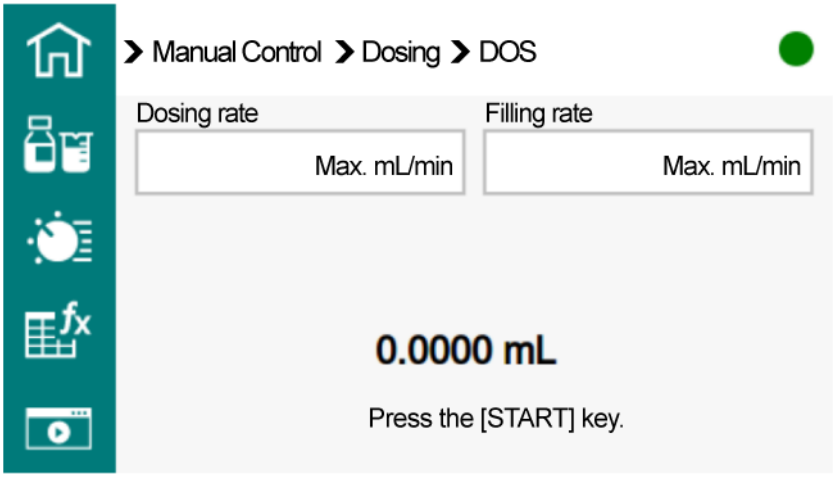
The dosed volume is shown on the screen.

After the volume of one cylinder has been dosed, the cylinder will be refilled automatically.

Dosing continuously (DOS)

1 Selecting the dosing function

Click on **Start page** ▶ **Manual control** ▶ **Dosing** ▶ **DOS**.



2 Configuring the dosing function

- The dosing and filling rates should be decreased for viscous and highly volatile liquids.
- The maximum dosing rate and maximum filling rate depend on the cylinder volume.

- Enter the dosing rate.
- Enter the filling rate (filling the cylinder).

3 Starting the dosing

- Press the ▶ key for as long as dosing should take place.

  Pausing the dosing: Release the ▶ key.

  Continuing the dosing: Press the ▶ key again for as long as dosing should take place.

The dosed volume is shown on the touch screen.

4 Use the ■ button to stop the process and fill the cylinder.

6.4.2 Manual control – Measurement

The following measuring functions are available in the manual control:

- **pH** – pH measurement
- **U** – potentiometric potential measurement

Measuring manually

1 Selecting the measuring function

Click on **Start page** ▶ **Manual control** ▶ **Measurement**.

2 Selecting the measured quantity

Click on **[pH]** or **[U]**.

3 Configuring the measuring mode

- Select the required **electrode** from the sensor list. The selection depends on the measuring mode.
  The sensor list can be managed under **System** ▶ **Sensors** on the **Start page**.
- Enter the **measuring temperature** if no temperature sensor is connected.
  If a temperature sensor is connected, then the temperature will be measured automatically.
  The measuring temperature is used for automatic temperature compensation with pH measurements.

4 Starting the measurement

Press the ▶ key.

The current measured value and the measuring temperature are shown on the screen.

5 Stopping the measurement

Press the ■ key.

6.4.3 Exchanging the cylinder unit

In the **Exchange cylinder unit** function, the drive moves the push rod into the exchange position.

NOTICE

Material damage caused by incorrect handling of the cylinder unit

The cylinder unit is blocked or damaged in some other way and must be replaced.

- Follow strictly the instructions for assembly, disassembly, and maintenance of the cylinder unit.
- Use only the tools specified.

NOTICE

Material damage from aggressive chemical hazardous substances

If the product comes into contact with aggressive chemical substances, this can lead to malfunctions or the product may be damaged and must be replaced.

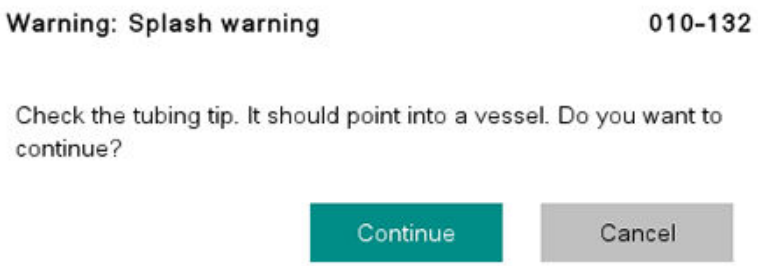
- Clean up spilled liquids and solids immediately.
- Use protective grounding when working with highly flammable chemical substances and gases.
- If you suspect that chemical substances have penetrated the product, disconnect the product from the energy supply immediately. Then notify the regional Metrohm service representative.

Emptying and removing the cylinder unit

1 On the **Start page**, open the **Manual control** menu.

Click **[Exchange cylinder unit]**.

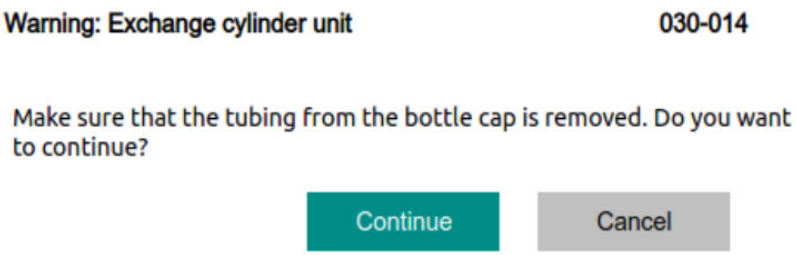
A splash warning appears:



2
- Make sure that the tubing tip points into a vessel.
- **[Continue]**

The piston rises and the cylinder empties as much as possible. The message **Exchanging cylinder unit...** appears.

Once the push rod has reached the top position, the following warning appears:



3

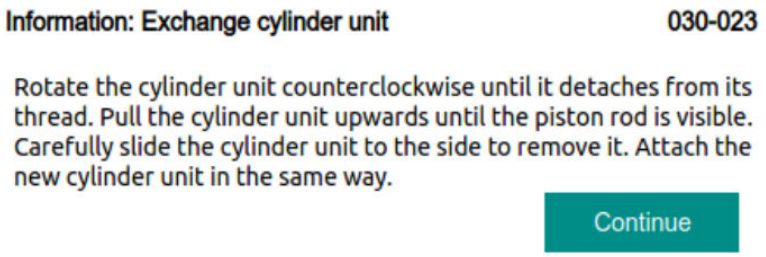
- Make sure that the tubing from the bottle cap is removed.
- **[Continue]**

The message **Exchanging cylinder unit...** appears and the piston is lowered down to the height at which the cylinder unit can be disassembled.

4

- Remove the tubing from the cylinder unit.
- **[Continue]**

The following message is displayed:



5 **Dismantling the cylinder unit**

- Rotate the cylinder unit counterclockwise until it detaches from its thread.
- Pull the cylinder unit vertically upwards until the piston rod is visible.
- Carefully slide the cylinder unit to the side to remove it.

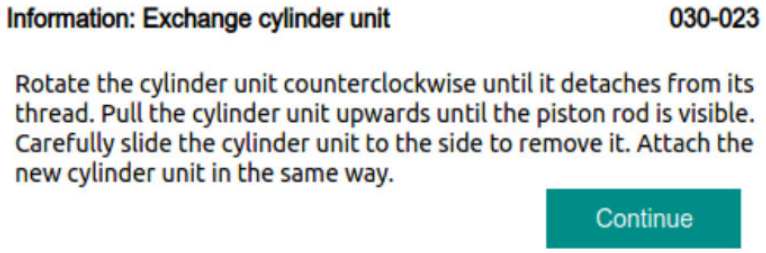
The disassembled cylinder unit can be cleaned and reused or replaced with a new cylinder unit.

Mounting the cylinder unit

Prerequisite:

- The instrument is switched on.
- The **[Exchange cylinder unit]** process was executed up to the point when the cylinder unit can be removed from the instrument.

- The instrument is carrying out the **[Exchange cylinder unit]** procedure and the push rod of the dosing drive is at the height at which the cylinder unit can be mounted. The following message is displayed:



- The maintenance has been carried out professionally or a new cylinder unit is ready for assembly.
  The cylinder unit is prepared:

1. Connect the cylinder unit to the push rod and carefully align the piston rod into the hook profile of the push rod while doing so.

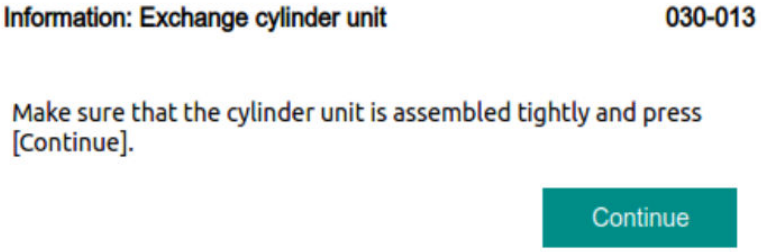
2. Grasp the cylinder unit at the light protection and press it **carefully and straight** down (the piston is pressed into the cylinder) until the mounting ring rests on the housing.

   Make sure that the sealing lips and the piston in the cylinder are not damaged.

3. Screw the cylinder unit securely into the thread of the housing and tighten it.

4. **[Continue]**

   The push rod moves the piston into the basic position.

5. 

   Make sure that the cylinder unit has been mounted correctly.

   [Continue]

6. **[Continue]**

Make sure in the **System** ▶ **Settings** menu that the value of the cylinder volume matches the volume of the mounted cylinder unit.

The cylinder unit is ready and the **Prepare (PREP)** command can be executed.

6.4.4 Preparing (PREP)

The **PREP** function is used to rinse the cylinder unit and tubings and fill them free of air bubbles.

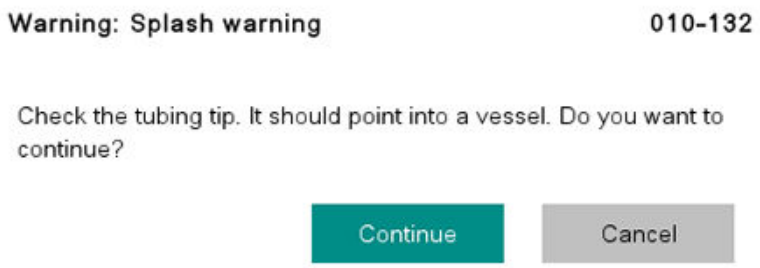
Metrohm recommends executing the function (PREP) before the first determination.

Preparing (PREP)

1 On the **Start page**, click on **[Manual control]**.

2 Click on **[Prepare (PREP)]**.

A splash warning appears:



3 Make sure that the tubing tip points into a vessel.

[Continue]

The piston rises and sinks and the cylinder empties and fills in 2 cycles.

The cylinder unit is prepared and can be used.

6.4.5 Operating the magnetic stirrer

Switching the stirrer on and off

Prerequisite:

- The instrument is switched on.

1 Add a stirring bar to the sample vessel.

2 On the **Start page**, click on the **[Manual control]** button.

3 Click on the **[Stirrer]** button.

The controls for the magnetic stirrer appear:

4 **Switching on the stirrer**

Click on ▶. This icon is visible only when the stirrer is switched off.

The stirrer begins stirring with the most recently set stirring rate.

5 **Switching off the stirrer**

Click on ■. This icon is visible only when the stirrer is switched on.

The stirrer stops.

Setting the stirring rate

The stirring rate can be adjusted in 15 steps. The default value is Step 8.

The stirring rate should be high enough to form a small vortex. Select the appropriate stirring rate, otherwise incorrect measured values may result.

Table 6 Consequences of incorrect stirring rate

The stirring rate is too high	Air bubbles are stirred into the measuring solution.
The stirring rate is too low	The solution is not mixed well at the electrode.

Prerequisite:

- The magnetic stirrer controls are opened: **Start page** ▶ **Manual control** ▶ **Stirrer**
- The stirrer is switched on.

1 **Reducing the stirring rate in steps**

Click < repeatedly until the desired stirring rate has been reached.

With each click, the stirring rate is reduced by one step. The current stirring rate is displayed.

2 Increasing the stirring rate in steps

Click (>) repeatedly until the desired stirring rate has been reached.

With each click, the stirring rate is increased by one step. The current stirring rate is displayed.

6.5 Methods

Definition

A **method** determines how determinations are carried out. The titration mode, measured quantity and further parameters are defined in a method.

Methods are saved under a freely selectable method name. A method name consists of a maximum of 12 characters.

Method selection bar

The **method selection bar** on the start page shows the method that has been loaded. If needed, another method can be loaded in the method selection bar. Determinations can be executed with the method that has been loaded.

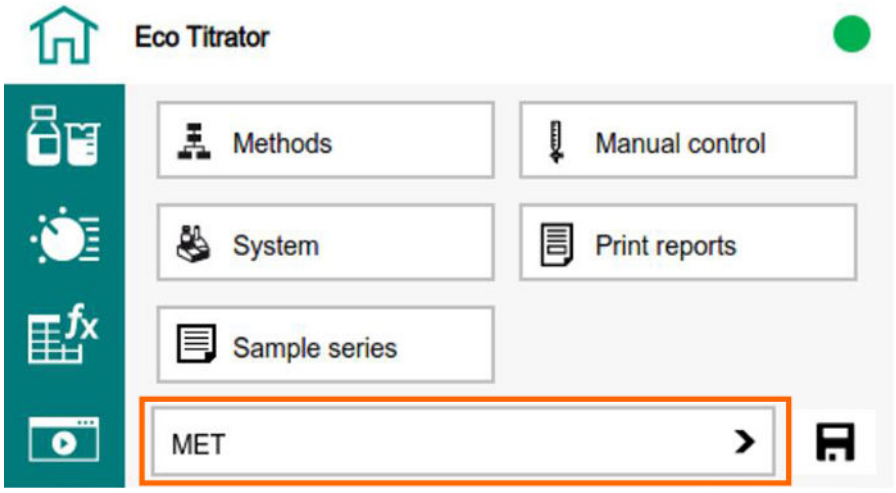


Figure 28 Method selection bar

Display in the method selection bar	Example	Meaning
Method name	MET_pH	The method is saved in the method list.

Display in the method selection bar	Example	Meaning
Method name [New]	MET_pH [New]	The method has just been created. It has not been saved.
Method name [Modified]	MET_pH [Modified]	The method has been modified. The modifications have not been saved.

A new or modified method is available for determinations until it is changed or until another method is loaded. To use the method at a later point, it can be saved in the method list.

Method list

The **[Method]** button on the start page shows a list of all the saved methods. Methods can be created, exported and deleted here.

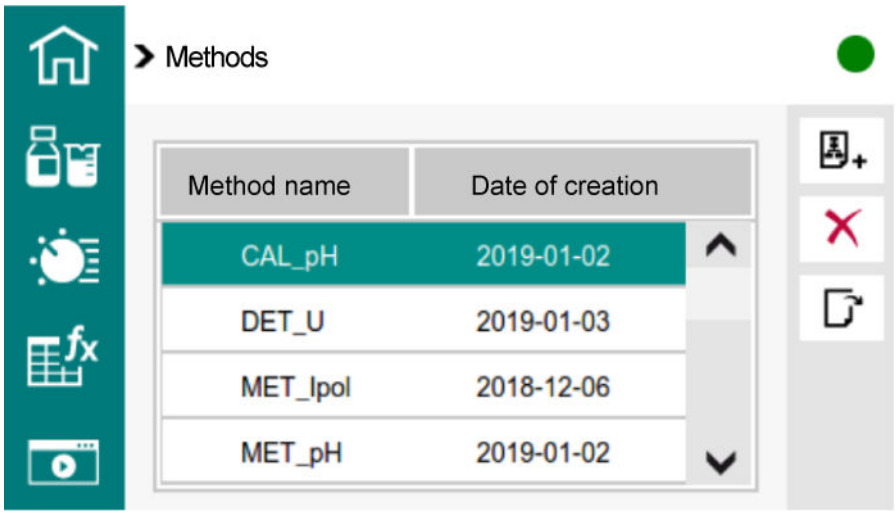


Figure 29 Method list (example)

A scroll bar appears if the list is longer.

Titration mode

Each method is based on a titration mode. The following titration modes are available:

- **MET** – Monotonic equivalence point titration
  3 measured quantities are available: pH, U or Ipol
- **DET** – Dynamic equivalence point titration
  3 measured quantities are available: pH, U or Ipol
- **SET** – Endpoint titration
  3 measured quantities are available: pH, U or Ipol
- **CAL** – Calibration of pH electrodes
  Measured quantity: pH

6.5.1 Using and managing methods

Methods are used as follows:

- **Load method** – Allows for the execution of determinations with the method that has been loaded. Allows for changes of the method that has been loaded.
- **Change method parameters** – Changes the parameters of the method that has been loaded.
- **Store method** – The method that has been loaded can be added to the method list.

The following options are available to create and manage methods:

- **Create new method**
- **Delete method** – Remove the method from the method list.
- **Export method** – Print out the method or save it to a USB flash drive.
- **Import method** – Add a method from a USB flash drive to the method list.

Loading the method

1 Open the method selection bar on the **Start page**:

Click on ❯.

A list with the saved methods appears. The list can be searched with the scroll bar.

2 Select the desired method.

The desired method appears in the method selection bar and is loaded.

3 Change the method parameters if necessary.

The method is available for determinations.

Changing the method parameters

1 Load the method that you want to change in the method selection bar on the **Start page**.

2 Open the **Parameters** work area:

3 Set the parameters if necessary.

4 Continue with one of the following steps:

- Carry out determinations with the modified method.
- Go to the **Start page** and save the method for later use.

Saving a method

If the method parameters change, then they can be saved as your own method. A maximum of 120 methods can be saved.

Prerequisite:

- The method that you want to save is loaded in the **method selection bar**.
- The method is marked [New] or [Modified].

1 Save the method:

An input field for the name appears.

2 Click on the input field.

A keyboard appears.

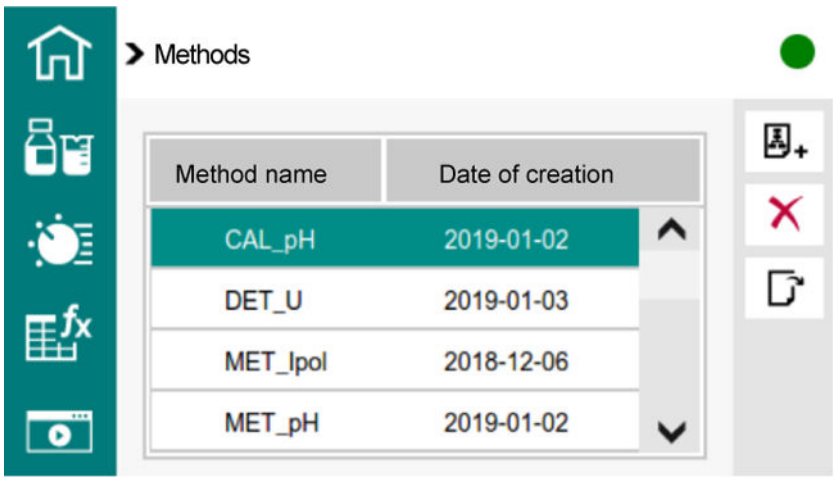
3 Enter the desired name with the keyboard. Finish with **[OK]**.

The name that was entered appears in the method selection bar. The method is now saved in the method list.

Creating a new method

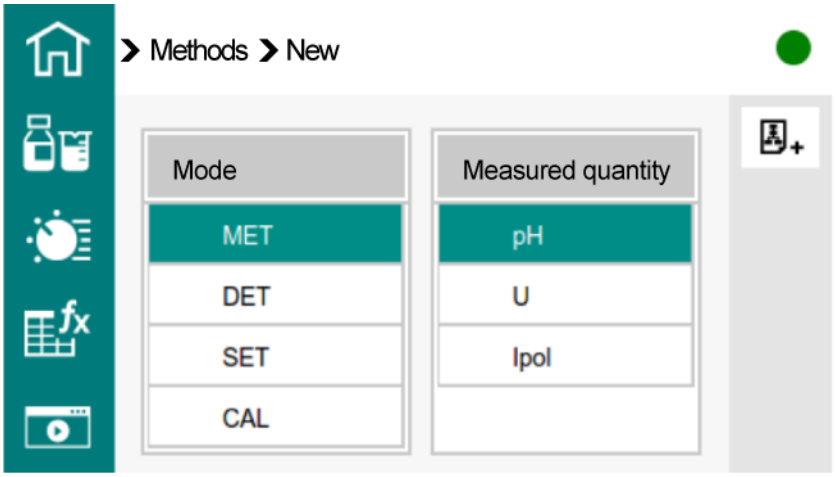
1 On the **Start page**, click on the **[Methods]** button.

The method list opens.



2 Create a new method:

A selection of titration modes and measured quantities appears.



If modifications on the method that was loaded before have not been saved, the following warning appears:

Store method: The modifications of the current method have not been saved. Do you want to load the method anyway?

- **[Yes]** – a new method is created. The changes on the method that is currently loaded are discarded.
- **[Cancel]** – creation of the new method is canceled.

3
- Select the desired titration mode by clicking on it. Example: MET
- Click to select the desired measured quantity. Example: pH
- Click on .

The new method appears in the method selection bar. The method is marked with **[New]**. Example: MET_pH [New]

4 Set the method parameters.

5 Continue with one of the following steps:
- Carry out determinations with the new method.
- Save the method for later use.

Deleting a method

1 On the **Start page**, click on the **[Methods]** button.

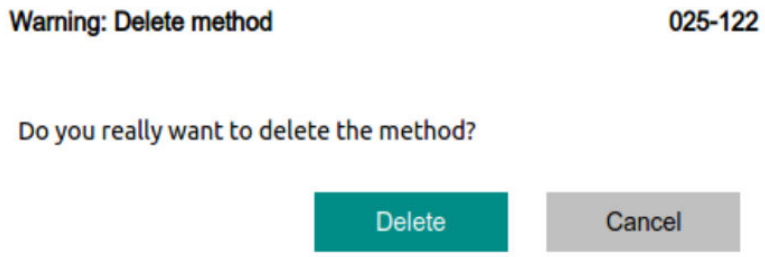
The method list appears.

2 Select the method that you want to delete by clicking on it.

The selected method is highlighted in green.

3 Delete the highlighted method:

The warning **Delete method** appears.



4 Confirm deleting: **[Delete]**

The deleted method is no longer available in the method list.

Exporting a method

1 Connect the USB flash drive to the instrument.

2 On the **Start page**, click on the **[Methods]** button.

The method list appears.

3 Select the method that you want to export by clicking on it.

The selected method is highlighted in green.

4 Export the marked method:

The message **Exporting method to USB flash drive...** appears.

Once the message has disappeared, the method is saved to the USB flash drive that is connected.

If a method with the same name already exists on the USB flash drive, then the following warning appears: **Store method: Method name already exists. Do you want to overwrite the name?**.

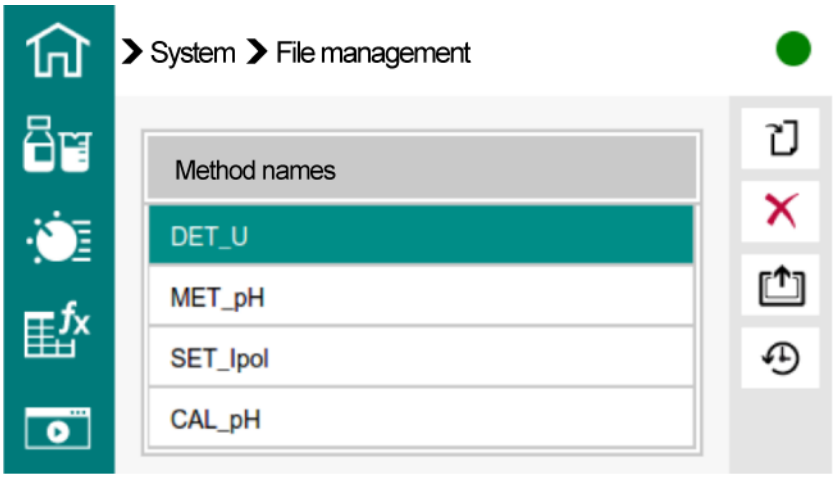
- **[Yes]**: The method on the USB flash drive will be overwritten.
- **[No]**: The method will not be exported.

Importing a method

1 Connect the USB flash drive to the instrument.

2 On the **Start page**, click on the **[System]** button. Move to page 2 and click on **[File management]**.

A list with the methods saved on the USB flash drive appears.



3 Select the method that you want to import by clicking on it.

The selected method is highlighted in green.

4 Import the highlighted method:

The message **Importing method from USB flash drive...** appears.

Once the message has disappeared, the method is saved to the instrument.

If a method with the same name already exists on the instrument, then the following warning appears: **Store method: Method name already exists. Do you want to overwrite the name?**.

- **[Yes]**: The method on the instrument will be overwritten.
- **[No]**: The method will not be imported.

6.6 Sample data

Definition

A **sample** is the substance to be analyzed. With the **sample data**, the samples can be identified.

Input options

There are 2 options for entering sample data:

- Directly in the **Sample data** work area.
- Automatic request immediately after the start of the determination.

Entering the sample data in the Sample data work area

Click on the button to display the **Sample data** work area:

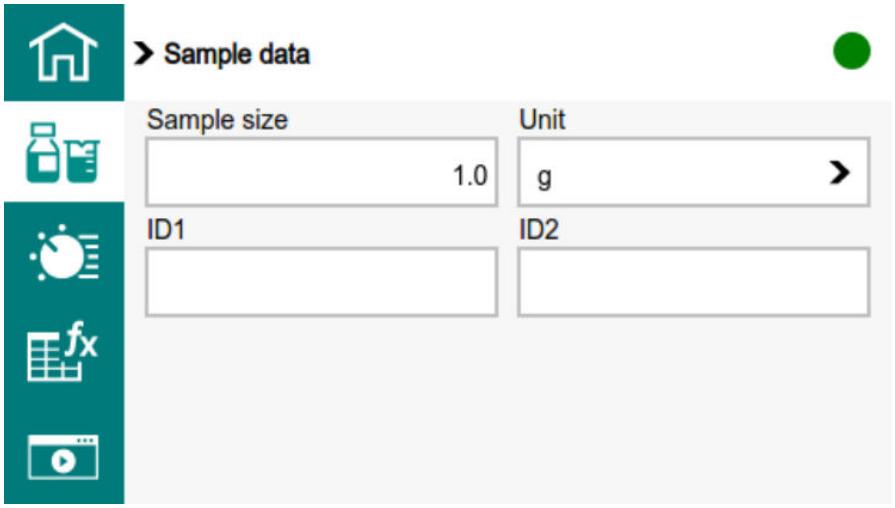


Figure 30 Sample data

The data for the sample can be entered in the **Sample data** work area, even if the determination is ongoing.

ID1

The sample identification **ID1** can be used in calculations as the variable **CI1**.

Input: max. 10 characters

Default value: empty

ID2

The sample identification **ID2** can be used in calculations as the variable **CI2**.

Input: max. 10 characters

Default value: empty

Sample size

The value of the sample size can be used in calculations as the variable **C00**.

Input range	**–999,999,999** to **9999999999**
Default value	**1.0**

Unit

Unit of the sample size.

Selection:

- **g**
- **mg**
- **µg**
- **mL**
- **µL**
- **Pieces**
- **User-defined**
  A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined.

Default value: **g**

Requesting sample data at the start of the determination

The sample data can be automatically requested immediately after the start of the determination in order to ensure that the sample data entry is not forgotten. This automatic request is indispensable if the samples are weighed by difference.

The automatic sample data request can be controlled for each method separately. The following parameters are available under **[Start conditions]** in the **Parameters** work area:

- **Request sample ID**
- **Request sample size**
- **Request sample unit**
- If the **Hold at request** parameter is activated, the run will be paused and must be continued with ▶ after the sample data has been entered.

- If **Hold at request** is deactivated, then the titration will be started in the background. This dialog will be displayed until the entering of the sample data is confirmed with ▶ or until the sample data is transferred from the balance, even if the titration is already completed. This ensures that the sample data is available for calculations.

6.6.1 Sample series

Metrohm recommends operating the Eco instrument together with the 885 Oven Sample Changer. Activation of the sample series is necessary for this application.

Use the 6.2141.390 remote cable (sold separately) to connect the instruments.

The following options are available for creating and managing sample data:

- **Enabling the sample table**
- **Creating new samples**
- **Editing samples**
- **Deleting individual samples** – Delete samples from the sample table.
- **Resetting the sample table** – All samples are reset to not executed.
- **Creating a new sample table** – Delete all samples from the sample table.

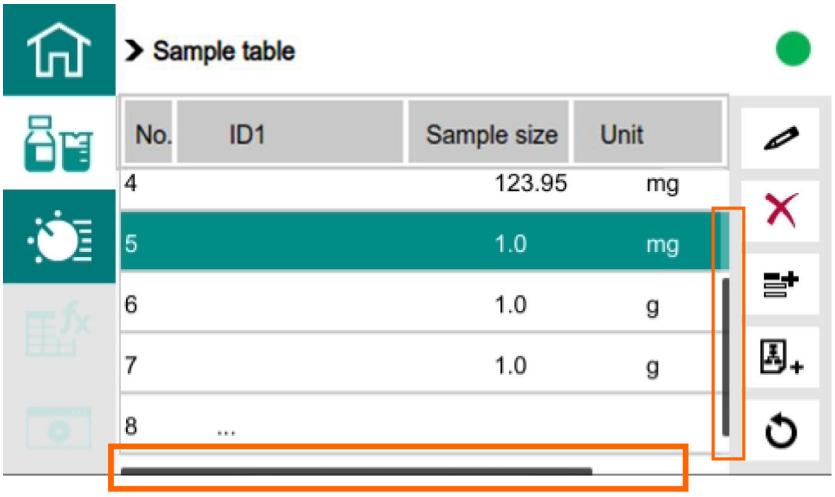
Enabling the sample table

1 On the **Start page**, click on the **[Sample series]** button.

2 Click on **[ON]**.

The sample table is now enabled.

The **sample table** is displayed under the **Sample data** work area:



The sample table can be scrolled horizontally and vertically.

Creating new samples

Prerequisite:

- The sample table is activated.

1. Open the **Sample data** work area:

   The **sample table** is displayed.

2. Insert a new sample:

   The message **Inserting a new sample...** appears.

   The new sample is inserted in the **sample table** as soon as the message disappears.

Editing samples

Prerequisite:

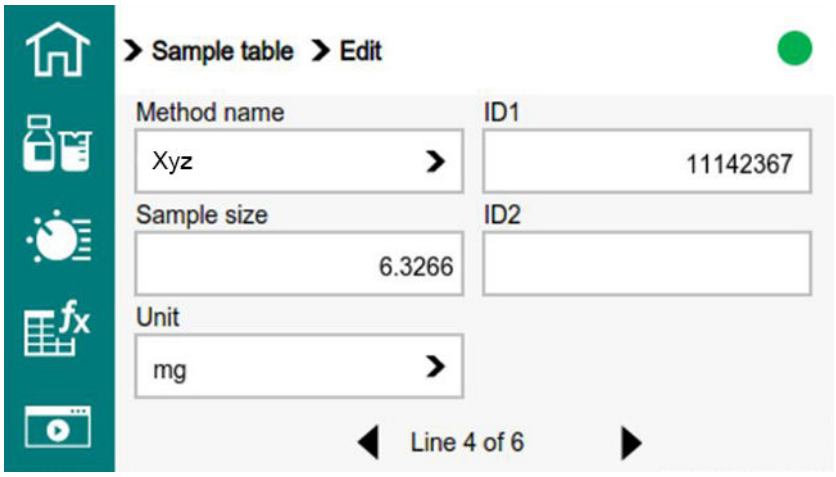
- The sample table is activated.

1. Go to the **Sample data** work area:

2. Click on the sample that you want to edit.

   The selected sample is highlighted in green.

3 Edit the sample:



4 Make the desired changes.

Deleting individual samples

Prerequisite:

- The sample table is activated.

1 Go to the **Sample data** work area:

2 Click on the sample that you want to delete.

The selected sample is highlighted in green.

3 Delete the sample:

The message **Do you really want to delete the selected line?** appears.

4 Confirm deleting: **[Delete]**

The sample is no longer available in the **sample table**.

Resetting the sample table

Prerequisite:

- The sample table is activated.

1 Go to the **Sample data** work area:

2 Reset **sample table**:

The **sample table** is reset. All samples can be measured again.

Creating a new sample table

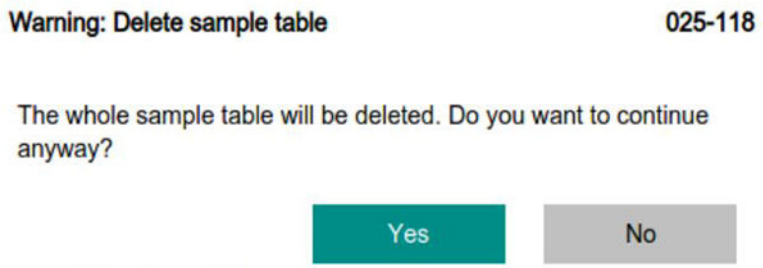
Prerequisite:

- The sample table is activated.

1 Go to the **Sample data** work area:

2 Create a new sample table:

The message **The whole sample table will be deleted. Do you want to continue anyway?** appears.



3 Confirm deleting: **[Yes]**

The existing **sample table** is now deleted and the samples can be created once again.

6.7 System – Configuration

The system configuration of the Eco Titrator defines the basic, method-independent configuration of the instrument.

The following submenus can be found under the **[System]** button on the **Start page**:

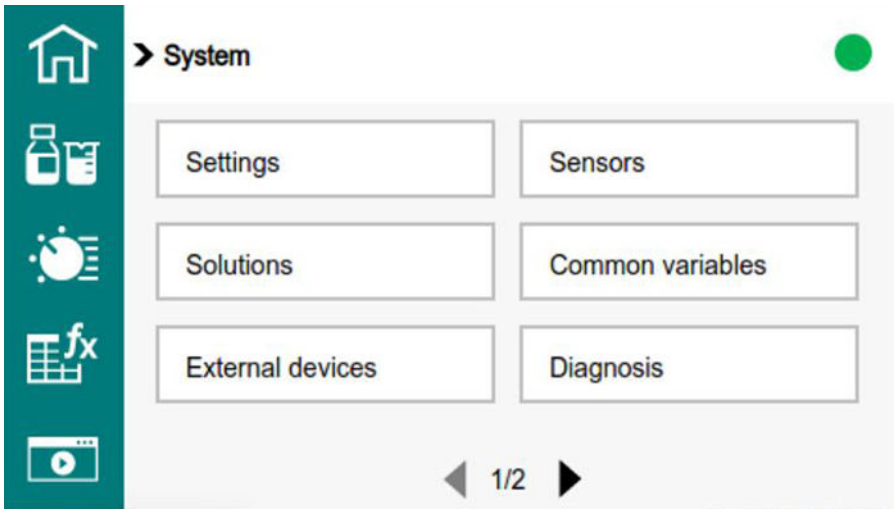


Figure 31 System menu page 1

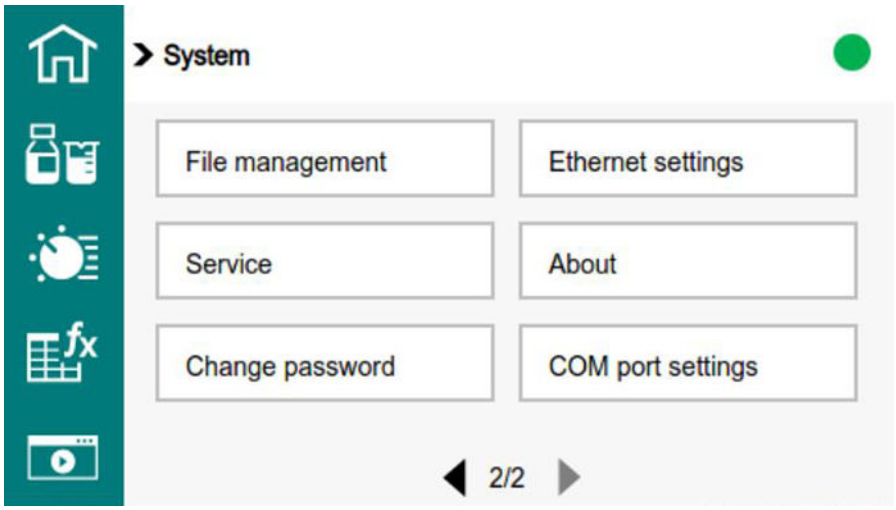


Figure 32 System menu page 2

- Settings – Basic instrument settings.
- Sensors – Manage the sensor list and define the sensor data.
- Solutions
- Common variables
- External devices (peripherals)
- Diagnosis
- File management
- Ethernet settings
- Service
- About
- Change password
- COM port settings

6.7.1 System – Settings

System ▶ Settings

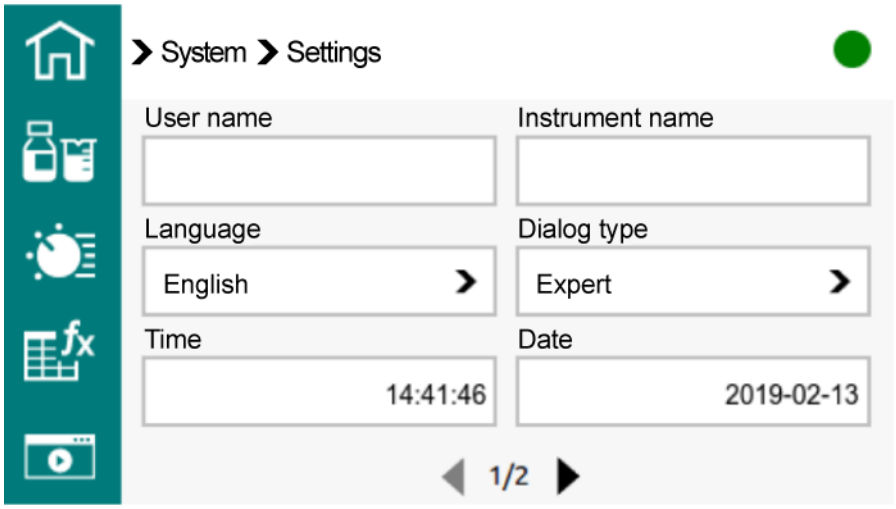


Figure 33 System – Settings page 1

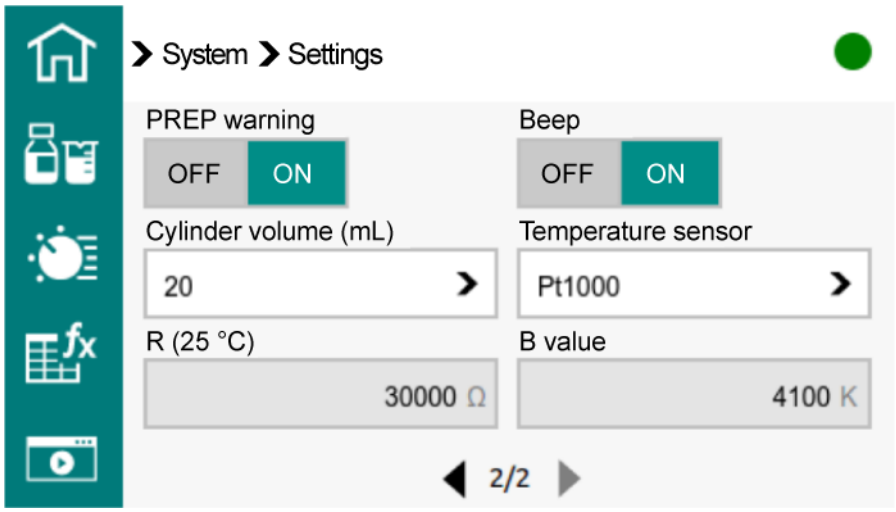


Figure 34 System – Settings page 2

User name

Enter a user name here for the report. This parameter will be printed only if a user has been defined.

Input: max. 12 characters

Default value: empty

Instrument name

Enter an instrument name here for the report. This parameter will be printed only if a designation has been defined.

Input: max. 10 characters

Default value: empty

Language

Set the dialog language.

Dialog type

The user dialog can be limited for routine operations. The resetting of the dialog will take effect as soon as you exit the start page.

- Dialog type **Expert** (default value)
  In the dialog type **Expert**, all the user settings are available.
- Dialog type **Routine**
  In the dialog type **Routine**, the availability of the settings is restricted. The **[System]** and **[Methods]** menus as well as the **Parameters** work area can only be opened with a password. Methods can be loaded, however, on the start page.

The **Routine** setting will only take effect once the **[System]** menu has been exited.

To switch back to expert mode, open the **[System]** menu and enter the password:

- Password for firmware version 57.1008.0010 or higher: **METROHM9100**
- Password for firmware version 57.1008.0009 or lower: **MSH9101**

Then activate the **Expert** dialog type.

Selection:

- **Expert**
- **Routine**

Default value: **Expert**

Time

Current time. Only numbers that make sense can be entered.

Format: hh:mm:ss

Date

Current date. Only numbers that make sense can be entered.

Format: YYYY:MM:DD

PREP warning

If the **PREP warning** is activated, then the recommendation to execute the **Prepare (PREP)** function will appear:

- After the device is switched on.
- Each time a cylinder unit is attached.

All tubing and the cylinder are rinsed with this function.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **ON**

Beep

If **Beep** is activated, a short acoustic signal sounds in the following cases:

- At the press of a key.
- At the end of the determination.
- If the system remains conditioned without interruption for 10 seconds.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **ON**

Cylinder volume (mL)

Volume of the cylinder in the cylinder unit in mL.

Selection:

- **5**
- **10**
- **20**
- **50**

Default value: **20**

Temperature sensor

The instrument supports the use of two different temperature measurement techniques:

- NTC (Negative Temperature Coefficient)
- Pt1000 (platinum resistance)

Select the type here that is connected to the instrument. If an NTC sensor is used, then it is required that two characteristics for the sensor are

entered in addition. These characteristics are listed in the specifications of the sensor.

Selection:

- **NTC**
- **Pt1000**

Default value: **Pt1000**

R (25 °C)

This parameter is visible only when Temperature sensor = NTC.

Nominal resistance of the NTC sensor at 25 °C.

Input range	**1,000** to **99,999 Ω**
Default value	**30,000 Ω**

B value

This parameter is visible only when Temperature sensor = NTC.

Material constant of the NTC sensor. B values of NTC sensors are frequently based on different reference temperatures (usually 25 °C and 50–100 °C).

Input range	**1,000** to **9,999 K**
Default value	**4,100 K**

6.7.1.1 Setting the language, date and time

Setting the language

Prerequisite:

- The instrument is switched on.

1 On the **Start page**, open the **System** ▶ **Settings** menu.

2 Click on ❯ for **Language** to expand the list.

The list of available languages is displayed.

3 Select the desired language from the list.

If the desired language is not available, import the language: *(see "Importing a language pack", chapter 6.7.2, page 72)*

The user interface is now displayed in the selected language.

Setting the date and time

Prerequisite:

- The instrument is switched on.

1. On the **Start page**, open the **System** ▶ **Settings** menu.
2. Click in the **Date** input field.
3. Enter the current date. Format: YYYY-MM-DD.
4. Confirm the entry with **[OK]**.
5. Click in the **Time** input field.
6. Enter the current time. Format: hh:mm:ss.
7. Confirm the entry with **[OK]**.

6.7.1.2 Setting the dialog type

The user rights can be restricted with the **Dialog type** input field:

- Dialog type **Expert** (default value)
  In the dialog type **Expert**, all the user settings are available.
- Dialog type **Routine**
  In the dialog type **Routine**, the availability of the settings is restricted. The **System** and **Methods** menus as well as the **Parameters** work area can only be opened with a password. Methods can be loaded, however, on the start page.

If the instrument is switched off, the dialog type that was set remains activated.

Setting the Routine dialog type

1. On the **Start page**, open the **System** ▶ **Settings** menu.
   The **[Dialog type]** input field is on page 2/2:

2. Expand the **Dialog type** input field. Select the **Routine** dialog type.

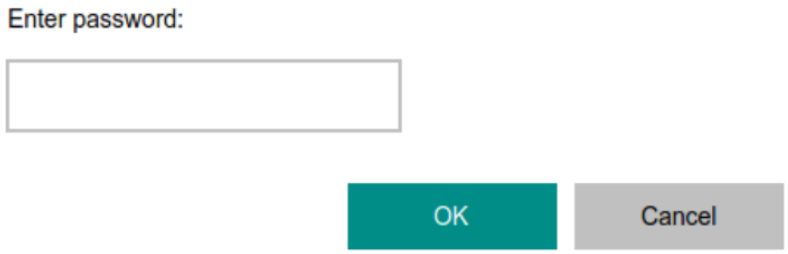
3 Exit the **System** menu.

The instrument is now in **Routine** mode. The availability of the settings is restricted.

Setting the Expert dialog type

1 On the **Start page**, click on the **System** button.

The **Enter password** prompt appears:



2 Click in the input field.

A keyboard appears.

3 Enter the password:

- Password for firmware version 57.1008.0010 or higher: **METROHM9100**
- Password for firmware version 57.1008.0009 or lower: **MSH9101**

Confirm with **[OK]**.

4 Confirm the entry with **[OK]**.

The **System** menu opens. The menu is now ready for use.

If you exit the **System** menu at this point, the instrument will return to Routine mode.

5 Click on the **[Settings]** button.

6 Expand the **Dialog type** input field. Select the **Expert** dialog type.

All the user settings are available.

6.7.2 Importing a language pack

The following 3 languages are saved on the instrument by default:

- English
- German
- Chinese

Importing additional languages

Required accessories:

- 6.6081.030 USB flash drive

Prerequisite:

- The instrument is switched off.

1 Insert the 6.6081.030 USB flash drive into a free USB connector .

2 Switch on the instrument:

The start page appears.

3 Open **System** ▶ **File management**.

After a few seconds, the contents of the USB flash drive are displayed.

4 Click on .

The following message appears: **Select a language file from the USB flash drive.**

5 Click on **[Next]**.

The list of available languages is displayed.

6 Click on the desired language.

The following message appears: **Do you really want to add a new language file?**

7 Add language: **[Next]**

The following message appears: **New language file added successfully.**

8 Confirm: **[Continue]**

The list of available languages is displayed. The imported language is listed.

Select the imported language:

A **maximum of 5 languages** can be saved on the instrument.
If the maximum has already been reached, a message appears that a language must be deleted. A wizard is started.

- Follow the wizard to delete a language and import the desired language.
- English cannot be deleted.

6.7.3 Managing sensors

System ▶ Sensors

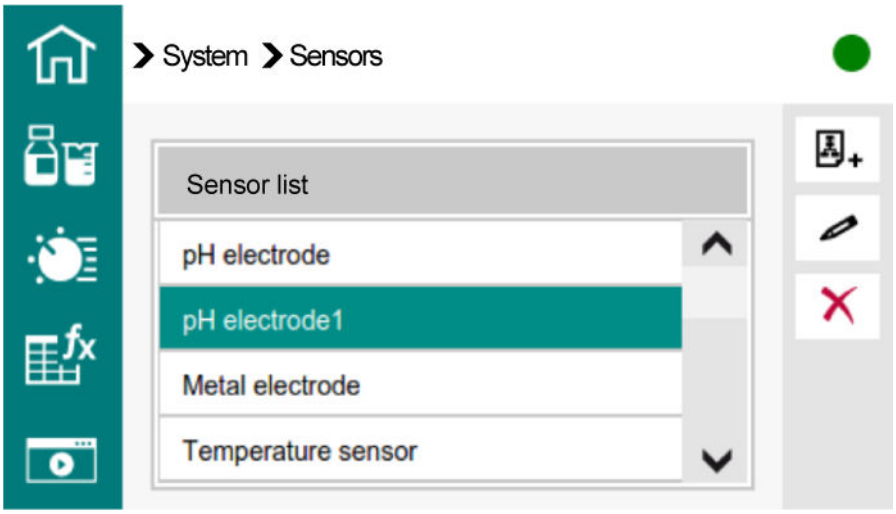


Figure 35 Sensor list (example)

3 standard sensors are defined in the sensor list: **pH electrode**, **Metal electrode** and **Temperature sensor**. These sensors cannot be deleted or renamed. The sensor list can contain a maximum of 10 sensors.

Every sensor is identified with a unique name. This means that it is not possible to use the same name twice, e.g. for a pH electrode and for a metal electrode.

Table 7 Managing the sensor list

	Add a new sensor to the list. Sensor data see below. The following sensor types can be selected: ▪ pH electrode ▪ Metal electrode ▪ Temperature sensor ▪ Other sensor, e.g. Spectrosense

	Edit the data of the selected sensor. Sensor data see below.
	Delete the selected sensor from the list.

Sensor data

Name

The designation of the sensor is used for unambiguous identification.

Input: max. 24 characters

Default value: empty

Type

The sensor type is displayed.

Selection:

- **pH electrode**
- **Metal electrode**
- **Temperature sensor**
- **Other sensor**

Slope

This parameter is only visible with pH electrodes.

Slope of the pH electrode. With a 1-point calibration, only pH(0) can be calculated, 100.0% is used as the slope.

Input range	**–999.9** to **999.9 %**
Default value	**100 %**

pH(0)

This parameter is only visible with pH electrodes.

pH value of the pH electrode at 0 mV. Apart from the slope, pH(0) is the second characteristic of the calibration curve.

Input range	**–20.000** to **20.000**
Default value	**7.000**

Calibration temperature

This parameter is only visible with pH electrodes.

Temperature at which the last calibration was carried out.

Input range	**–20.0** to **150.0 °C**
Default value	**25.0 °C**

Calibration date

This parameter is only visible with pH electrodes.

Date of the last calibration.

Monitoring

This parameter is only visible with pH electrodes.

Activate and deactivate the calibration monitoring.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Time interval

This parameter is visible only when **Monitoring = ON**.

When you start a method, you will be notified if this time interval (in days) has already elapsed. You can then select whether or not you would still like to start the method.

Input range	**1** to **999 d**
Default value	**999 d**

6.7.4 Managing solutions

System ► Solutions

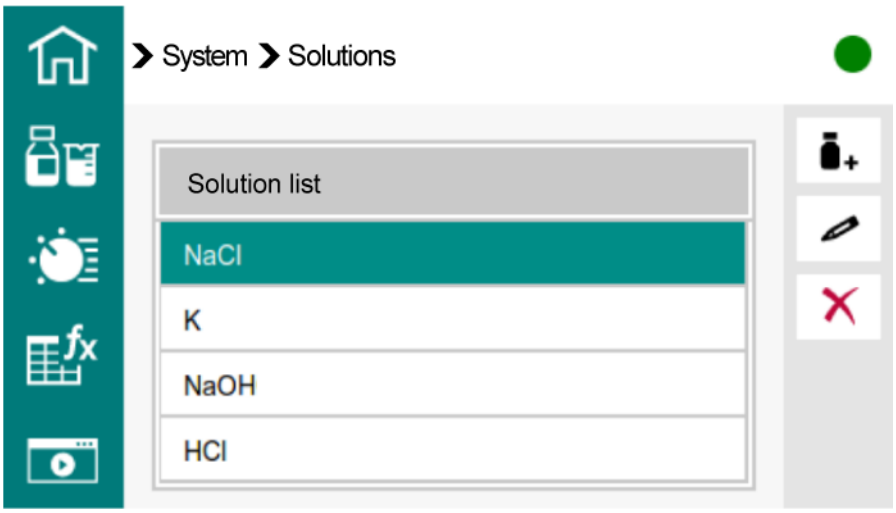


Figure 36 Solution list (example)

A maximum of 20 solutions can be saved.

Table 8 Managing the solution list

	Add a new solution to the list. Solution data see below.
	Edit the data of the selected solution. Solution data see below.
	Delete the selected solution from the list.

Solution data

The solution data for **New** ( ) and **Edit** ( ) are the same, therefore only pictures for **System** ▶ **Solutions** ▶ **New** are shown:

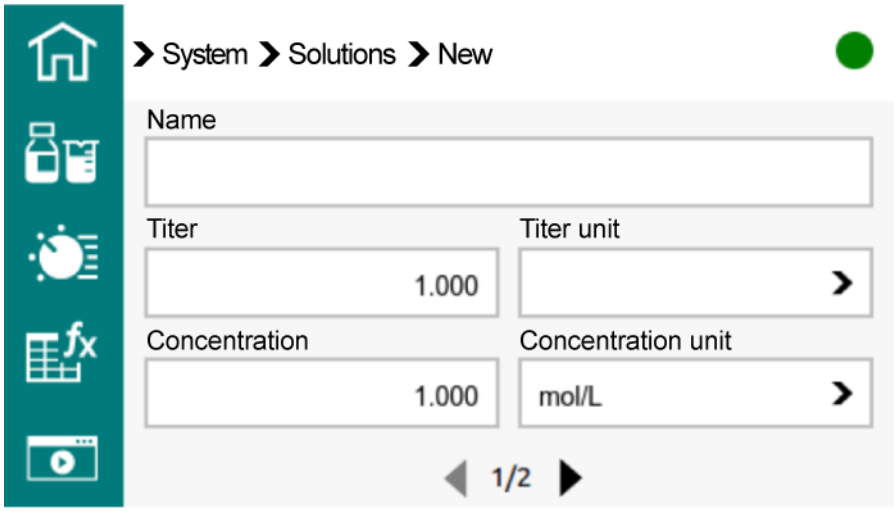


Figure 37 Solutions – Solution data page 1

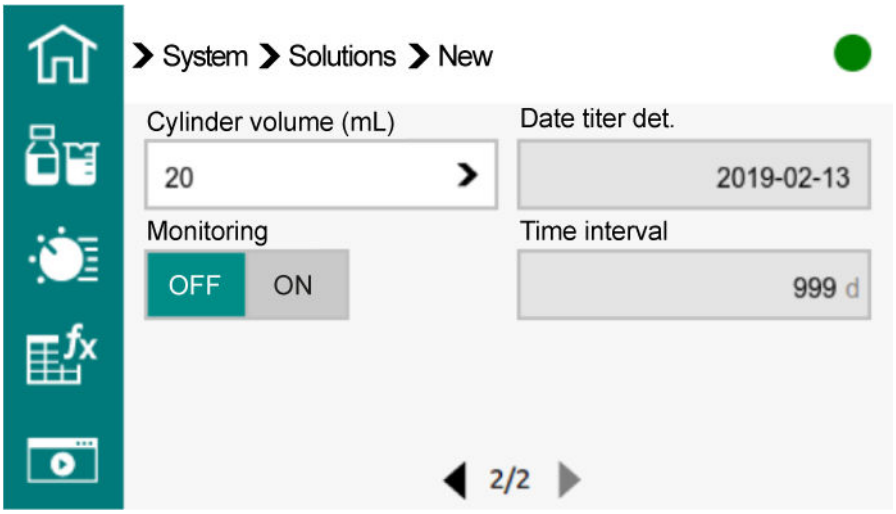


Figure 38 Solutions – Solution data page 2

Name

The designation of the solution is used for unique identification.

Input: max. 24 characters

Default value: empty

Titer

Titer of the solution.

Input range	**–999,999,999** to **9,999,999,999**
Default value	**1.000**

Titer unit

Unit of the titer.

Selection:

- **µmol/mL**
- **mmol/L**
- **mol/L**
- **g/L**
- **mg/L**
- **mg/mL**
- **µg/L**
- **ppm**
- **%**
- **mEq/L**
- **empty**
- **User-defined**
  A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined. An empty entry can be generated this way as well.

Default value: **empty**

Concentration

Concentration of the solution.

Input range	**–999,999,999** to **9999999999**
Default value	**1.000**

Concentration unit

Unit of the concentration.

Selection:

- **mol/L**
- **%**
- **g/L**
- **mEq/L**
- **mg/L**
- **mg/mL**
- **mmol/L**
- **ppm**
- **µg/L**
- **µmol/mL**
- **User-defined**
  A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined. An empty entry can be generated this way as well.

Default value: **mol/L**

Cylinder volume (mL)

Volume of the cylinder in the cylinder unit in mL.

Selection:

- **5**
- **10**
- **20**
- **50**

Default value: **20**

Date titer det.

Date of the last titer determination.

Monitoring

Activate and deactivate titer monitoring.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Time interval

This parameter is visible only when **Monitoring = On**.

When you start a method, you will be notified if this time interval (in days) has already elapsed. You can then select whether or not you would still like to start the method.

Input range	**1** to **999 d**
Default value	**999 d**

6.7.5 Managing common variables

System ▶ Common variables

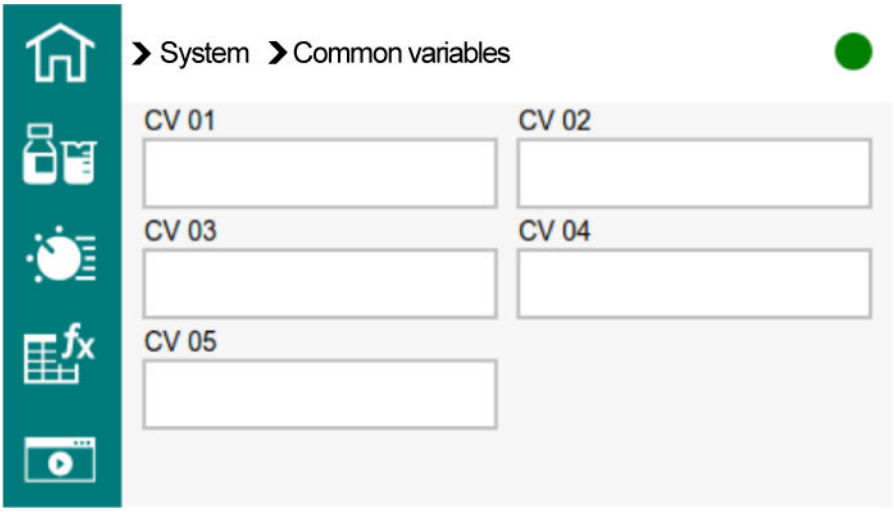


Figure 39 Common variables

The instrument offers the possibility of saving 5 **method-independent variables**, so-called **common variables**. These variables remain saved in the instrument and can be used in future calculations. Common variables are useful, e.g. for the following applications:

- Determination of a blank value which will be taken into account during the content determination of the sample.
- Determination of the content of a standard solution, which will be taken into account during the content determination of the sample.

The common variables have the designations **CV01–CV05** that cannot be changed. The value for every variable is displayed. No unit can be assigned to the common variables.

Editing common variables

The common variables can be modified as follows:

- Manually in this dialog.
- Automatic assignment from the determination run. A calculation result must be configured accordingly for this purpose (see below).

Assigning a result automatically to a common variable

1 Loading the method

- Load the method that contains the result to be used in the **method selection bar** on the **Start page**.

2 Opening the editing dialog of the result

- Open the **Parameters** work area.
- Click on the **[Calculation]** button.
- Select the result whose value is to be assigned to a common variable.
- Edit the highlighted result:

3 Adjusting the result properties

- Activate the **Save as CV** button:

The assignment of the result to a common variable occurs automatically according to the following scheme:

- Result **R1** ⇨ Common variable **CV01**
- Result **R2** ⇨ Common variable **CV02**
- etc.

If the parameter **Statistics** is set to **[ON]**, then the mean value of the results will be assigned to the respective common variable.

6.7.6 Managing external devices

System ▶ External devices

PC/LIMS report

Specification of the storage location for the PC/LIMS report. The PC/LIMS report is a machine-readable report with all of the important data for a determination. It can be saved as follows:

- as a TXT file on a USB flash drive.
- to a LIMS via the Ethernet interface and an RS-232 instrument server.

Selection:

- **USB flash drive**
- **Ethernet/RS-232**

Default value: **USB flash drive**

USB flash drive	The report is saved as a TXT file on the USB flash drive in the folder **pc_lims_report**.
Ethernet/ RS-232	The report is sent via an RS-232 instrument server. The interface parameters are set on the RS-232 instrument server (see 8.0010.5026).

Printer

If a printer is connected, define the printer type here in order for the reports to be printed out correctly.

The printers that have the designation **ESC-POS** are so-called POS printers (point-of-sale printers), i.e. they print on continuous paper.

Selection:

- **PDF** (Save on USB flash drive)
- **Custom (ESC-POS)**
- **PostScript**

Default value: **Custom (ESC-POS)**

Commercially available A4 printers that communicate via postscript can be connected directly via USB.

Keyboard layout

Layout of the on-screen keyboard.

Selection:

- **English US**

Balance

Selection:

- **Sartorius**

For balances with serial interface: Use the 6.2148.050 USB/RS Converter.

Configure the serial interface: **System ▶ COM port settings**

The parameters set for the RS-232 interface on the balance must match those on the Eco Titrator.

6.7.7 System – File management

Start page ▶ System ▶ File management

This dialog offers the following functions:

- Importing a method from a USB flash drive to the instrument.
- Delete the method on the USB flash drive.
- Write a system backup to a USB flash drive.

- Restore the system of the instrument with an existing backup.

The backup contains all the data and settings of the instrument. However, the password for the **Expert** dialog type is **not** included in the backup.

When restoring to another instrument, the default value of the password applies.

Metrohm recommends creating a backup of the current system status before restoring the system.

Folder structure on the USB flash drive

A folder with the device number will be created on the USB flash drive. The structure within this folder appears as follows:

Backup	All of the files of the backup are stored in this folder. The folder is created as soon as a backup is created for the first time. The file names of the backups are structured as follows: *SF_YYYY-MM-DD_hhmmss.ods*
Files	Exported methods are stored in this folder. The folder is created as soon as a method is exported for the first time. Only methods located in this folder can be imported.
pc_lims_report	PC/LIMS reports are stored in this folder as TXT files. The folder is created as soon as a PC/LIMS report is printed for the first time.

Importing a method

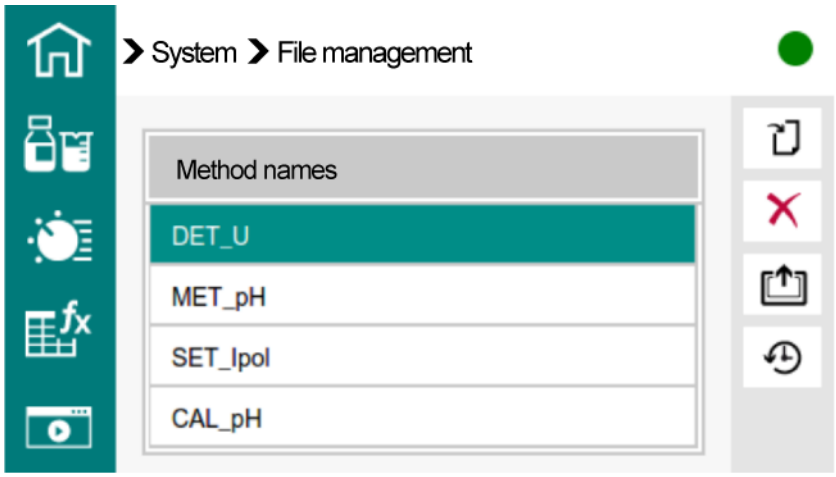
Prerequisite:

- A USB flash drive is connected.

If no USB flash drive is connected, the message **Connect USB flash drive** will appear.

1 On the **Start page**, click on the **[System]** button. Move to page 2 and click on **[File management]**.

A list with the methods saved on the USB flash drive appears.



2 Select the method that you want to import by clicking on it.

The selected method is highlighted in green.

3 Import the highlighted method:

The message **Importing method from USB flash drive...** appears.

Once the message has disappeared, the method is saved to the instrument.

If a method with the same name already exists on the instrument, then the following warning appears: **Store method: Method name already exists. Do you want to overwrite the name?**.

- **[Yes]**: The method on the instrument will be overwritten.
- **[No]**: The method will not be imported.

Deleting the method on the USB flash drive

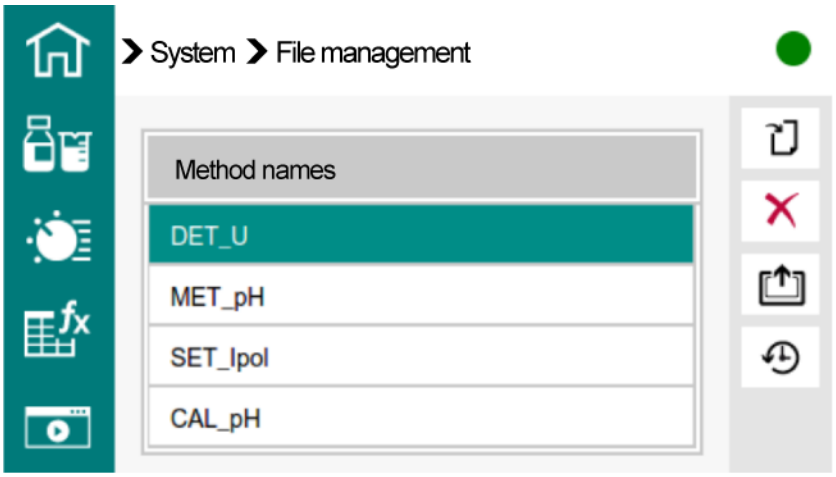
Prerequisite:

- A USB flash drive is connected.

If no USB flash drive is connected, the message **Connect USB flash drive** will appear.

1 On the **Start page**, click on the **[System]** button. Move to page 2 and click on **[File management]**.

A list with the methods saved on the USB flash drive appears.



2 Select the method that you want to delete by clicking on it.

The selected method is highlighted in green.

3 Delete the highlighted method:

The message **Method deleted successfully from USB flash drive.** confirms the deletion process.

Creating a backup

Prerequisite:

- A USB flash drive is connected.

If no USB flash drive is connected, the message **Connect USB flash drive** will appear.

1 On the **Start page**, click on the **[System]** button. Move to page 2 and click on **[File management]**.

2 Start the backup:

The message **Backing up data and settings to USB flash drive...** appears.

Once the message has disappeared, the backup is saved to the USB flash drive.

Restoring

Prerequisite:

- A USB flash drive is connected.

If no USB flash drive is connected, the message **Connect USB flash drive** will appear.

1 On the **Start page**, click on the **[System]** button. Move to page 2 and click on **[File management]**.

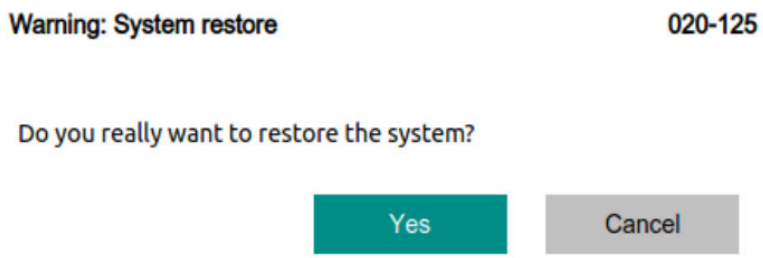
2 Restore the system:

A list with the backups saved on the USB flash drive appears.

The file names of the backups are structured as follows: *SF_YYYY-MM-DD_hhmmss.ods*

3 Click on the desired backup.

The **System restore** warning appears.



4 Confirm the system restore: **[Yes]**

The following message appears before the instrument is restarted: **System files are restored. Press [Continue] to restart the instrument.**

5 Restart the instrument: **[Continue]**

The instrument restarts. The system is restored.

6.7.8 Instrument diagnosis

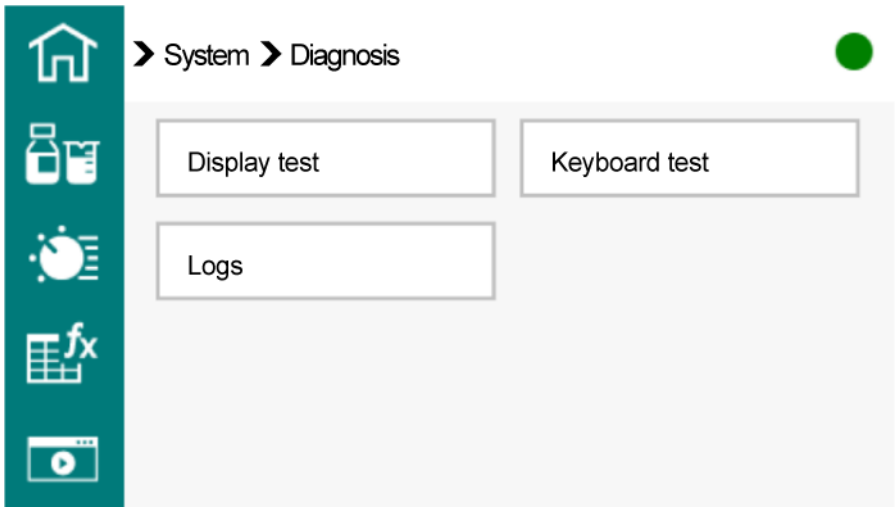


Figure 40 System menu – Diagnosis

Display test

The **[Display test]** button offers settings for brightness, various test images and a calibration program for the screen:

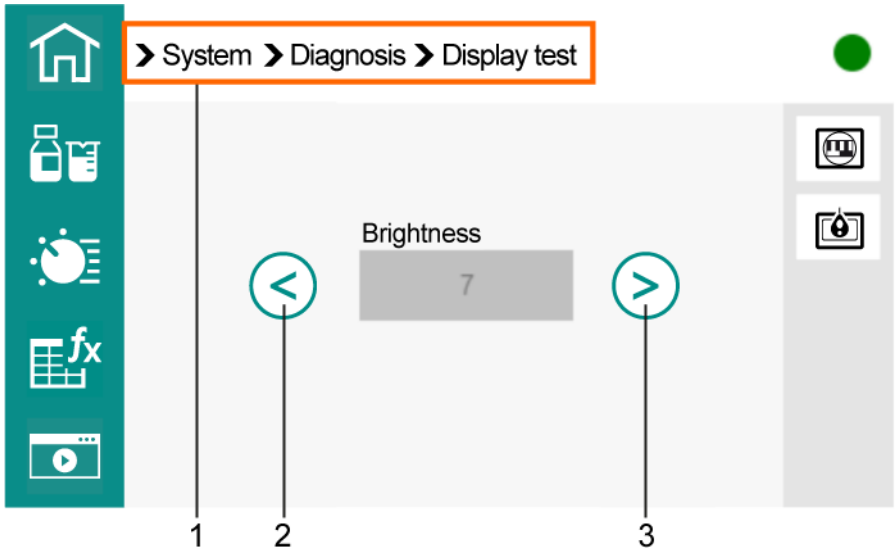


Figure 41 Display – Controls

1	**Menu path**	**2**	**Reducing brightness**
3	**Increasing brightness**		

Brightness	The current brightness is displayed.
	Shows a number of test images for checking image quality.

Starts the calibration program.

- Look at the screen in such a way that your line of sight is vertical to the screen.
- A crosshair appears in succession at various places on the screen. Each time, click in the center of the crosshair.

Once the calibration has been completed, the instrument is restarted automatically.

Keyboard test

- Start the test: **[Keyboard test]**
- Press the 5 keys of the control bar one after the other:

- The instrument confirms each successful press of a key with a check mark: ✓

Logs

- Show error log: **[Logs]**
- Save error log to a USB flash drive:

If the instrument displays an error, then the error log is deleted again after the second start.

6.7.9 Ethernet settings

System ▶ Ethernet settings

Example of usage: Reports can be sent to a LIMS directly via an RS-232/ Ethernet Box.

Mode

This network configuration can be done manually or automatically.

Selection:

- **Static**
  The network configuration is done manually. The input fields **IP address**, **Subnet mask** and **Gateway** are used for this.
- **DHCP**
  The network configuration is assigned automatically via a server.

Default value: **DHCP**

6.7.10 Service – Brief description

The **[Service]** button leads to a protected area to which only regional Metrohm service representatives have access.

6.7.11 Changing the password

With the password for the **Expert** dialog type you can control access to the menus **System** and **Methods** as well as the **Parameters** work area.

Changing the password for the **Expert** dialog type:

1. On the **Start page**, open the **System** ▶ **Change password** menu.
2. Enter the current password and then the new password twice.
3. Perform the change: ✓

   The password is changed.

Make a note of the password and store it in a safe place.
If you lose the password, the system must be reset to factory settings with a system initialization. The default password is:

- Password for firmware version 57.1008.0010 or higher: **METROHM9100**
- Password for firmware version 57.1008.0009 or lower: **MSH9101**

The system can then be restored with a backup.

6.7.12 COM port settings

System ▶ **COM port settings**

When using a balance with serial interface, adjust the corresponding settings. The parameters set for the RS-232 interface on the balance must match those on the instrument.

Use the USB/RS-232 Converter (6.2148.050). This converter provides the serial connector.

Baud rate

Transfer rate in characters per second.

Selection:

- **1200**
- **2400**
- **4800**
- **9600**
- **19200**
- **38400**
- **57600**
- **115200**

Default value: **9600**

Data bits

Number of data bits.

Selection:

- **7**
- **8**

Default value: **8**

Stop bits

Number of stop bits.

Selection:

- **1**
- **2**

Default value: **1**

Parity

Type of parity testing.

Selection:

- **Even**
- **None**
- **Odd**

Default value: **None**

Handshake

Type of data transfer protocol.

Selection:

- **Hardware**
- **Software**
- **none**

Default value: **Hardware**

If communication problems occur, set the parameter **Handshake** to **Software**, and make another attempt.

6.7.13 Displaying system data

The **System** ▶ **About** menu path shows detailed information on:

- Program version
- Instrument
- Main board
- Measuring interface

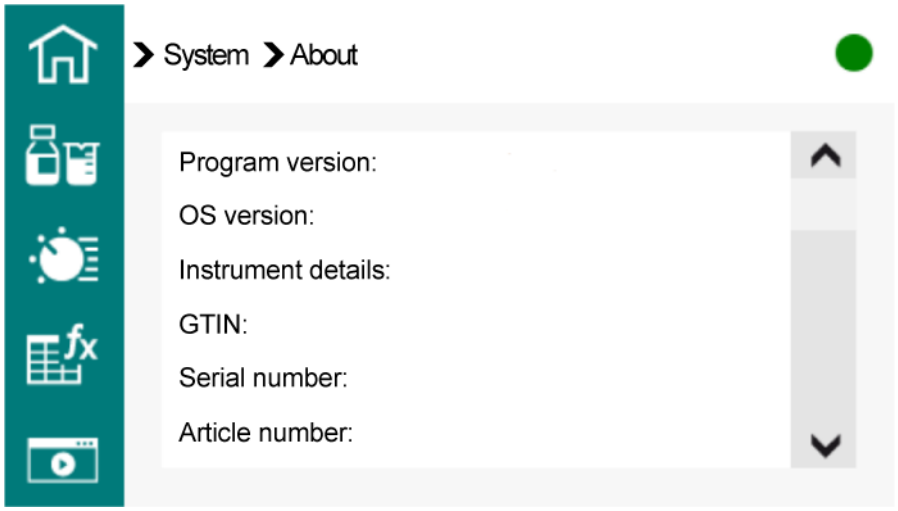


Figure 42 System data

6.8 Carrying out a pH calibration

1 Loading the method

Load a calibration method (CAL).

2 Setting the parameters

- Open **Parameters** ▶ **Calibration parameters**. Select the pH electrode used in the **[Sensor]** input field.
- Open **Parameters** ▶ **Buffers**. Enter the type and number of buffers that need to be used. The pH values of the buffers to be used must be entered manually for the **Special** buffer type.
  We recommend to measure at least 3 buffers (3-point calibration).

3 Measuring buffer 1

- Immerse the pH electrode in the buffer 1.
- Press the ▶ key.
- Enter the current temperature. If a temperature sensor is connected, then the temperature will be measured automatically.

The measurement is started. The on-screen display changes to the **Live status** work area:

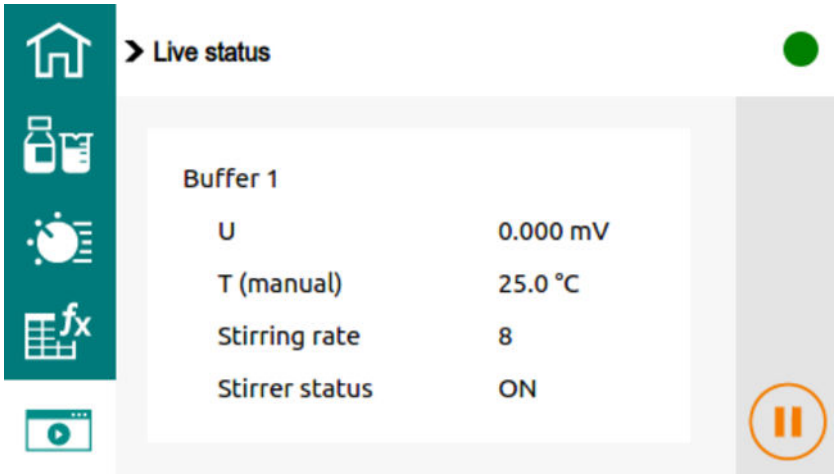


Figure 43 Live status – Calibration mode CAL

⏸ Pauses the measurement.

▶ Continues the measurement.

This button appears as soon as the measurement is paused.

After the measurement has been completed successfully, the warning message **New buffer** appears.

4 Measuring further buffers

Follow these steps for the remaining buffers:

- Rinse the electrode.
- Change to the next buffer.
- Immerse the pH electrode in the new buffer.
- Click on the **OK** button.
- Once the warning message **New buffer** appears, repeat step 4.

5 Calibration completed successfully

Once the last buffer has been measured, the new calibration data is saved for the corresponding pH electrode.

You can view the calibration data if needed:

- **System** ▶ **Sensors** ▶
- Select the calibrated pH electrode.
- Click on ✎.

6.9 Carrying out a determination

1 Loading the method

Load the method.

2 Preparing the sample

Calculate the amount of the sample so that it results in titrant consumption of 10 to 90% of the cylinder volume.

- Weigh in or measure the sample in a sample vessel.
- Add solvent if necessary.
- Add the stirring bar to the sample vessel.
- Place the sample vessel on the stirrer.
- Immerse the electrode and tubing tip in the solution.

3 Entering the sample size

Enter the sample size.

4 Starting the titration

Press the ▶ button.

The titration is started. The on-screen display changes to the **Live status** work area:

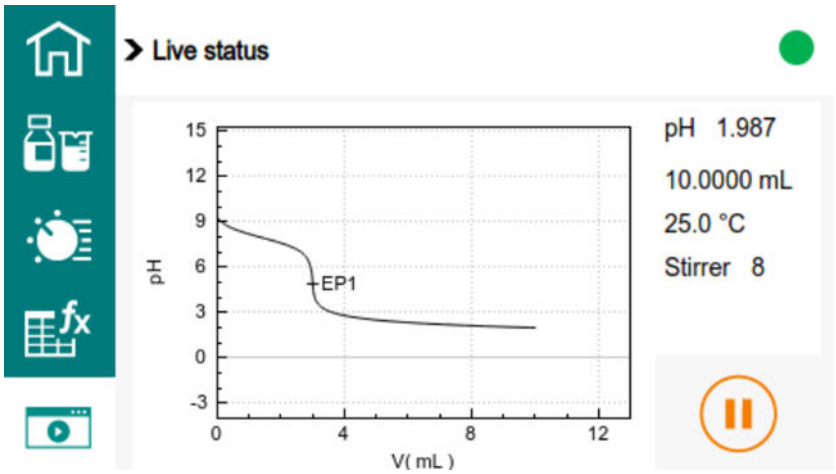


Figure 44 Live status – Titration modes DET, MET, SET

The axes are scaled automatically.

Pauses the determination.

Continues the determination.

This button appears as soon as the determination is paused.

5 Live modifications

Make live modifications if necessary:

- Editing the sample data of the running determinationEdit the sample data of the running determination
- Editing the method parameters of the running determination
- Modifying the stirring rate

6 Canceling the determination manually (if necessary)

A determination can be canceled at any time with the key.

The determination data is saved up to the point of cancellation.

7 Determination completed successfully

The on-screen display changes to the **Results** work area.

Editing the sample data of the running determination

The sample data can be entered or modified in the **Samples** work area while a determination is running. The sample data entered at the end of the titration in the **Samples** work area is always used in calculations.

Make sure that the editing dialogs are closed before the determination is finished.
If the determination is finished while an editing dialog is opened (e.g. of the sample size), then this will be closed automatically and the results dialog will be displayed. The value entered must be entered once more and the determination must be recalculated.

1 Opening the Samples work area

Click on .

The **Samples** work area appears. The determination continues to run in the background.

2 Editing the sample data

Edit the sample data.

3 Opening the Live status work area

Click on .

The **Live status** work area appears again.

Editing the method parameters of the running determination

Certain method parameters can be edited while a determination is being carried out. Only parameters that are not grayed out can be edited.
The modified parameters are taken into account at once. However, if for instance the start conditions are modified after the start volume has been dosed, then these modifications will not be taken into account until the next determination.

1 Opening the Parameters work area

Click on .

The **Parameters** work area appears. The determination continues to run in the background.

2 Editing the method parameters

Edit the method parameters.

3 **Opening the Live status work area**

Click on .

The **Live status** work area appears again.

Modifying the stirring rate

1 The stirring rate of the magnetic stirrer can be changed with the control bar while a determination is carried out.

- Increase the stirring rate in steps:
- Reduce the stirring rate in steps:

6.10 Results

shows the **Results** work area.

After a titration has been completed, the **Results** work area opens automatically.

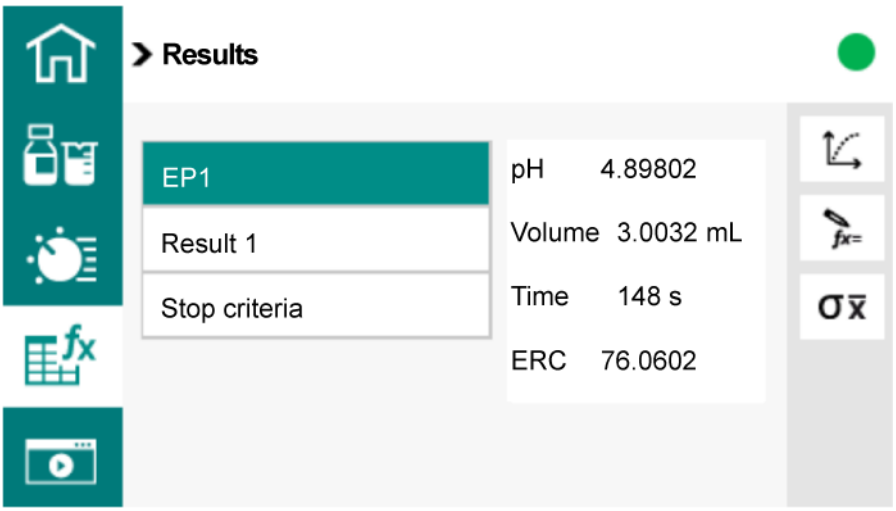


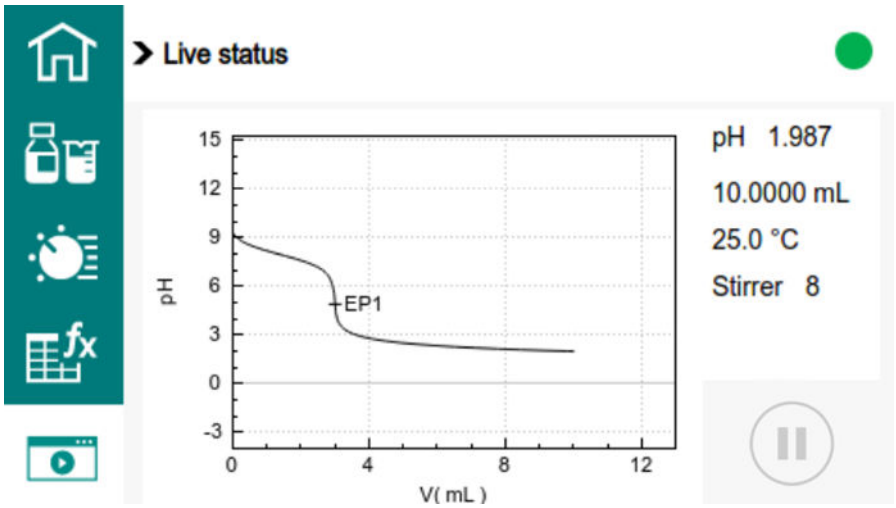
Figure 45 Results overview

The result overview shows the calculated results and the stop criterion:

- Click on the desired result row or stop criterion row.

Curve

By clicking on the key, the curve of the current determination is displayed.



Recalculating

By clicking on the fx= key, the current determination is recalculated. The procedure will be executed immediately.

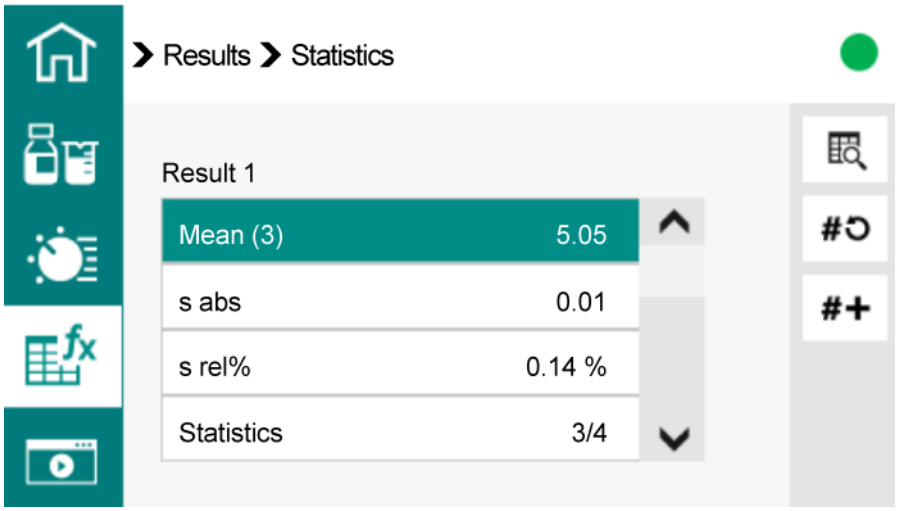
Recalculation cannot be undone.

All the results of the determination that was carried out last are recalculated with the **Recalculation** function. This is necessary if, for example, the calculation, the titer or the sample size has been modified.

Statistics

Click on the σ x̄ key to display the statistical overview of a determination series.

This function is visible only if the **Statistics** parameter is set to **[ON]**.



The mean value **Mean**, the absolute standard deviation **s abs** and the relative standard deviation **s rel** are displayed in the overview. For the

mean value, the number of individual results from which it has been calculated is displayed in parentheses. In this example, it is 3.

The Statistics row shows how many determinations have already been carried out and how many determinations are to be carried out in total. 3 out of 4 determinations were carried out in this example.

	Details Shows further data of the determination series. The result and the sample size of each determination are shown. A determination can be removed from the Statistics in the column **On/Off**. That row is then marked with ✓. All the results from the highlighted determination are removed from the statistics. The statistics are automatically recalculated.
#↻	**Reset** Deletes all statistics data. The statistics data is deleted automatically in the following cases: ▪ Once all the determinations of the determination series have been carried out and a new determination is started. ▪ Once a new method is being loaded.
#+	**Increase** Adds an additional sample to a determination series, e.g. because a determination was faulty and had to be removed from the statistics. The second number in the **Statistics** line will be increased automatically by one.

6.11 Printing reports

The following reports can be printed out:

- **Result**
  Result report with determination properties, sample data, calculated results, etc.
- **Curve**
  Curve report.
- **Measuring point list**
  Measuring point list report and additionally a CSV file with the corresponding measuring point list.
- **Parameters**
  Report with all method parameters of the loaded method.
- **System**
  System report with system settings, solution list, external devices, etc.

- **Calculations/statistics**
  Calculation report. The statistics are also printed out in the case of multiple determinations. The individual determinations with the respective sample size, the mean value, the absolute and the relative standard deviation are printed out for each result.
- **Report as in method**
  The reports that are defined in the method will be printed out.
- **PC/LIMS**
  Machine-readable report with all of the data for a determination. This report can be saved as a TXT file to a connected USB flash drive.

Preparing to print

1 On the **System** ► **External devices** start page, click on the **Printer** button.

A list of output options opens:

- PDF
- Custom (ESC-POS)
- A4 printer

2 Select the required output.

If the command **Print reports** is executed, then the reports are printed out on the selected printer or saved in PDF form on the connected USB flash drive.

Printing reports manually

1 On the start page, click on the **Print reports** button.

A list with the following options opens:

- Result
- Curve
- Measuring point list
- Parameters
- System
- Calculation/statistics
- Report as in method
- PC/LIMS

2 Select the desired report.

The report data is recorded and output.

6.12 Parameters

Titrations

Dynamic equivalence point titration (DET)

Dynamic equivalence point titration is a titration mode for all standard titrations. The reagent is added in variable volume steps. The volume steps vary as a function of the slope of the curve. An attempt is made to reach constant measured value changes with each dosing. The optimal volume for dosing is determined from the measured value changes of the previous dosings. Measured value acceptance is drift-controlled (equilibrium titration) or after a waiting time. Equivalence points are evaluated automatically.

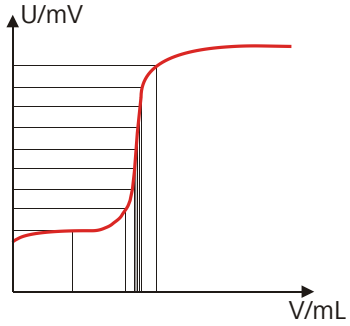


Figure 46 Reagent dosing for DET

Monotonic equivalence point titration (MET)

Monotonic equivalence point titration is a titration mode for titrations with relatively high signal fluctuations or suddenly occurring potential jumps and for slow titrations or slow-response electrodes. The reagent is added in constant volume steps. Measured value acceptance is drift-controlled (equilibrium titration) or after a waiting time. Equivalence points are evaluated automatically.

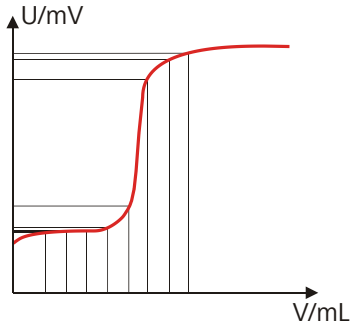


Figure 47 Reagent dosing for MET

Endpoint titration (SET)

Endpoint titration is a titration mode for rapid routine determinations to a preset endpoint (e.g. titrations in accordance with special standards) and titrations for which reagent overflow must be avoided. The titration termination at the endpoint takes place either drift-controlled or after a

waiting time. The volume dosed until the endpoint is used for calculating the content of the sample.

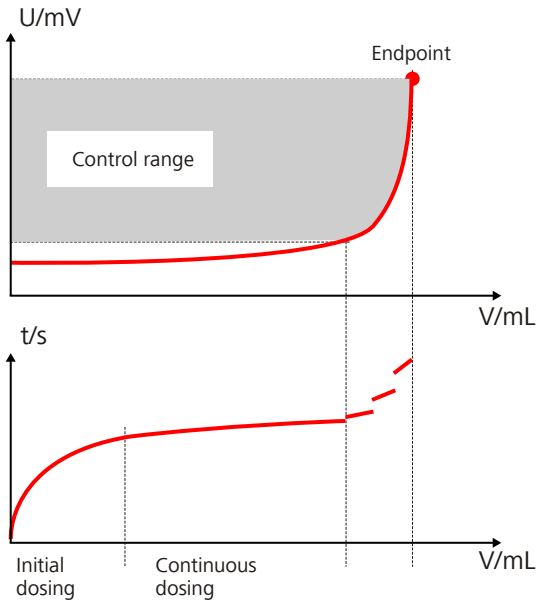


Figure 48 Reagent dosing for SET

6.12.1 Dynamic equivalence point titration (DET)

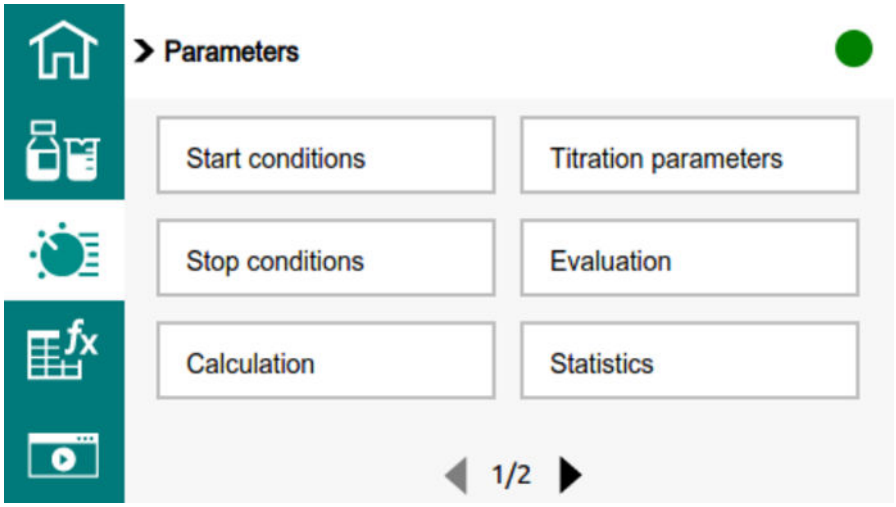


Figure 49 DET parameters – Menu page 1

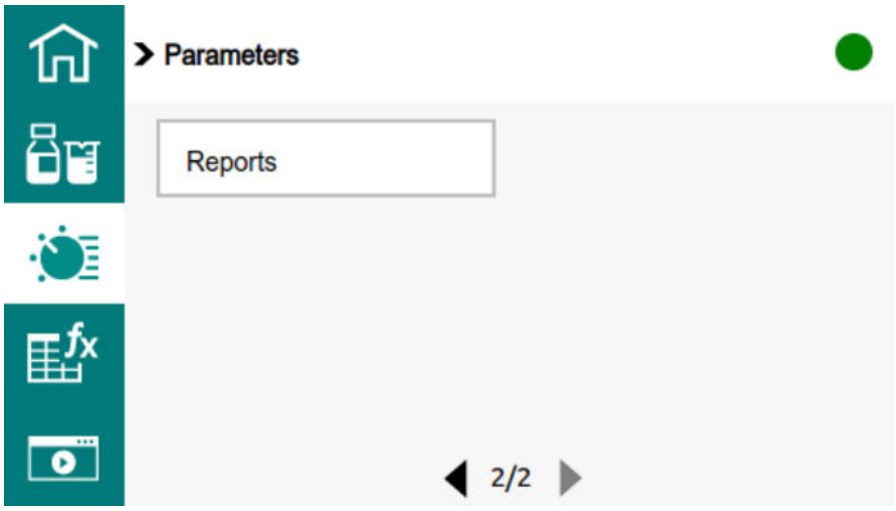


Figure 50 DET parameters – Menu page 2

6.12.1.1 Start conditions

Parameters ▶ Start conditions

The parameters that are carried out before the start of titration are defined under **[Start conditions]**.

Request sample ID

Selection of the sample identification that is queried at the start of the determination.

Selection:

- **ID1**
- **ID2**
- **ID1&ID2**
- **Off**

Default value: **Off**

Start delay time

Waiting time after the start of the determination, before the titration is started.

During this period, substances such as auxiliary solution can be added with a Dosimat (parameterization on the Dosimat, although the **Activation pulse** switch must be switched on for this).

Input range	**0** to **999,999 s**
Default value	**0 s**

Start volume

Volume that is dosed prior to the start of the titration.

Input range	**0.00000** to **9,999.99 mL**
Default value	**0.00000 mL**

Dosing rate

Rate at which the start volume is dosed.

Input range **0.02** to **Max. mL/min**
Additional selection: **Max.** = maximum dosing rate.

Default value: **Max.**

The maximum dosing rate depends on the cylinder volume (see table).

If volatile solvents/solutions or solutions with a high viscosity are used, the dosing rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 9 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Pause

Waiting time, e.g. for the stabilization of the measured value after the start, for dissolving solid substances or a reaction time after the dosing of a start volume.

Input range	**0** to **999,999 s**
Default value	**0 s**

Activation pulse

If it is activated, then an activation pulse is sent to a remote line that starts a connected Dosimat. Metrohm recommends defining a **Start delay time** for this.

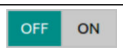
Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Request sample size

If this parameter is activated, then the *value* for the sample size will be requested at the start of the determination.

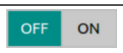
Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Request sample unit

If this parameter is activated, then the *unit* for the sample size will be requested at the start of the determination.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Pause at request

If this parameter is activated, then the run will be paused during the request. If the parameter is switched off, then the titration will be started in the background.

Switch:

- **OFF**
- **ON**

Default value: **ON**

6.12.1.2 Titration parameters

Parameters ▶ Titration parameters

The parameters that are carried out at the start of titration are defined under **[Titration parameters]**.

Stirrer

If this parameter is activated, then the stirrer is switched on at the start of the determination.

Switch:

- **OFF**
- **ON**

Default value: **ON**

Stirring rate

Setting the stirring rate. The stirring direction is always clockwise.

Conversion: Value x 120 ± 5 rpm = stirring rate in rpm

e.g.: 8 × 120 ± 5 rpm = 960 ± 40 rpm

Input range	**1** to **15**
Default value	**8**

Temperature

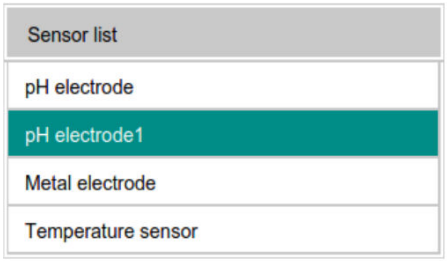
Manually entered titration temperature. If a temperature sensor is connected, then the temperature will be measured continuously. For determinations in pH mode, the value is used for temperature compensation (electrode slope is adjusted accordingly).

Input range	**–20.0** to **150.0 °C**
Default value	**25.0 °C**

Sensor

Open the selection list ❯ and select a sensor.

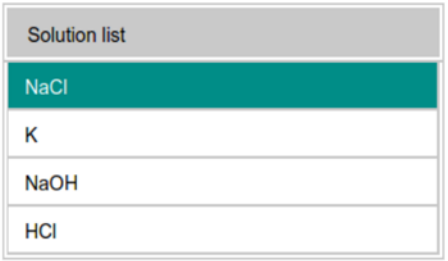
The selection depends on the measuring mode. Sensors are defined and listed under **System** ▶ **Sensors**, e.g.:



Solution

Open the selection list ❯ and select a solution.

Solutions are defined and listed under **System** ▶ **Solutions**, e.g.:



Metrohm always recommends selecting the solution.

This ensures that accurate data (titer, concentration, etc.) is always used for the calculation and that the volume of the selected solution is compared to the volume defined under **System** ▶ **Settings**.

Titration rate

3 predefined sets of parameters and 1 set of parameters that can be defined manually are available for setting the titration rate.

Selection:

- **Slow**: For titrations in which the finest details are to be visible. This can, however, also lead to an increase in noise, which may result in unwanted equivalence points.
- **Optimal**: For all standard titrations. The parameters have been optimized for the most frequent applications.
- **Fast**: For fast and less critical titrations.
- **User**: The individual titration parameters can be modified.

Default value: **Optimal**

Table 10 Default values of the predefined sets of parameters for DET

	Slow	Optimal	Fast
Measuring point density	2	4	6
Min. increment	10.00 µL	10.00 µL	30.00 µL
Max. increment	Off	Off	Off
Dosing rate	Max.	Max.	Max.
Signal drift	20.0 mV/min	50.0 mV/min	80.0 mV/min
Min. waiting time	0 s	0 s	0 s
Max. waiting time	38 s	26 s	21 s

Select **Optimal** as titration rate if you are developing a new titration method. This parameter is suitable for virtually all titrations and needs adaptation only in special cases.

Measuring point density

This parameter is only active if the titration rate is set to **User**.

A lower value means there are more measuring points per unit:

- Low value: High measuring point density
  All the finest details are shown in the curve. This may cause noise and unwanted equivalence points.
- High value: Low measuring point density
  Allows for faster titrations. It is an advantage if you work with low cylinder volumes for dosing (you should also set a smaller signal drift and a higher EP criterion at the same time).

Input range	**0** to **9**
Default value	**4**

Min. Increment

This parameter is only active if the titration rate is set to **User**.

This smallest permitted volume increment is dosed at the start of the titration and with steep curves in the region of the equivalence point. Very small values should be used only if a low titrant consumption is expected. Otherwise unwanted equivalence points may be evaluated.

Input range	**0.05** to **999.90 µL**
Default value	**10.0 µL**

Max. Increment

This parameter is only active if the titration rate is set to **User**.

A maximum volume increment should be selected in the following cases:

- If titrant consumption is very low until the equivalence point is reached.
- If a start volume is dosed until shortly before the equivalence point is reached.
- If the change of direction in the jumping range is very abrupt, because otherwise it is easily possible for an excessively large volume to be dosed in the region of the equivalence point.

The value should not be set to less than 1/100 of the cylinder volume.

Input range	**0.1** to **9,999.9 µL**
Additional selection: **Off**	
Default value: **Off**	

It is not advisable to select similar volumes for the minimum and the maximum increment. Monotonic equivalence point titration (MET) is suitable for these applications.

Min. waiting time

This parameter is only active if the titration rate is set to **User**.

The measured value acceptance does not take place until after the minimum waiting time has elapsed, even if the signal drift has already been

reached. The minimum waiting time is important only for drift-controlled measurements.

Input range	**0** to **999,999 s**
Default value	**0 s**

Max. Waiting time

This parameter is only active if the titration rate is set to **User**.

If the signal drift has been switched off or has not yet been reached, then the measured value will be accepted once the maximum waiting time has elapsed.

Input range	**0** to **999,999 s**
Default value	**26 s**

Signal drift

This parameter is only active if the titration rate is set to **User**.

Maximum permissible drift for the measured value acceptance, i.e. maximum change of the measured value per minute. This type of titration is often referred to as equilibrium titration.

A constant measured value is often only reached after a certain time, as mixing and the reaction itself require a certain time. The response time of an electrode can also increase with time, i.e., reaching a constant measured value takes longer and longer. Drift-controlled measured value acceptance is particularly advisable in such cases, as the measured values are applied only as soon as equilibrium has almost been reached.

Input range	**0.1** to **999.0 mV/min**
Default value	**50.0 mV/min**

Additional selection: **Off**: Measured value acceptance will take place after the maximum waiting time has elapsed. This can be useful if the titration reaction proceeds slowly or if the electrode is slow to respond.

Dosing rate

This parameter is only active if the titration rate is set to **User**.

Rate at which the volume increments are dosed.

Input range	**0.01** to **Max. mL/min**

Additional selection: **Max.** = maximum dosing rate.

Default value: **Max.**

The maximum dosing rate depends on the cylinder volume (see table).

If volatile solvents/solutions or solutions with a high viscosity are used, the dosing rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 11 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Ipol

This parameter is only active with Ipol determinations.

The polarization current is the current that is applied to a polarizable electrode during voltametric measurement.

Selection:

- **1 µA**
- **20 µA**
- **50 µA**
- **100 µA**

Default value: **1 µA**

Electrode check

This parameter is only active with Ipol determinations.

For polarizable electrodes, an electrode check can be carried out. A check is made that the electrode is properly connected and that no short circuit is present. The electrode check is carried out as soon as the determination is started.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

6.12.1.3 Stop conditions

Parameters ▶ Stop conditions

The conditions for canceling the titration are defined under **[Stop conditions]**.

Stop volume

The titration is canceled as soon as the specified volume has been dosed since the start of the titration.

Adjust this volume to the size of the titration vessel in order to prevent the contents from overflowing.

Input range	**0.00000** to **9,999.99 mL**
Default value	**100.000 mL**
Additional selection:	**Off**

Stop measured value (measured quantity pH)

The titration is canceled as soon as the specified measured value has been reached since the start of the titration.

Input range	**–20.000** to **20.000**
Default value	**Off**
Additional selection:	**Off**

Stop measured value (measured quantities U and Ipol)

The titration is canceled as soon as the specified measured value has been reached since the start of the titration.

Input range	**–2,000.0** to **2,000.0 mV**
Additional selection:	**Off**

Default value: **Off**

Stop EP

The titration is canceled as soon as the specified number of equivalence points has been found.

Input range	**1** to **9**
Default value	**9**
Additional selection:	**Off**

Volume after EP

The entered volume will be dosed if the number of equivalence points defined under **Stop EP** has been found. The curve shape after the equivalence point can also be seen this way.

Input range **0.01000** to **9,999.99 mL**
Additional selection: **Off**

Default value: **Off**

Stop time

The titration is canceled as soon as the specified time has elapsed since the start of the titration.

Input range **0** to **999,999 s**
Additional selection: **Off**

Default value: **Off**

Filling rate

Rate at which the cylinder is filled after the titration.

Input range **0.01** to **Max. mL/min**
Additional selection: **Max.** = maximum filling rate.

Default value: **Max.**

The maximum filling rate depends on the cylinder volume (see table).
If volatile solvents/solutions or solutions with a high viscosity are used, then the filling rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 12 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

6.12.1.4 Evaluation

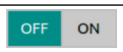
Parameters ▶ Evaluation

The parameters for the evaluation of the titration curve are defined under **[Evaluation]**.

Window

If **ON** is selected, a measured value range (window) can be defined. Only equivalence points that are within this window are recognized.

Only one window can be defined.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

EP recognition (Window = OFF)

Filters for the sought equivalence points:

Selection:

- **All**: All equivalence points will be recognized.
- **Greatest**: Only the equivalence point with the greatest ERC value, i.e. the steepest jump, will be recognized.
- **Last**: Only the last equivalence point will be recognized.
- **Off**: No evaluation takes place.

Default value: **All**

EP recognition (Window = ON)

Filters for the sought equivalence points:

Selection:

- **First**: Only the first equivalence point will be recognized.
- **Greatest**: Only the equivalence point with the greatest ERC value, i.e. the steepest jump, will be recognized.
- **Last**: Only the last equivalence point will be recognized.

Default value: **First**

Fixed EP1 (measured quantity pH)

The associated volume will be interpolated from the measuring point list for the measured value entered. The fixed point must lie between the first and the final entry in the measuring point list.

Input range **–20** to **20**
Additional selection: **Off**

Default value: **Off**

Fixed P1 (measured quantities U and Ipol)

The associated volume will be interpolated from the measuring point list for the measured value entered. The fixed point must lie between the first and the final entry in the measuring point list.

Input range	**–2,000.0** to **2,000.0 mV**
Additional selection: **Off**	
Default value: **Off**	

Fixed EP2 (measured quantity pH)

see fixed EP1

Fixed P2 (measured quantities U and Ipol)

see fixed EP1

Lower limit (measured quantity pH)

This parameter is only active if Window = **ON**.

Measured value for the lower limit.

Input range	**–20.000** to **20.000**
Default value	**–20.000**

Upper limit (measured quantity pH)

This parameter is only active if Window = **ON**.

Measured value for the upper limit.

Input range	**–20.000** to **20.0000**
Default value	**20.000**

Lower limit (measured quantities U and Ipol)

This parameter is only active if Window = **ON**.

Measured value for the lower limit.

Input range	**–2,000.0** to **2,000.0 mV**
Default value	**–2,000.0 mV**

Upper limit (measured quantities U and Ipol)

This parameter is only active if Window = **ON**.

Measured value for the upper limit.

Input range	**–2,000.0** to **2,000.0 mV**
Default value	**2,000.0 mV**

EP criterion

The equivalence point criterion found (ERC = Equivalence point Recognition Criterion) is compared with this value. Equivalence points whose ERC is less than the value defined here will be ignored.

Input range	**0** to **200**
Default value	**5**

Evaluation and equivalence point criterion with DET

The equivalence points (EP) are localized in a way similar to the Tubbs method [1][2]. The volume value of the equivalence point (V_E) is shifted from the inflection point (see arrow) towards the smaller circle of curvature for real asymmetric titration curves.

[1] C. F. Tubbs, *Anal. Chem.* **1954**, *26*, 1670–1671.

[2] E. Bartholomé, E. Biekert, H. Hellmann, H. Ley, M. Weigert, E. Weise, *Ullmanns Encyklopädie der technischen Chemie*, Vol. 5, Verlag Chemie, Weinheim, 1980, p. 659.

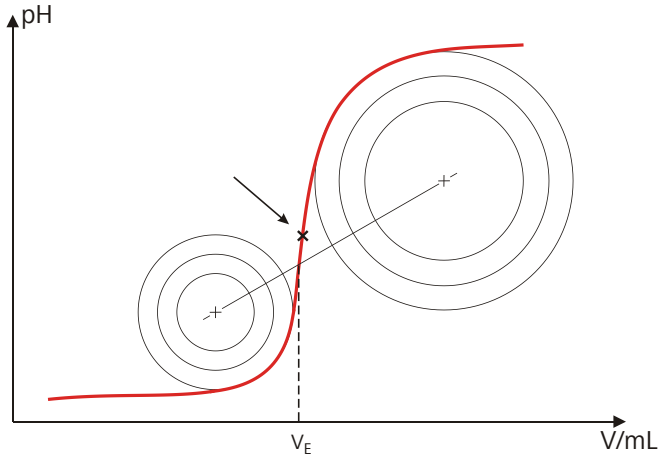


Figure 51 Tubbs method for determining the equivalence point

The figure shows that the evaluation still requires measured values from the measuring point list even after the equivalence point.

For the recognition of the EPs found, the set EP criterion is compared to the ERC (Equivalence point Recognition Criterion) found. The ERC is the first derivative of the titration curve combined with a mathematical function that is more sensitive for flat jumps than for steeper ones. EPs whose ERC is smaller than the defined EP criterion will not be recognized.

The ERC is displayed under **Results** for each discovered and recognized EP.

If the EP criterion is adjusted retroactively in order to recognize more or fewer EPs, then you can initiate a reevaluation under **Results**.

6.12.1.5 Calculation

Parameters ▶ Calculation

A maximum of five calculations can be defined in one method. A series of variables (raw data from the determination, previously calculated results) is available for the calculations.

For each calculation, you can define whether the result is to be saved as a titer or as a common variable.

The five possible calculations are shown in a list:

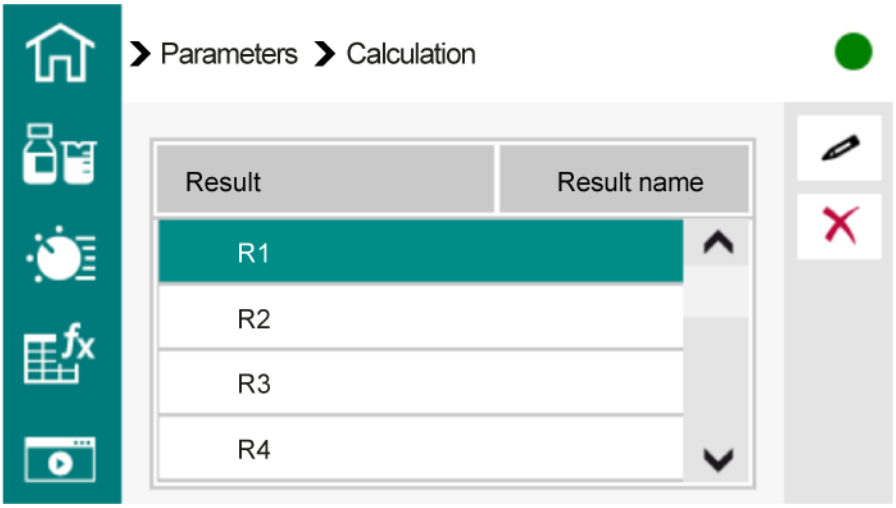


Figure 52 Parameters calculation – Result list

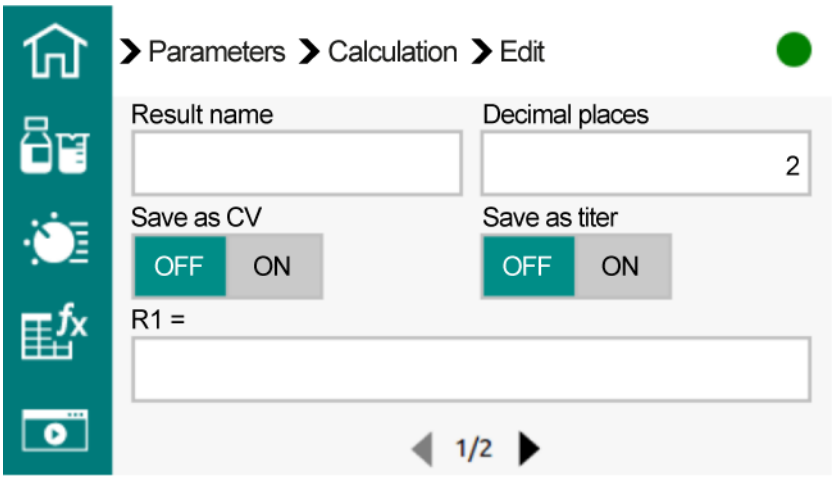
The result name is specified in the list for each calculation.

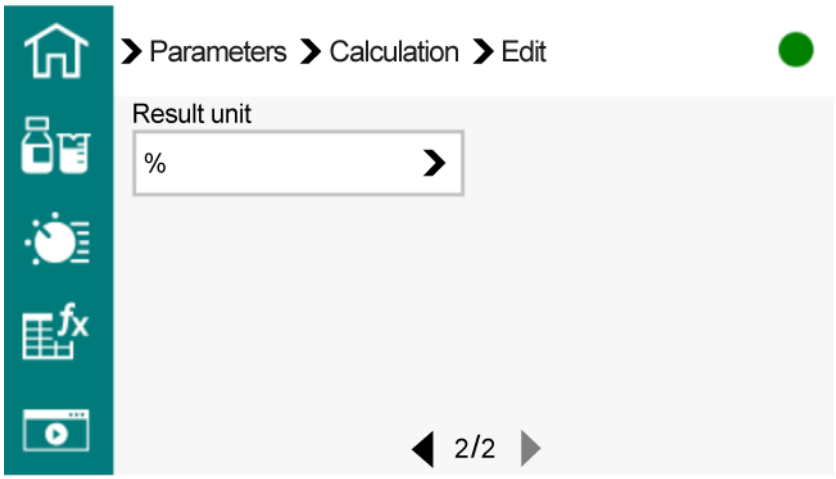
Scroll down for result R5.

Editing a calculation

1 Select a calculation in the result list.

2 Click on ✎.





3 Make the desired changes.

Result name

The result name is the text that will be shown in the result view and in the report.

Input: max. 12 characters

Default value: empty

Decimal places

Number of decimal places used to display the result.

Input range	**0** to **5**
Default value	**2**

Save as CV

The calculated result can be saved as a method-independent variable, called a common variable. The result is then also available in other methods for calculations. If statistics has been switched on, then the current mean value of the determination series will be saved.

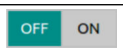
Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Save as titer

The result can be saved as titer for the selected solution (the solution must be selected). If statistics has been switched on, then the current mean value of the determination series will be saved.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

R1=... – R5=...

Shows the calculation formula. The formula editor is opened for the definition.

Result unit

The result unit is displayed and saved along with the result.

Selection:

- **%**
- **mol/L**
- **mmol/L**
- **g/L**
- **mg/L**
- **mg/mL**
- **ppm**
- **g**
- **mg**
- **mL**
- **mg/piece**
- **°C**
- **µL**
- **mL/min**
- **User-defined**

Default value: **%**

6.12.1.6 Statistics

Parameters ▶ Statistics

The statistics calculation of a multiple determination is activated under **[Statistics]** and definition is made as to how many determinations the series contains.

Statistics

If it is set to **ON**, statistics calculations will be carried out for all of the defined results.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Number of samples

The number of determinations that are carried out for the statistics calculations.

Input range	**2** to **20**
Default value	**3**

6.12.1.7 Reports

Parameters ▶ Reports

The reports that will be printed out automatically or saved as a PDF report after a determination are defined under **[Reports]**.

Results

The result report contains the calculated results, equivalence points, endpoints, sample data, etc.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Curve

The report is shown as a curve.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Calculation/statistics

Output of the calculation formulas for the individual results. Results are specified with full accuracy. This makes checking with an external program possible.

If the switch under **Parameters ▶ Statistics** is set to **ON**, the following data will be printed out as well:

- Result and sample size of the individual determinations
- Mean value as well as absolute and relative standard deviation

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Measuring point list

Output of the measuring point list.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Parameters

All of the parameters of the current method are shown in the parameter report.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

The printer for the report data above is defined under **Start page** ▶ **System** ▶ **External devices** ▶ **Printer**.

- If a connected printer is selected, then the report contains the data defined by the switches above.
- If **[PDF]** is selected as printer and at least one switch is set to ON, then the report contains the complete data except for the measuring point list. The measuring points are only printed if the switch **measuring point list** is set to ON.

PC/LIMS

The PC/LIMS report is a machine-readable report with all of the important data for a determination. This report can be saved as a TXT file on a USB flash drive or sent to a LIMS via an RS-232 interface. The output location is defined under **Start page** ▶ **System** ▶ **External devices** ▶ **PC/LIMS report**.

The file name of the TXT file has the following structure:

PC_LIMS_Report_ID1_YYYYMMDD-hhmmss.txt

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

6.12.2 Monotonic equivalence point titrations (MET)

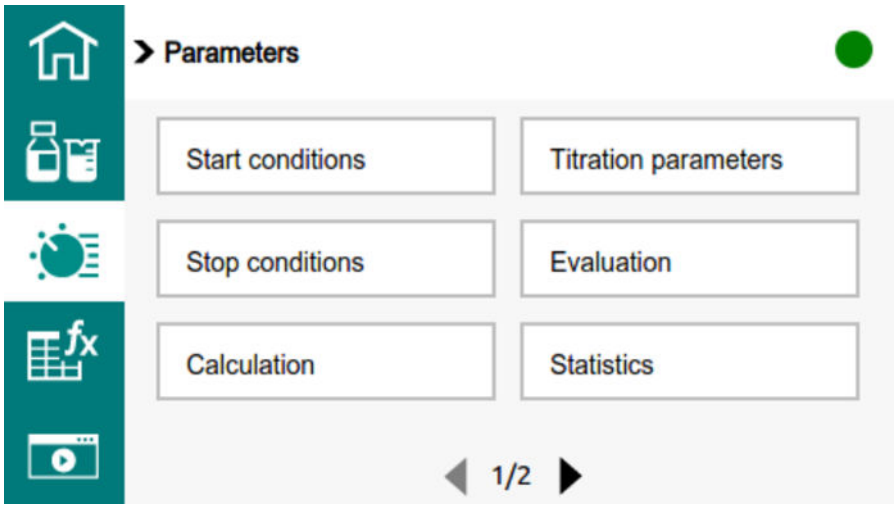


Figure 53 MET parameters – Menu page 1

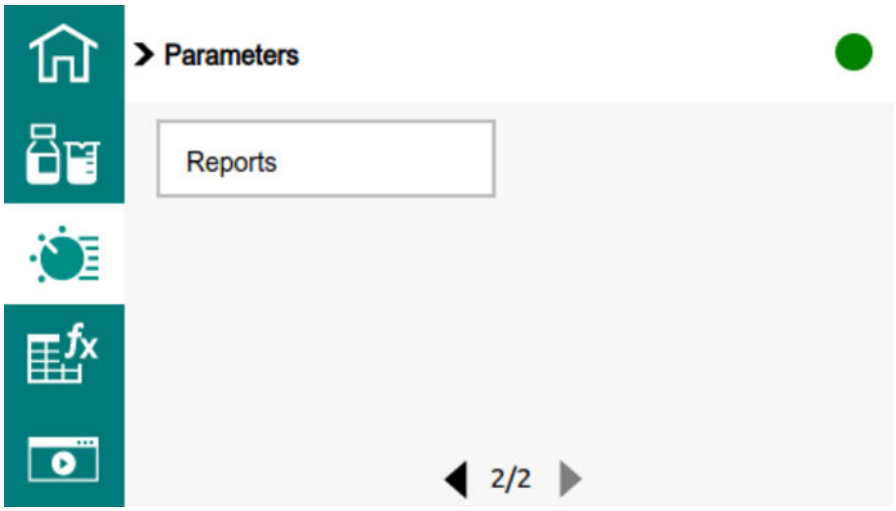


Figure 54 MET parameters – Menu page 2

6.12.2.1 Start conditions

Parameters ▶ Start conditions

The parameters that are carried out before the start of titration are defined under **[Start conditions]**.

Request sample ID

Selection of the sample identification that is queried at the start of the determination.

Selection:

- **ID1**
- **ID2**
- **ID1&ID2**
- **Off**

Default value: **Off**

Start delay time

Waiting time after the start of the determination, before titration takes place.

During this period, substances such as auxiliary solution can be added with a Dosimat (parameterization on the Dosimat, although the **Activation pulse** switch must be switched on for this).

Input range	**0** to **999,999 s**
Default value	**0 s**

Start volume

Volume that is dosed prior to the start of the titration.

Input range	**0.00000** to **9,999.99 mL**
Default value	**0.00000 mL**

Dosing rate

Rate at which the start volume is dosed.

Input range **0.02** to **Max. mL/min**
Additional selection: **Max.** = maximum dosing rate.

Default value: **Max.**

The maximum dosing rate depends on the cylinder volume (see table).

If volatile solvents/solutions or solutions with a high viscosity are used, the dosing rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 13 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min

Cylinder volume	maximum dosing rate / filling rate
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Pause

Waiting time, e.g. for the stabilization of the measured value after the start, for dissolving solid substances or a reaction time after the dosing of a start volume.

Input range	**0** to **999,999 s**
Default value	**0 s**

Activation pulse

If it is activated, then an activation pulse is sent to a remote line that starts a connected Dosimat. Metrohm recommends defining a **Start delay time** for this.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Request sample size

If this parameter is activated, then the *value* for the sample size will be requested at the start of the determination.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Request sample unit

If this parameter is activated, then the *unit* for the sample size will be requested at the start of the determination.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Pause at request

If this parameter is activated, then the run will be paused during the request. If the parameter is switched off, then the titration will be started in the background.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **ON**

6.12.2.2 Titration parameters

Parameters ▶ Titration parameters

The parameters that are carried out at the start of titration are defined under **[Titration parameters]**.

Titration rate

3 predefined sets of parameters and 1 set of parameters that can be defined manually are available for setting the titration rate.

Selection:

- **Slow**: For titrations in which the finest details are to be visible. This can, however, also lead to an increase in noise, which may result in unwanted equivalence points.
- **Optimal**: For all standard titrations. The parameters have been optimized for the most frequent applications.
- **Fast**: For fast and less critical titrations.
- **User**: The individual titration parameters can be modified.

Default value: **Optimal**

Table 14 Default values of the predefined sets of parameters for MET

	Slow	Optimal	Fast
Volume increment	2	4	6
Dosing rate	Max.	Max.	Max.
Signal drift	20.0 mV/min	50.0 mV/min	80.0 mV/min
Min. waiting time	0 s	0 s	0 s
Max. waiting time	38 s	26 s	21 s

For a new titration method, select **Optimal** as the titration rate. This parameter is suitable for virtually all titrations and needs adaptation only in special cases.

Volume increment

This parameter is only active if the titration rate is set to **User**.

Volume dosed at each dosing step.

High accuracy requires using the correct volume increment. A good guideline is 1/20 of the expected endpoint volume. The volume increment should be closer to 1/100 of the endpoint volume for steep jumps and closer to 1/10 for flat jumps.

Small volume increments are used for determining blank values or with very asymmetrical curves. The accuracy of the evaluation cannot be increased by using smaller increments as the measured value changes between two measuring points are then of the same magnitude as the noise.

Input range	**0.00005** to **999.900 mL**
Default value	**0.10000 mL**

Dosing rate

This parameter is only active if the titration rate is set to **User**.

Rate at which the volume increments are dosed.

Input range **0.01** to **Max. mL/min**
Additional selection: **Max.** = maximum dosing rate.

Default value: **Max.**

The maximum dosing rate depends on the cylinder volume (see table).
If volatile solvents/solutions or solutions with a high viscosity are used, the dosing rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 15 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Signal drift

This parameter is only active if the titration rate is set to **User**.

Maximum permissible drift for the measured value acceptance, i.e. maximum change of the measured value per minute. This type of titration is often referred to as equilibrium titration.

A constant measured value is often only reached after a certain time, as mixing and the reaction itself require a certain time. The response time of an electrode can also increase with time, i.e., reaching a constant measured value takes longer and longer. Drift-controlled measured value acceptance is particularly advisable in such cases, as the measured values are applied only as soon as equilibrium has almost been reached.

Input range	**0.1** to **999.0 mV/min**
Default value	**50.0 mV/min**

Additional selection: **Off**: Measured value acceptance will take place after the maximum waiting time has elapsed. This can be useful if the titration reaction proceeds slowly or if the electrode is slow to respond.

Min. waiting time

This parameter is only active if the titration rate is set to **User**.

The measured value acceptance does not take place until after the minimum waiting time has elapsed, even if the signal drift has already been reached. The minimum waiting time is important only for drift-controlled measurements.

Input range	**0** to **999,999 s**
Default value	**0 s**

Max. Waiting time

This parameter is only active if the titration rate is set to **User**.

If the signal drift has been switched off or has not yet been reached, then the measured value will be accepted once the maximum waiting time has elapsed.

Input range	**0** to **999,999 s**
Default value	**26 s**

Stirrer

If this parameter is activated, then the stirrer is switched on at the start of the determination.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **ON**

Stirring rate

Setting the stirring rate. The stirring direction is always clockwise.

Conversion: Value x 120 ± 5 rpm = stirring rate in rpm

e.g.: 8 × 120 ± 5 rpm = 960 ± 40 rpm

Input range	**1** to **15**
Default value	**8**

Temperature

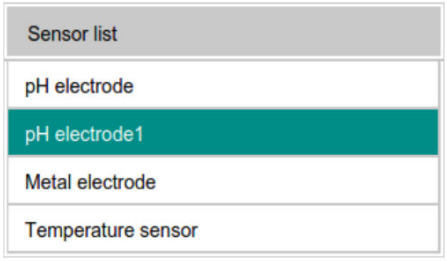
Manually entered titration temperature. If a temperature sensor is connected, then the temperature will be measured continuously. For determinations in pH mode, the value is used for temperature compensation (electrode slope is adjusted accordingly).

Input range	**–20.0** to **150.0 °C**
Default value	**25.0 °C**

Sensor

Open the selection list ❯ and select a sensor.

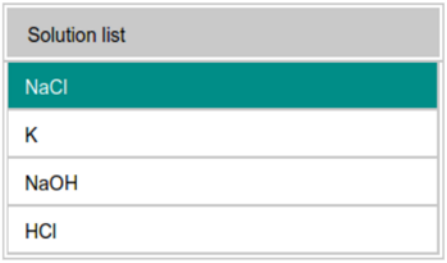
The selection depends on the measuring mode. Sensors are defined and listed under **System** ▶ **Sensors**, e.g.:



Solution

Open the selection list ❯ and select a solution.

Solutions are defined and listed under **System** ▶ **Solutions**, e.g.:



Metrohm always recommends selecting the solution.

This ensures that accurate data (titer, concentration, etc.) is always used for the calculation and that the volume of the selected solution is compared to the volume defined under **System** ▶ **Settings**.

Ipol

This parameter is only active with Ipol determinations.

The polarization current is the current that is applied to a polarizable electrode during voltametric measurement.

Selection:

- **1 µA**
- **20 µA**
- **50 µA**
- **100 µA**

Default value: **1 µA**

Electrode check

This parameter is only active with Ipol determinations.

For polarizable electrodes, an electrode check can be carried out. A check is made that the electrode is properly connected and that no short circuit is present. The electrode check is carried out as soon as the determination is started.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

6.12.2.3 Stop conditions

Parameters ▶ **Stop conditions**

The conditions for canceling the titration are defined under **[Stop conditions]**.

Stop volume

The titration is canceled as soon as the specified volume has been dosed since the start of the titration.

Adjust this volume to the size of the titration vessel to prevent it from overflowing.

Input range	**0.00000** to **9,999.99 mL**
Default value	**100.000 mL**
Additional selection:	**Off**

Stop measured value (measured quantity pH)

The titration is canceled as soon as the specified measured value has been reached since the start of the titration.

Input range	**–20.000** to **20.000**
Default value	**Off**
Additional selection:	**Off**

Stop measured value (measured quantities U and Ipol)

The titration is canceled as soon as the specified measured value has been reached since the start of the titration.

Input range	**–2,000.0** to **2,000.0 mV**
Additional selection:	**Off**

Default value: **Off**

Stop EP

The titration is canceled as soon as the specified number of equivalence points has been found.

Input range	**1** to **9**
Default value	**9**
Additional selection:	**Off**

Volume after EP

The entered volume will be dosed if the number of equivalence points defined under **Stop EP** has been found. The curve shape after the equivalence point can also be seen this way.

Input range	**0.01000** to **9,999.99 mL**
Additional selection:	**Off**

Default value: **Off**

Stop time

The titration is canceled as soon as the specified time has elapsed since the start of the titration.

Input range **0** to **999,999 s**
Additional selection: **Off**

Default value: **Off**

Filling rate

Rate at which the cylinder is filled after the titration.

Input range **0.01** to **Max. mL/min**
Additional selection: **Max.** = maximum filling rate.

Default value: **Max.**

The maximum filling rate depends on the cylinder volume (see table).

If volatile solvents/solutions or solutions with a high viscosity are used, then the filling rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 16 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

6.12.2.4 Evaluation

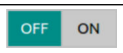
Parameters ▶ Evaluation

The parameters for the evaluation of the titration curve are defined under **[Evaluation]**.

Window

If **ON** is selected, a measured value range (window) can be defined. Only equivalence points that are within this window are recognized.

Only one window can be defined.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

EP recognition (Window = OFF)

Filters for the sought equivalence points:

Selection:

- **All**: All equivalence points will be recognized.
- **Greatest**: Only the equivalence point with the greatest ERC value, i.e. the steepest jump, will be recognized.
- **Last**: Only the last equivalence point will be recognized.
- **Off**: No evaluation takes place.

Default value: **All**

EP recognition (Window = ON)

Filters for the sought equivalence points:

Selection:

- **First**: Only the first equivalence point will be recognized.
- **Greatest**: Only the equivalence point with the greatest ERC value, i.e. the steepest jump, will be recognized.
- **Last**: Only the last equivalence point will be recognized.

Default value: **First**

Fixed EP1 (measured quantity pH)

The associated volume will be interpolated from the measuring point list for the measured value entered. The fixed point must lie between the first and the final entry in the measuring point list.

Input range **–20** to **20**
Additional selection: **Off**

Default value: **Off**

Fixed P1 (measured quantities U and Ipol)

The associated volume will be interpolated from the measuring point list for the measured value entered. The fixed point must lie between the first and the final entry in the measuring point list.

Input range **–2,000.0** to **2,000.0 mV**
Additional selection: **Off**

Default value: **Off**

Fixed EP2 (measured quantity pH)

see fixed EP1

Fixed P2 (measured quantities U and Ipol)

see fixed EP1

Lower limit (measured quantity pH)

This parameter is only active if Window = **ON**.

Measured value for the lower limit.

Input range	**–20.000** to **20.000**
Default value	**–20.000**

Upper limit (measured quantity pH)

This parameter is only active if Window = **ON**.

Measured value for the upper limit.

Input range	**–20.000** to **20.0000**
Default value	**20.000**

Lower limit (measured quantities U and Ipol)

This parameter is only active if Window = **ON**.

Measured value for the lower limit.

Input range	**–2,000.0** to **2,000.0 mV**
Default value	**–2,000.0 mV**

Upper limit (measured quantities U and Ipol)

This parameter is only active if Window = **ON**.

Measured value for the upper limit.

Input range	**–2,000.0** to **2,000.0 mV**
Default value	**2,000.0 mV**

EP criterion (measured quantity pH)

The equivalence point criterion found (ERC = Equivalence point Recognition Criterion) is compared with this value. Equivalence points whose ERC is less than the value defined here will be ignored.

Input range	**0.10** to **9.99**
Default value	**0.50**

EP criterion (measured quantities U and Ipol)

The equivalence point criterion found (ERC = Equivalence point Recognition Criterion) is compared with this value. Equivalence points whose ERC is less than the value defined here will be ignored.

Input range	**1** to **999 mV**
Default value	**30 mV**

Evaluation and equivalence point criterion with MET

The equivalence points (EP) are localized by a method based on the Fortuin method, which has been adapted by Metrohm for numerical methods. A search is made for the largest measured value change (Δ_n). The exact EP is determined by using an interpolation factor ρ that depends on the Δ values before and after Δ_n:

$$V_{EP} = V_0 + \rho \cdot \Delta V$$

V_{EP}: EP volume

V_0: Dosed total volume before Δ_n

ΔV: Volume increment

ρ: Interpolation factor according to Fortuin

For the recognition of the EPs found, the set EP criterion is compared to the ERC (Equivalence point Recognition Criterion) found. The ERC is the sum of the measured value changes before and after the jump:

$$|\Delta_{n-2}| + |\Delta_{n-1}| + |\Delta_n| + |\Delta_{n+1}| + |\Delta_{n+2}|$$

In certain cases, only 3 or only 1 summand is taken into account.

For the recognition of the EPs found, the set EP criterion is compared to the ERC (Equivalence point Recognition Criterion) found. The ERC is the first derivative of the titration curve combined with a mathematical function that is more sensitive for flat jumps than for steeper ones. EPs whose ERC is smaller than the defined EP criterion will not be recognized.

The ERC is displayed under **Results** for each discovered and recognized EP.

If the EP criterion is adjusted retroactively in order to recognize more or fewer EPs, then you can initiate a reevaluation under **Results**.

6.12.2.5 Calculation

Parameters ▶ Calculation

A maximum of five calculations can be defined in one method. A series of variables (raw data from the determination, previously calculated results) is available for the calculations.

For each calculation, you can define whether the result is to be saved as a titer or as a common variable.

The five possible calculations are shown in a list:

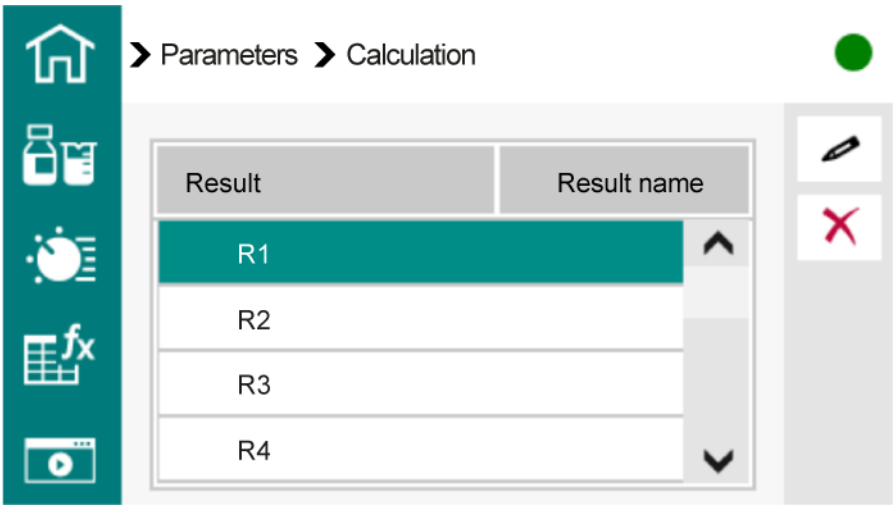


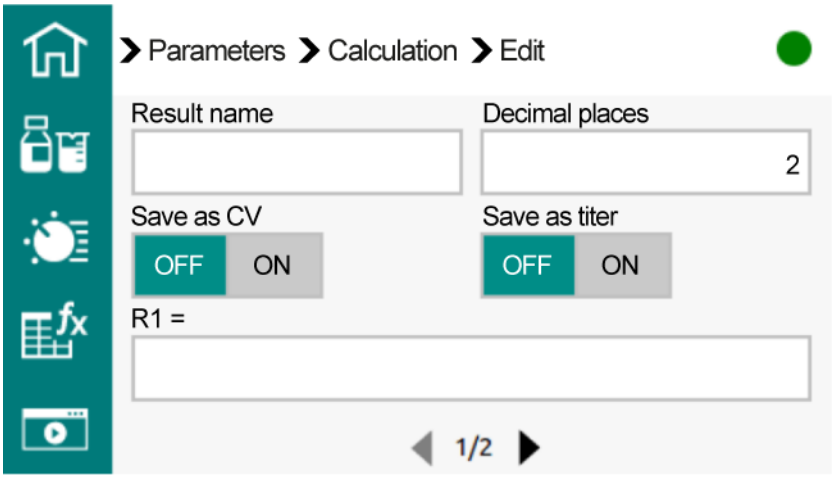
Figure 55 Parameters calculation – Result list

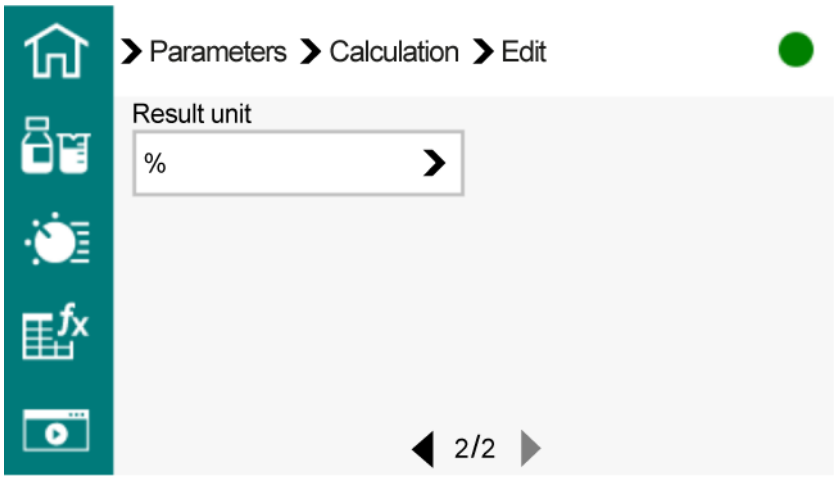
The result name is specified in the list for each calculation.

Scroll down for result R5.

Editing a calculation

1. Select a calculation in the result list.
2. Click on ✎.





3 Make the desired changes.

Result name

The result name is the text that will be shown in the result view and in the report.

Input: max. 12 characters

Default value: empty

Decimal places

Number of decimal places used to display the result.

Input range	**0** to **5**
Default value	**2**

Save as CV

The calculated result can be saved as a method-independent variable, called a common variable. The result is then also available in other methods for calculations. If statistics has been switched on, then the current mean value of the determination series will be saved.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Save as titer

The result can be saved as titer for the selected solution (the solution must be selected). If statistics has been switched on, then the current mean value of the determination series will be saved.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

R1=... - R5=...

Shows the calculation formula. The formula editor is opened for the definition.

Result unit

The result unit is displayed and saved along with the result.

Selection:

- **%**
- **mol/L**
- **mmol/L**
- **g/L**
- **mg/L**
- **mg/mL**
- **ppm**
- **g**
- **mg**
- **mL**
- **mg/piece**
- **°C**
- **µL**
- **mL/min**
- **User-defined**

Default value: **%**

6.12.2.6 Statistics

Parameters ▶ Statistics

The statistics calculation of a multiple determination is activated under **[Statistics]** and definition is made as to how many determinations the series contains.

Statistics

If it is set to **ON**, statistics calculations will be carried out for all of the defined results.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Number of samples

The number of determinations that are carried out for the statistics calculations.

Input range	**2** to **20**
Default value	**3**

6.12.2.7 Reports

Parameters ▶ Reports

The reports that will be printed out automatically or saved as a PDF report after a determination are defined under **[Reports]**.

Results

The result report contains the calculated results, equivalence points, endpoints, sample data, etc.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Curve

The report is shown as a curve.

Switch: OFF ON

- **OFF**
- **ON**

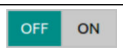
Default value: **OFF**

Calculation/statistics

Output of the calculation formulas for the individual results. Results are specified with full accuracy. This makes checking with an external program possible.

If the switch under **Parameters ▶ Statistics** is set to **ON**, the following data will be printed out as well:

- Result and sample size of the individual determinations
- Mean value as well as absolute and relative standard deviation

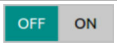
Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Measuring point list

Output of the measuring point list.

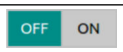
Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Parameters

All of the parameters of the current method are shown in the parameter report.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

The printer for the report data above is defined under **Start page** ▶ **System** ▶ **External devices** ▶ **Printer**.

- If a connected printer is selected, then the report contains the data defined by the switches above.
- If **[PDF]** is selected as printer and at least one switch is set to ON, then the report contains the complete data except for the measuring point list. The measuring points are only printed if the switch **measuring point list** is set to ON.

PC/LIMS

The PC/LIMS report is a machine-readable report with all of the important data for a determination. This report can be saved as a TXT file on a USB flash drive or sent to a LIMS via an RS-232 interface. The output location is defined under **Start page** ▶ **System** ▶ **External devices** ▶ **PC/LIMS report**.

The file name of the TXT file has the following structure:

PC_LIMS_Report_ID1_YYYYMMDD-hhmmss.txt

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

6.12.3 Endpoint titrations (SET)

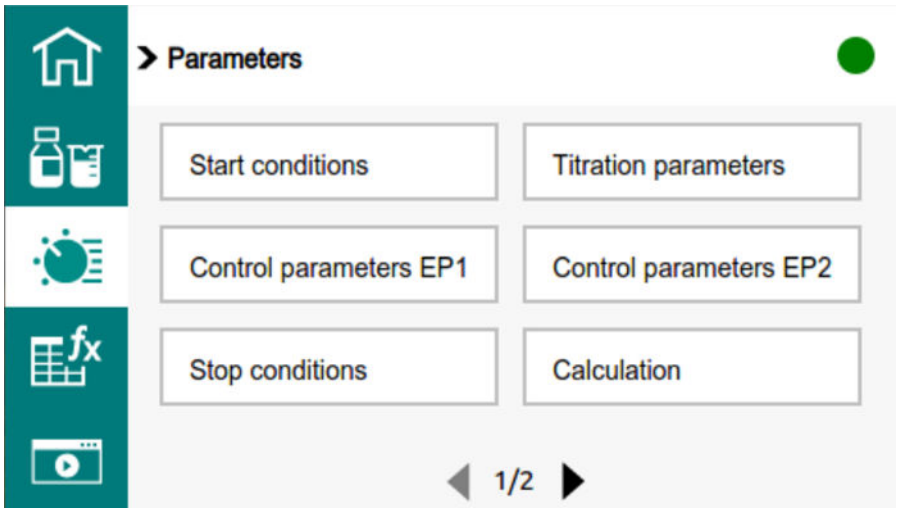


Figure 56 SET parameters – Menu page 1

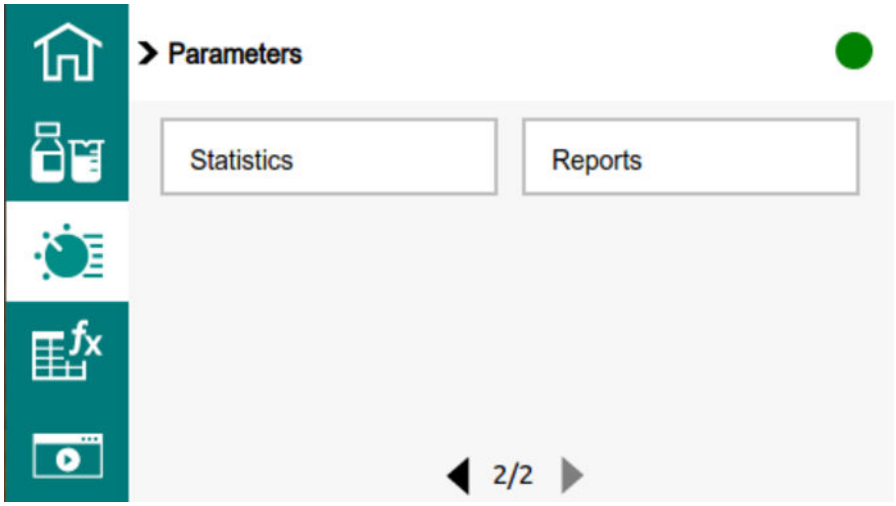


Figure 57 SET parameters – Menu page 2

6.12.3.1 Start conditions

Parameters ▶ Start conditions

The parameters that are carried out before the start of titration are defined under **[Start conditions]**.

Request sample ID

Selection of the sample identification that is queried at the start of the determination.

Selection:

- **ID1**
- **ID2**
- **ID1&ID2**
- **Off**

Default value: **Off**

Start delay time

Waiting time after the start of the determination, before titration takes place.

During this period, substances such as auxiliary solution can be added with a Dosimat (parameterization on the Dosimat, although the **Activation pulse** switch must be switched on for this).

Input range	**0** to **999,999 s**
Default value	**0 s**

Start volume

Volume that is dosed prior to the start of the titration.

Input range	**0.00000** to **9,999.99 mL**
Default value	**0.00000 mL**

Dosing rate

Rate at which the start volume is dosed.

Input range **0.02** to **Max. mL/min**
Additional selection: **Max.** = maximum dosing rate.

Default value: **Max.**

The maximum dosing rate depends on the cylinder volume (see table).

If volatile solvents/solutions or solutions with a high viscosity are used, the dosing rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 17 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min

Cylinder volume	maximum dosing rate / filling rate
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Pause

Waiting time, e.g. for the stabilization of the measured value after the start, for dissolving solid substances or a reaction time after the dosing of a start volume.

Input range	**0** to **999,999 s**
Default value	**0 s**

Activation pulse

If it is activated, then an activation pulse is sent to a remote line that starts a connected Dosimat. Metrohm recommends defining a **Start delay time** for this.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Request sample size

If this parameter is activated, then the *value* for the sample size will be requested at the start of the determination.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Request sample unit

If this parameter is activated, then the *unit* for the sample size will be requested at the start of the determination.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Pause at request

If this parameter is activated, then the run will be paused during the request. If the parameter is switched off, then the titration will be started in the background.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **ON**

6.12.3.2 Titration parameters

Parameters ▶ Titration parameters

The parameters that are carried out at the start of titration are defined under **[Titration parameters]**.

Stirrer

If this parameter is activated, then the stirrer is switched on at the start of the determination.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **ON**

Stirring rate

Setting the stirring rate. The stirring direction is always clockwise.

Conversion: Value x 120 ± 5 rpm = stirring rate in rpm

e.g.: 8 × 120 ± 5 rpm = 960 ± 40 rpm

Input range	**1** to **15**
Default value	**8**

Temperature

Manually entered titration temperature. If a temperature sensor is connected, then the temperature will be measured as follows:

- For measured quantity Ipol: Temperature measurement in the beginning and at the end of the titration.
- For measured quantities U and pH: Continuous temperature measurement.

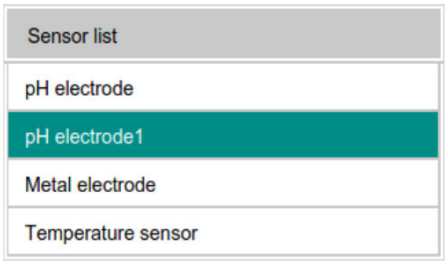
For determinations in pH mode, the value is used for temperature compensation (electrode slope is adjusted accordingly).

Input range	**–20.0** to **150.0 °C**
Default value	**25.0 °C**

Sensor

Open the selection list ❯ and select a sensor.

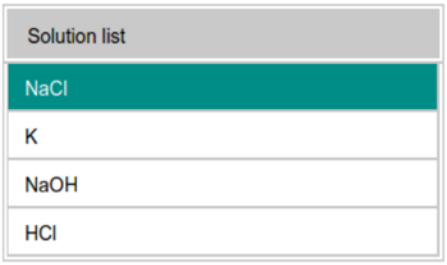
The selection depends on the measuring mode. Sensors are defined and listed under **System** ▶ **Sensors**, e.g.:



Solution

Open the selection list ❯ and select a solution.

Solutions are defined and listed under **System** ▶ **Solutions**, e.g.:



Metrohm always recommends selecting the solution.

This ensures that accurate data (titer, concentration, etc.) is always used for the calculation and that the volume of the selected solution is compared to the volume defined under **System** ▶ **Settings**.

Titration direction

Metrohm recommends that you specify whenever possible whether the measured value change is positive or negative.

If two endpoints have been set, then the titration direction will be defined automatically. In this case, the setting will be ignored.

Selection:

- **+**: Positive measured value change, i.e. in the direction of a higher pH value, greater voltage or greater current.
- **-**: Negative measured value change, i.e. in the direction of a lower pH value, lesser voltage or lesser current.
- **Auto**: The titration direction is determined automatically from the initial measured value and the set endpoint.

Default value: **Auto**

Extraction time

Minimum duration of the titration. The titration will not be canceled during the extraction time, even if the endpoint has already been reached. The titration is, however, canceled if a **stop condition** is fulfilled in this time. The entry of an extraction time is advisable, e.g., for the titration of samples of low solubility.

Input range	**0** to **999,999 s**
Default value	**0 s**

Time interval MP

Time interval for entering a measuring point in the measuring point list. The measuring point list is limited to 1000 measuring points.

Input range	**0.1** to **999,999.0 s**
Default value	**2.0 s**

Ipol

This parameter is only active with Ipol determinations.

The polarization current is the current that is applied to a polarizable electrode during voltametric measurement.

Selection:

- **1 µA**
- **20 µA**
- **50 µA**
- **100 µA**

Default value: **1 µA**

Electrode check

This parameter is only active with Ipol determinations.

For polarizable electrodes, an electrode check can be carried out. A check is made that the electrode is properly connected and that no short circuit is present. The electrode check is carried out as soon as the determination is started.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

6.12.3.3 Control parameters EP1

Parameters ▶ Control parameters EP1

The control parameters for the first endpoint are defined under **[Control parameters EP1]**.

Endpoint 1 at (measured quantity pH)

Measured value for the first endpoint.

Input range **–20.000** to **20.000**
Additional selection: **Off**

Default value: **Off**

Endpoint 1 at (measured quantities U and Ipol)

Measured value for the first endpoint.

Input range **–2,000.0** to **2,000.0 mV**
Additional selection: **Off**

Default value: **Off**

Titration rate

3 predefined sets of parameters and 1 set of parameters that can be defined manually are available for setting the titration rate.

Selection:

- **Slow**: For titrations with a long reaction time or a steep increase/ decrease at the endpoint. The titration time can be very long.
- **Optimal**: For all standard titrations. The parameters have been optimized for the most frequent applications.
- **Fast**: For titrations that show a flat curve progression at the endpoint. The titration is carried out very fast.
- **User**: The individual titration parameters can be modified.

Default value: **Optimal**

For a new titration method, select **Optimal** as the titration rate. This parameter is suitable for virtually all titrations and needs adaptation only in special cases.

Table 18 Default values of the predefined sets of parameters for MET

	Slow	Optimal	Fast
Control range pH	5.000	2.000	0.500
Control range U and Ipol	300.0 mV	100.0 mV	30.0 mV
Min. rate	5.00 µL/min	25.00 µL/min	50.00 µL/min
Max. rate	1.00 mL/min	10.00 mL/min	Maximum dosing rate

Minimum rate

This parameter is only active if the titration rate is set to **User**.

Rate at which dosing is carried out at the very beginning of the titration and in the control range at the end of the titration.

This parameter has a vital influence on the titration rate and thus also on the accuracy. The smaller the selected minimum rate, the slower the titration.

Input range	**0.01** to **9,999.00 µL/min**
Default value	**25.00 µL/min**

Maximum rate

This parameter is only active if the titration rate is set to **User**.

Rate at which dosing is carried out outside of the control range.

Input range	**0.01** to **Max. mL/min**
Default value	**10.00 mL/min**

Additional selection: **Max.** = maximum dosing rate.

The maximum dosing rate depends on the cylinder volume (see table).

If volatile solvents/solutions or solutions with a high viscosity are used, the dosing rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 19 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Control range (measured quantity pH)

This parameter is only active if the titration rate is set to **User**.

This parameter defines the control range before the specified endpoint. Individual volume steps are dosed in the control range; the dosing is finely controlled. Within the control range, dosing is done with the rate defined under **Minimum rate**.

The larger the control range, the slower the titration. Outside of the control range, dosing is carried out continuously; the dosing rate is defined under **Maximum rate**.

Input range	**0.001** to **20.000**
Default value	**2.000**
Additional selection: **Off**	

Control range (measured quantities U and Ipol)

This parameter is only active if the titration rate is set to **User**.

This parameter defines the control range before the specified endpoint. Individual volume steps are dosed in the control range; the dosing is finely controlled. The closer the endpoint, the slower the dosing until the dosing rate defined under **Minimum rate** has been reached.

The larger the control range, the slower the titration. Outside of the control range, dosing is carried out continuously; the dosing rate is defined under **Maximum rate**.

Input range	**0.1** to **1,250.0 mV**
Default value	**100.0 mV**
Additional selection: **Off**	

Stop criterion

The titration is canceled as soon as the endpoint has been reached and this stop criterion has been fulfilled. If no stop criterion was defined, the titration is completed according to the stop conditions.

Selection:

- **Drift**: The titration is canceled once the **stop drift** has been reached.
- **Time**: The titration is canceled once the **Delay time** has been reached.
- **Off**: The titration will not be canceled until the **stop conditions** are fulfilled.

Default value: **All**

Stop drift

This parameter is only active if the stop criterion is set to **Drift**.

The titration is canceled as soon as the endpoint and the stop drift have been reached.

Input range	**1** to **999 µL/min**
Default value	**20 µL/min**

Delay time

This parameter is active only if the stop criterion is set to **Time**.

As soon as the endpoint has been reached, the specified **Delay time** is allowed to elapse after the last dosing and the titration is then canceled.

Input range	**0** to **999 s**
Default value	**10 s**

6.12.3.4 Control parameters EP2

Parameters ▶ Control parameters EP2

The control parameters for the second endpoint are defined under **[Control parameters EP2]**.

The parameters and their selection and input ranges are identical to the **Control parameters EP1**.

6.12.3.5 Stop conditions

Parameters ▶ Stop conditions

The conditions for canceling the titration are defined under **[Stop conditions]**, if this does not occur automatically. This happens if the set endpoint was not reached or if the stop criterion was not fulfilled.

Stop volume

The titration is canceled if the specified volume has been dosed since the start of the titration.

Adjust this volume to the size of the titration vessel in order to prevent the contents from overflowing.

Input range	**0.00000** to **9,999.99 mL**
Default value	**100.000 mL**
Additional selection: **Off**	

Stop time

The titration is canceled if the specified time has elapsed since the start of the titration.

Input range	**0** to **999,999 s**
Additional selection: **Off**	

Default value: **Off**

Filling rate

Rate at which the cylinder is filled after the titration.

Input range **0.01** to **Max. mL/min**
Additional selection: **Max.** = maximum filling rate.

Default value: **Max.**

The maximum filling rate depends on the cylinder volume (see table).
If volatile solvents/solutions or solutions with a high viscosity are used, then the filling rate must be reduced accordingly so that the cylinder unit is not overloaded.

Table 20 Maximum dosing rate / filling rate

Cylinder volume	maximum dosing rate / filling rate
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

6.12.3.6 Calculation

Parameters ▶ Calculation

A maximum of five calculations can be defined in one method. A series of variables (raw data from the determination, previously calculated results) is available for the calculations.

For each calculation, you can define whether the result is to be saved as a titer or as a common variable.

The five possible calculations are shown in a list:

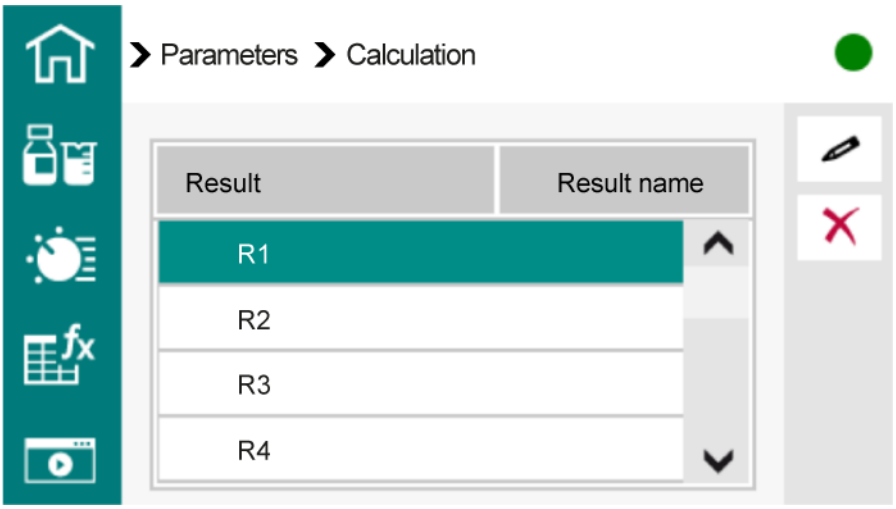


Figure 58 Parameters calculation – Result list

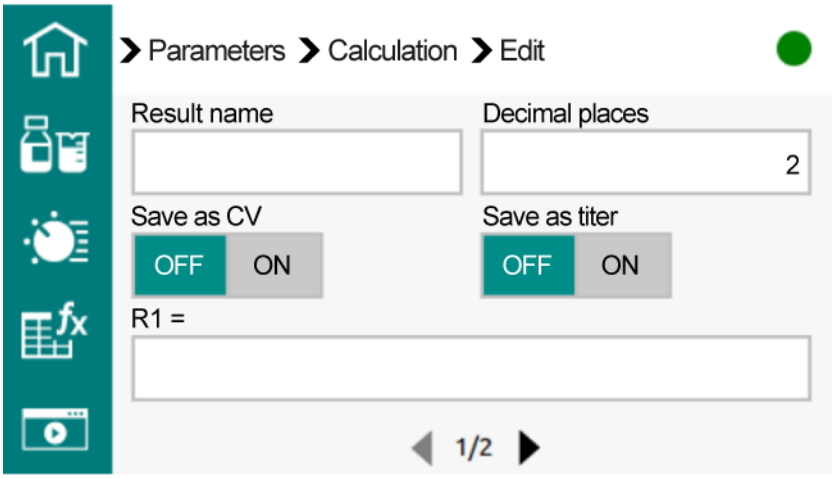
The result name is specified in the list for each calculation.

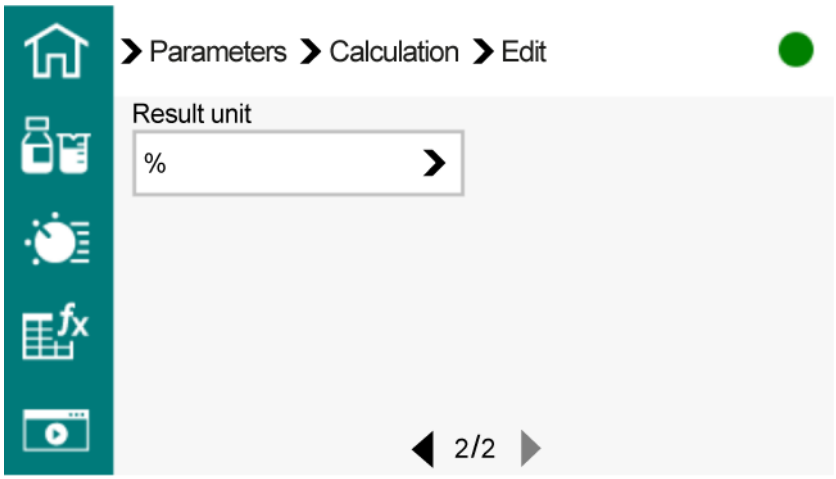
Scroll down for result R5.

Editing a calculation

1 Select a calculation in the result list.

2 Click on ✎.





3 Make the desired changes.

Result name

The result name is the text that will be shown in the result view and in the report.

Input: max. 12 characters

Default value: empty

Decimal places

Number of decimal places used to display the result.

Input range	**0** to **5**
Default value	**2**

Save as CV

The calculated result can be saved as a method-independent variable, called a common variable. The result is then also available in other methods for calculations. If statistics has been switched on, then the current mean value of the determination series will be saved.

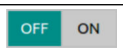
Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Save as titer

The result can be saved as titer for the selected solution (the solution must be selected). If statistics has been switched on, then the current mean value of the determination series will be saved.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

R1=... - R5=...

Shows the calculation formula. The formula editor is opened for the definition.

Result unit

The result unit is displayed and saved along with the result.

Selection:

- **%**
- **mol/L**
- **mmol/L**
- **g/L**
- **mg/L**
- **mg/mL**
- **ppm**
- **g**
- **mg**
- **mL**
- **mg/piece**
- **°C**
- **µL**
- **mL/min**
- **User-defined**

Default value: **%**

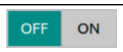
6.12.3.7 Statistics

Parameters ▶ Statistics

The statistics calculation of a multiple determination is activated under **[Statistics]** and definition is made as to how many determinations the series contains.

Statistics

If the switch is set to **ON**, statistics calculations will be carried out for all of the defined results.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Number of samples

The number of determinations that are carried out for the statistics calculations.

Input range	**2** to **20**
Default value	**3**

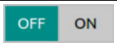
6.12.3.8 Reports

Parameters ▶ Reports

The reports that will be printed out automatically or saved as a PDF report after a determination are defined under **[Reports]**.

Results

The result report contains the calculated results, equivalence points, endpoints, sample data, etc.

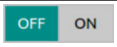
Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Curve

The report is shown as a curve.

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Calculation/statistics

Output of the calculation formulas for the individual results. Results are specified with full accuracy. This makes checking with an external program possible.

If the switch under **Parameters ▶ Statistics** is set to **ON**, the following data will be printed out as well:

- Result and sample size of the individual determinations
- Mean value as well as absolute and relative standard deviation

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Measuring point list

Output of the measuring point list.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

Parameters

All of the parameters of the current method are shown in the parameter report.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

The printer for the report data above is defined under **Start page** ▶ **System** ▶ **External devices** ▶ **Printer**.

- If a connected printer is selected, then the report contains the data defined by the switches above.
- If **[PDF]** is selected as printer and at least one switch is set to ON, then the report contains the complete data except for the measuring point list. The measuring points are only printed if the switch **measuring point list** is set to ON.

PC/LIMS

The PC/LIMS report is a machine-readable report with all of the important data for a determination. This report can be saved as a TXT file on a USB flash drive or sent to a LIMS via an RS-232 interface. The output location is defined under **Start page** ▶ **System** ▶ **External devices** ▶ **PC/LIMS report**.

The file name of the TXT file has the following structure:

PC_LIMS_Report_ID1_YYYYMMDD-hhmmss.txt

Switch: OFF ON

- **OFF**
- **ON**

Default value: **OFF**

6.12.4 pH calibration (CAL)

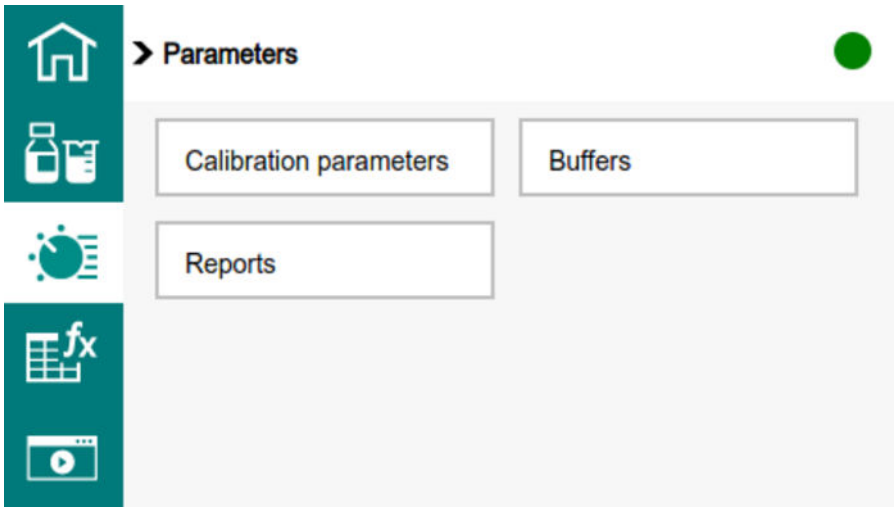


Figure 59 CAL parameters – Menu

6.12.4.1 Calibration parameters

Parameters ▶ Calibration parameters

The parameters that are carried out at the start of calibration are defined under **[Calibration parameters]**.

Signal drift

Maximum permissible drift for the measured value acceptance, i.e. maximum change of the measured value per minute.

Input range	**0.1** to **999.0 mV/min**
Default value	**2.0 mV/min**

Additional selection: **Off**: Measured value acceptance will take place after the maximum waiting time has elapsed. This can be useful when the electrode is slow to respond.

Temperature

Calibration temperature. If a temperature sensor is connected, the calibration temperature is automatically applied. The calibration temperature can also be entered manually.

The calibration temperature allows for the temperature compensation during a determination. If a temperature sensor is connected, this happens automatically. If there is no temperature sensor, the temperature can be

entered manually as a method parameter. The calibration temperature is necessary for selecting the corresponding pH value of the buffer.

Input range	**–20.0** to **150.0 °C**
Default value	**25.0 °C**

Min. waiting time

The measured value is not accepted until the minimum waiting time has elapsed, even if the signal drift has already been reached. The minimum waiting time is only important for drift-controlled measurements.

Input range	**0** to **999,999 s**
Default value	**10 s**

Max. Waiting time

If the signal drift has been switched off or has not yet been reached, then the measured value will be accepted once the maximum waiting time has elapsed.

Input range	**0** to **999,999 s**
Default value	**110 s**

Sensor

Open the selection list ❯ and select a sensor.

Only sensors of the pH electrode type can be selected.

Stirrer

If this parameter is activated, then the stirrer is switched on at the start of the determination.

Switch: OFF ON

- **OFF**
- **ON**

Default value: **ON**

Stirring rate

Setting the stirring rate. The stirring direction is always clockwise.

Conversion: Value × 120±5 rpm = stirring rate in rpm

e.g.: 8 × 120±5 rpm = 960±40 rpm

Input range	**1** to **15**
Default value	**8**

6.12.4.2 Buffers

Parameters ▶ Buffers

The statistics calculation of a multiple determination is activated under **[Buffers]** and definition is made as to how many determinations the series contains.

Buffer type

Selection of a predefined buffer series or definition of special buffers. In the case of predefined buffer series, the instrument automatically recognizes which buffer is involved.

Selection:

- **Baker**
- **Beckmann**
- **DIN**
- **Fisher**
- **Fluka Basel**
- **Hamilton**
- **Merck CertiPUR**
- **Merck Titrisol**
- **Metrohm**
- **Mettler**
- **NIST**
- **Precisa**
- **Radiometer**
- **Special**

Default value: **Metrohm**

Merck CertiPUR:
Reference temperature = 25 °C.
When using Merck CertiPUR buffers with a reference temperature of 20 °C, the buffer type **Merck Titrisol** must be selected.

Special:
Up to 5 calibration buffers can be defined in the method. The buffers are then **not** recognized automatically.
Enter the buffers exactly in the specified sequence.

Number of buffers

Number of buffers that are used for calibration.

If calibration is accomplished with more than two buffers, then certain buffers can be used repeatedly in order to give them more statistical weight. The first two buffers must, however, always be different from one another.

Selection:

- **1**
- **2**
- **3**
- **4**
- **5**

Default value: **2**

Buffer 1 pH

This parameter is only available if the buffer type is set to **Special**.

Input range	**–20.000** to **20.000**
Default value	**7.000**

Buffer 2 pH

This parameter is only available if the buffer type is set to **Special**.

Input range **–20.000** to **20.000**
Additional selection: **Off**

Default value: **4.000**

Buffer 3 pH

This parameter is only available if the buffer type is set to **Special**.

Input range **–20.000** to **20.000**
Additional selection: **Off**

Default value: **Off**

Buffer 4 pH

See buffer 3 pH

Buffer 5 pH

See buffer 3 pH

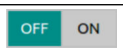
6.12.4.3 Reports

Parameters ► Reports

The reports that will be printed out automatically or saved as a PDF report after a determination are defined under **[Reports]**.

Results

The result report contains the specifications for the calibration (slope, pH(0), etc.).

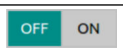
Switch: 

- **OFF**
- **ON**

Default value: **OFF**

Parameters

All of the parameters of the current method are shown in the parameter report.

Switch: 

- **OFF**
- **ON**

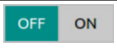
Default value: **OFF**

PC/LIMS

The PC/LIMS report is a machine-readable report with all of the important data for a determination. This report can be saved as a TXT file on a USB flash drive or sent to a LIMS via an RS-232 interface. The output location is defined under **System** ▶ **External devices**.

The file name of the TXT file has the following structure:

PC_LIMS_Report_ID1_YYYYMMDD-hhmmss.txt

Switch: 

- **OFF**
- **ON**

Default value: **OFF**

7 Maintenance

Perform maintenance work on the product at regular intervals to prevent functional disruptions and to ensure a long service life.

- Metrohm recommends having the products maintained by the regional Metrohm service representative as part of an annual service. Shorter maintenance intervals may be necessary if you frequently work with caustic and corrosive chemicals.
- Only perform maintenance work that is described in this instruction. Contact your regional Metrohm service representative for further maintenance work and repairs. The regional Metrohm service representative offers every form of technical advice for maintenance and service of all Metrohm products.
- Only use spare parts that meet the technical requirements of the manufacturer. Original spare parts always meet these requirements.

7.1 Performing maintenance on the cylinder unit

In the **Manual control** ▶ **Exchange cylinder unit** function, the drive moves the push rod into the exchange position.

NOTICE

Material damage caused by incorrect handling of the cylinder unit

The cylinder unit is blocked or damaged in some other way and must be replaced.

- Follow strictly the instructions for assembly, disassembly, and maintenance of the cylinder unit.
- Use only the tools specified.

NOTICE

Material damage from aggressive chemical hazardous substances

If the product comes into contact with aggressive chemical substances, this can lead to malfunctions or the product may be damaged and must be replaced.

- Clean up spilled liquids and solids immediately.
- Use protective grounding when working with highly flammable chemical substances and gases.
- If you suspect that chemical substances have penetrated the product, disconnect the product from the energy supply immediately. Then notify the regional Metrohm service representative.

Disassembling the cylinder unit

Prerequisite:

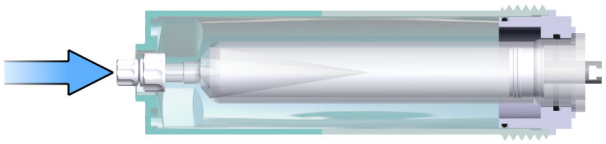
- The cylinder unit has been disassembled: *(see "Emptying and removing the cylinder unit", page 47)*

Required accessories:

- 6.1546.040 piston tool

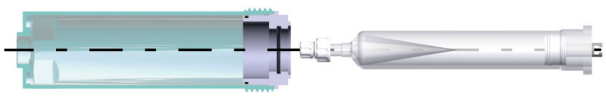
It is normally not necessary to remove the mounting ring out of the light protection or the screw nipple on the cylinder for cleaning. The parts can be cleaned while still in their pre-mounted state.

1



Push the cylinder out of the light protection from above.

2



Remove the cylinder from the light protection. Empty the remaining liquid from the cylinder.

3

Carefully lift the piston out of the cylinder. Use the 6.1546.040 piston tool to accomplish this.

The individual parts can now be cleaned and checked.

Cleaning the disassembled cylinder unit

Prerequisite:

- The cylinder unit has been taken apart.

Required accessories:

- Deionized water
- Dishwashing detergent

1 Clean the single parts of the cylinder unit with deionized water.

2 In the event of severe contamination, place the single parts in warm water with a little dishwashing detergent and then rinse off with deionized water.

3 Check the single parts of the cylinder unit (cylinder, piston, sealing lips, and piston rod) for the following defects:

- Are rough areas or scratches visible on the cylinder?
- Are scratches visible on the piston surface?
- Is any unevenness visible on the sealing lips of the piston?

If any of these defects is visible, replace the entire cylinder unit.

Assembling the cylinder unit

Prerequisite:

- The cylinder unit has been taken apart.
- The single parts of the cylinder unit have been cleaned and checked.
- The single parts of the cylinder unit show no defects.

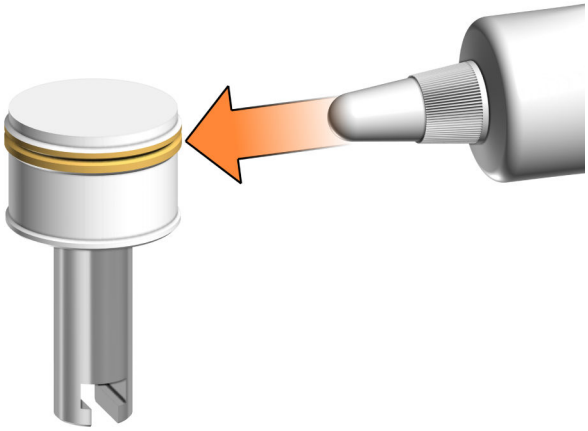
Required accessories:

- 6.2803.010 paraffin grease

- Lint-free cloth

1 **Greasing the piston**

- Grease the piston.



- Using your finger, carefully apply a trace of paraffin grease (6.2803.010) to the exterior of the sealing lips (orange marking) of the piston.
- Wipe off excess grease with the lint-free cloth.

The tip of the piston (area above the sealing lips) must be **free of grease**.

2 Carefully slide the piston far enough into the cylinder that the piston rod still protrudes out of it by approximately 6 mm.

3 Push the cylinder far enough into the light protection so that its flange is securely up against the mounting ring (gray plastic ring).

The cylinder unit can now be mounted: *(see "Mounting the cylinder unit", page 48)*

7.2 Cleaning the product surface

Regularly clean the product to prevent malfunctions and to ensure a long service life.

- Remove spilled chemicals immediately.
- Protect plug connections against contamination.

WARNING

Chemical hazardous substances

Contact with aggressive chemical substances may cause poisoning or chemical burns.

- Wear personal protective equipment (e.g. protective glasses, gloves).
- Use exhaust equipment when working with vaporizing hazardous substances.
- Clean contaminated surfaces.
- Only use detergents that do not cause any unwanted side reactions with the materials to be cleaned.
- Dispose of chemically contaminated materials (e.g. cleaning material) in accordance with regulations.

WARNING

Health hazards from electrical potential.

Severe injuries with possibly fatal consequences.

- Operate the product only if it is in perfect condition. The housing must also be intact.
- Only use the product with the covers fitted.
- Protect live components (e.g. power supply unit, power cord, connection sockets) against moisture.
- Always have maintenance work and repairs on electrical components carried out by a regional Metrohm service representative.

Prerequisite:

- The product is switched off and disconnected from the energy supply.

Required accessories:

- Cleaning cloth (soft, lint-free)
- Water or ethanol

1 Clean the surface with a damp cloth. Remove persistent contamination with ethanol.

2 Wipe the surface with a dry cloth.

3 Clean the connectors with a dry cloth.

8 Troubleshooting

Messages on malfunctions and errors are displayed in the control software or in the embedded software (e.g. on the display of an instrument) and contain the following information:

- Descriptions of causes of malfunctions (e.g. jammed drive)
- Descriptions of problems with the control (e.g. missing or invalid parameter)
- Information on how to solve the problem

System components with status display elements also indicate malfunctions and errors with a red flashing LED.

Troubleshooting on the product is often only possible with the control software or the embedded software (e.g. initializing, moving to a defined position).

See also

Signals (chapter 3.4, page 16)

8.1 Resetting the system

In very rare instances, a faulty file system (e.g. because of a program crash) may lead to an impairment of program functioning. The internal file system must be initialized in such cases.

If the system is reset, all user data (methods, solutions, etc.) will be deleted. The instrument will be reset to factory settings. The password for the **Expert** dialog type is then: **METROHM9100**

Metrohm recommends creating a backup of the system at regular intervals in order to avoid data losses.

The program version does not change when resetting the system.

Resetting the system

Prerequisite:

- The instrument is switched off.

1 Resetting the system

- Switch on the instrument.
- Wait until the following text is displayed in the bottom line of the screen: **Initialization, please wait...**

- Press the 3 keys simultaneously and hold them down for approx. 4 s.

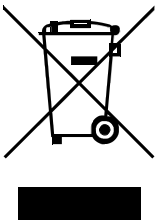
The **Factory reset** warning appears: All information (including saved methods, determination results, etc.) is deleted. Do you want to continue?

2 Confirming the reset

Confirm the warning with **[Continue]**.

The device deletes the user data and restarts.

9 Disposal



Properly dispose of chemicals and of the product to reduce negative effects on the environment and public health. Local authorities, waste disposal companies or dealers provide more detailed information on disposal. Observe the WEEE EU directive (WEEE = Waste Electrical and Electronic Equipment) for the proper disposal of waste electronic equipment within the European Union.

10 Technical specifications

10.1 Ambient conditions

Nominal function range	+5 to +45 °C	at max. 80% relative humidity, non-condensing
Storage	+5 to +45 °C	at max. 80% relative humidity, non-condensing
Altitude / Pressure range	max. 2,000 m. above sea level / min. 780 mbar	
Overvoltage category	II	
Pollution degree	2	

10.2 Energy supply

External power supply unit

Inlet

Nominal voltage range	100–240 V AC	±10%
Frequency range	50–60 Hz	
Current	max. 1.5 A	

Outlet

Nominal voltage	24 V DC
Current	max. 2.7 A
Power output	65 W

Instrument

Inlet

Nominal voltage	24 V DC

Power consumption	max. 65 W	
Outlet		
Nominal voltage	24 V DC	
Power output	max. 45 W	

USB connector

Nominal voltage	5 V	
Current at the power supply unit	500 mA	max. output current per channel

Protection

Internal fuse	1.5 A	cannot be replaced by the user

10.3 Measurements and weight

Measurements

Width	286 mm	
Height		
without cylinder unit	220 mm	
with cylinder unit	358 mm	
with support rod	508 mm	
Depth	286 mm	

Weight	3.6 kg	without accessories and power supply unit

10.4 Housing

Materials

Cover	PP	20% filled with talc
Back panel	1.4301	stainless steel
Base	PP	20% filled with talc
Front foils	PET	EBA 180, anti-glare

IP degree of protection IP 21

10.5 Connectors specifications

Power IN

Socket	round plug 4-pin

Power OUT

Socket	round plug 4-pin

Remote

Socket	D-Sub	9-pin

Ethernet

Type	CAT 6	
Socket	RJ-45	
Cable type	min. FFTP	shielded
Cable length	max. 10 m	*from Metrohm accessories*

USB

Type	2.0	
Socket	type A	
Cable type	shielded	

Cable length	max. 5 m	*from Metrohm accessories*

Measuring inputs

Ind		
Socket	type F	measuring input for potentiometric electrodes
Temp		
Socket	2 × 2 mm	measuring input for temperature sensors of the Pt1000 or NTC type for automatic temperature compensation
Pol		
Socket	type F	measuring input for polarizable electrodes
Ref		
Socket	4 mm	reference potential

10.6 Display specifications

Display

Type	LCD	VGA color display
Size	approx. 4.3"	diagonal
Resolution	480 × 272	pixels

Status display	LED	green

10.7 Operation specifications

Touch screen

Type	resistive

Resistance to chemicals	Ethanol
	Methanol
	Water

Keys	5 keys

10.8 Measurement specifications

Potentiometric

Measuring range	–2,000 to +2,000 mV	
Resolution	0.1 mV	
Measuring accuracy	±0.5 mV	in the measuring range –2,000 mV to +2,000 mV
Input resistance	≥ $1 \cdot 10^{12}$ Ω	
Offset current	≤ ±$1 \cdot 10^{-12}$ A	

Temperature

Pt1000		
Measuring range	–150 to +250 °C	
Measuring resolution	0.1 °C	
Measuring accuracy	±0.4 °C	in the measuring range –20.0 °C to +150.0 °C
NTC 30 kOhm		
Measuring range	–5 to +250 °C	
Measuring resolution	0.1 °C	
Measuring accuracy	±0.6 °C	in the measuring range +10.0 °C to +40.0 °C

Polarizer

Ipol DC

Polarization current	1, 20, 50, 100 µA	can be selected
Measuring range	0–3,500 mV	
Measuring resolution	0.1 mV	

Reference conditions

Instrument status	min. 30 minutes in operation
Adjusting interval	annual

Measuring accuracy applies to all measuring ranges without sensor error, under reference conditions, measuring interval 100 ms, room temperature +25 °C (± 3 °C), relative humidity ≤ 60%

10.9 Stirrer specifications

Version	magnetic	
Rotational speed range	+1 to +15	120–1,800 rpm
Rotational speed change per step	115–125 rpm	
Maximum rotational speed	1,700–1,900 rpm	

Lengths of stirring bar

The stirrer is designed for stirring bars in the following lengths:

- 8 mm
- 12 mm
- 16 mm
- 25 mm
- 30 mm

10.10 Liquid handling specifications

Cylinder unit

Cylinder volume	5, 10, 20, 50 mL	

Dosing drive

Dosing resolution	20,000	steps per cylinder volume
Dosing accuracy	according to ISO/DIN 8655-3	

Tubing

Tubing nipple outer thread	M6	
Inner diameter	2 mm	
Material	FEP	fluorinated ethylene propylene