

870 KF Titrino plus



Manual

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Manual

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Table of contents

1	Introduction	1
1.1	Instrument description	1
1.1.1	Titration and measuring modes	1
1.1.2	Connectors	1
1.1.3	Intended use	1
1.2	About the documentation	2
1.2.1	Symbols and conventions	2
1.3	Safety instructions	3
1.3.1	General notes on safety	3
1.3.2	Electrical safety	3
1.3.3	Tubing and capillary connections	4
1.3.4	Flammable solvents and chemicals	4
1.3.5	Recycling and disposal	4
2	Overview of the instrument	6
3	Water determination according to Karl Fischer (KFT)	8
4	Installation	9
4.1	Setting up the instrument	9
4.1.1	Packaging	9
4.1.2	Checks	9
4.1.3	Location	9
4.2	Connecting a sensor	9
4.3	Connecting a stirrer	10
4.4	Connecting a balance	11
4.5	Connecting a keyboard, printer and other USB devices	11
4.6	Connecting instruments to the remote connector	14
4.7	Attaching the exchange unit	15
4.8	Connecting the instrument to the power grid	16
5	Operation	17
5.1	Switching the instrument on and off	17
5.2	Fundamentals of operation	18
5.2.1	The keypad	18
5.2.2	Structure of the dialog windows	18
5.2.3	Navigating in the dialog	19
5.2.4	Entering text and numbers	19
5.2.5	Selecting from a selection list	20



5.3	Methods	21
5.3.1	Method templates	21
5.3.2	Loading a method	21
5.3.3	Saving a method	22
5.3.4	Exporting a method	22
5.4	Sample data	23
5.4.1	Entering sample data in the main dialog	23
5.4.2	Requesting sample data at the start of the determination	24
5.5	Carrying out a determination	25
5.6	Live modifications	28
5.6.1	Editing the sample data of the running determination	28
5.6.2	Editing the live parameters	29
5.7	Results	30
5.8	Statistics	31
5.9	Printing a report manually	32
5.10	Manual control	34
5.10.1	Dosing	34
5.10.2	Stirring	38
6	System settings	40
6.1	Basic settings	40
6.2	Managing solutions	43
6.2.1	General	43
6.2.2	Editing the solution data	44
6.3	File management	45
6.4	Configuring external devices	47
6.5	Instrument diagnosis	50
6.5.1	Loading program versions and language files	50
6.5.2	Diagnosis functions	51
7	Parameters	52
7.1	Karl Fischer titrations (KFT)	52
7.1.1	Conditioning	52
7.1.2	Start conditions	53
7.1.3	Control parameters	54
7.1.4	Titration parameters	57
7.1.5	Stop conditions	59
7.1.6	Calculation - Methods "Blank Ipol/Upol"	60
7.1.7	Calculation - Methods "Titer Ipol/Upol"	61
7.1.8	Calculation - Methods "KFT Ipol/Upol", "KFT Ipol/Upol- Blank"	62
7.1.9	Statistics	64
7.1.10	Reports	64

8	Troubleshooting	66
8.1	Karl Fischer titration	66
8.2	Miscellaneous	67
9	Appendix	69
9.1	Exchange unit	69
9.1.1	Maximum dosing and filling rate	69
9.1.2	Parameters for the preparing (PREP)	69
9.2	Stirring rate	70
9.3	Balance	70
9.4	USB devices	71
9.4.1	6.2147.000 numerical USB keypad	71
9.4.2	Key assignment of a USB keyboard	72
9.4.3	PC mouse	73
9.4.4	Printer	73
9.5	System initialization	73
9.6	Remote interface	75
9.6.1	Pin assignment of the remote interface	75
9.6.2	Status diagram of the remote interface	76
9.7	Remote control via an RS-232 connection	76
9.7.1	Commands and variables	77
9.8	Arithmetic algorithms in the 870 KF Titrino plus	79
10	Technical specifications	82
10.1	Measuring inputs	82
10.1.1	Polarizer	82
10.2	Dosing drive	83
10.3	Interfaces	83
10.4	Power connection	83
10.5	Ambient temperature	83
10.6	Reference conditions	84
10.7	Dimensions	84
11	Accessories	85
	Index	86



Table of figures

Figure 1	Front 870 KF Titrino plus	6
Figure 2	Rear 870 KF Titrino plus	7
Figure 3	Reagent dosing for KFT	8
Figure 4	Connecting a polarizable electrode	9
Figure 5	Connecting a stirrer	10
Figure 6	Connecting a balance	11
Figure 7	Connecting USB devices	12
Figure 8	Connecting the USB stick	13
Figure 9	Connecting the 6.2147.000 USB keyboard with USB stick and printer	13
Figure 10	Connecting the USB hub with USB stick, printer and the 6.2148.030 RS-232/USB Box (for connecting balances).	14
Figure 11	Connecting a remote cable	14
Figure 12	Attaching the exchange unit	15
Figure 13	Keypad 870 KF Titrino plus	18
Figure 14	Directory structure on the USB flash drive	46
Figure 15	Rotational speed depending on the stirring rate	70
Figure 16	Pin assignment of remote socket and remote plug	75
Figure 17	Remote status diagram	76
Figure 18	Connecting the RS-232/USB Box to the PC	77

1 Introduction

1.1 Instrument description

The 870 KF Titrino plus is an instrument used for volumetric water content determination according to Karl Fischer. There are method templates available which are already configured except for a few parameters. If parameters are changed, then these will be saved automatically. The methods can be exported to a connected USB flash drive. This function allows you to copy methods quickly and easily from one device to another.

1.1.1 Titration and measuring modes

The following titration and measuring modes are supported:

- **KFT**
Volumetric water content determination according to Karl Fischer.
Measuring modes:
 - **Ip_{ol}** (voltametric measurement with selectable polarization current)
 - **Up_{ol}** (amperometric measurement with selectable polarization voltage)

1.1.2 Connectors

The instrument is equipped with the following connectors:

- **MSB connector (Metrohm Serial Bus)**
For connecting a stirrer.
- **USB (OTG) connector**
The 6.2151.100 adapter can be used to connect, for example, a printer, a USB flash drive or a USB keyboard.
- **Electrode connector**
For connecting polarizable electrodes.
- **Remote connector**
For connecting instruments with a remote interface.

1.1.3 Intended use

The 870 KF Titrino plus is designed for usage as a titrator in analytical laboratories. Its main application field is volumetric titration.

This instrument is suitable for processing chemicals and flammable samples. Therefore, the use of the 870 KF Titrino plus requires the user to have basic knowledge and experience in handling toxic and caustic substances. Knowledge with respect to the application of the fire prevention measures prescribed for laboratories is also mandatory.



1.2 About the documentation



CAUTION

Please read through this documentation carefully before putting the instrument into operation. The documentation contains information and warnings which the user must follow in order to ensure safe operation of the instrument.

1.2.1 Symbols and conventions

The following symbols and formatting may appear in this documentation:

(5-12)

Cross-reference to figure legend

The first number refers to the figure number, the second to the instrument part in the figure.

1

Instruction step

Carry out these steps in the sequence shown.

Method

Dialog text, parameter in the software

File ▶ New

Menu or menu item

[Next]

Button or **key**



WARNING

This symbol draws attention to a possible life-threatening hazard or risk of injury.



WARNING

This symbol draws attention to a possible hazard due to electrical current.



WARNING

This symbol draws attention to a possible hazard due to heat or hot instrument parts.



WARNING

This symbol draws attention to a possible biological hazard.



CAUTION

This symbol draws attention to possible damage to instruments or instrument parts.

**NOTE**

This symbol highlights additional information and tips.

1.3 Safety instructions

1.3.1 General notes on safety

**WARNING**

Operate this instrument only according to the information contained in this documentation.

This instrument left the factory in a flawless state in terms of technical safety. To maintain this state and ensure non-hazardous operation of the instrument, the following instructions must be observed carefully.

1.3.2 Electrical safety

The electrical safety when working with the instrument is ensured as part of the international standard IEC 61010.

**WARNING**

Only personnel qualified by Metrohm are authorized to carry out service work on electronic components.

**WARNING**

Never open the housing of the instrument. The instrument could be damaged by this. There is also a risk of serious injury if live components are touched.

There are no parts inside the housing which can be serviced or replaced by the user.

Supply voltage

**WARNING**

An incorrect supply voltage can damage the instrument.

Only operate this instrument with a supply voltage specified for it (see rear panel of the instrument).



Protection against electrostatic charges



WARNING

Electronic components are sensitive to electrostatic charges and can be destroyed by discharges.

Do not fail to pull the power cord out of the power socket before you set up or disconnect electrical plug connections at the rear of the instrument.

1.3.3 Tubing and capillary connections



CAUTION

Leaks in tubing and capillary connections are a safety risk. Tighten all connections well by hand. Avoid applying excessive force to tubing connections. Damaged tubing ends lead to leakage. Appropriate tools can be used to loosen connections.

Check the connections regularly for leakage. If the instrument is used mainly in unattended operation, then weekly inspections are mandatory.

1.3.4 Flammable solvents and chemicals

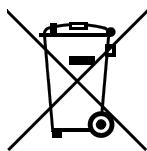


WARNING

All relevant safety measures are to be observed when working with flammable solvents and chemicals.

- Set up the instrument in a well-ventilated location (e.g. fume cupboard).
- Keep all sources of flame far from the workplace.
- Clean up spilled liquids and solids immediately.
- Follow the safety instructions of the chemical manufacturer.

1.3.5 Recycling and disposal



This product is covered by European Directive 2012/19/EU, WEEE – Waste Electrical and Electronic Equipment.

The correct disposal of your old instrument will help to prevent negative effects on the environment and public health.



More details about the disposal of your old instrument can be obtained from your local authorities, from waste disposal companies or from your local dealer.



2 Overview of the instrument

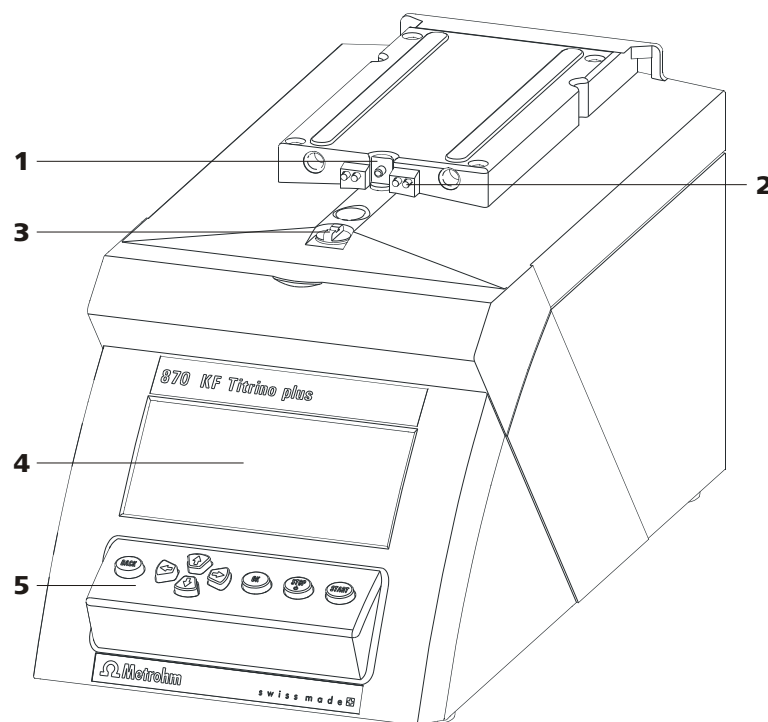


Figure 1 Front 870 KF Titrino plus

<p>1 Piston rod Of the dosing drive.</p>	<p>2 Contact pins For the data chip.</p>
<p>3 Coupling For switching the flat stopcock.</p>	<p>4 Display</p>
<p>5 Keypad</p>	

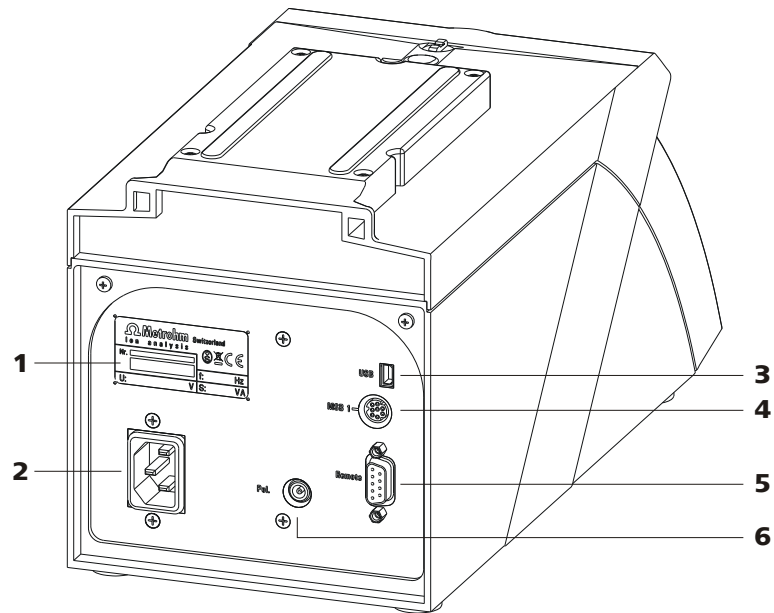


Figure 2 Rear 870 KF Titrino plus

<p>1 Type plate Contains specifications concerning mains voltage and serial number.</p>	<p>2 Mains connection socket</p>
<p>3 USB (OTG) connector For connecting printers, USB sticks, USB hubs, etc.</p>	<p>4 MSB connector Metrohm Serial Bus. For connecting a stirrer. Mini DIN, 9-pin.</p>
<p>5 Remote connector For connecting instruments with a remote interface. D-Sub, 9-pin.</p>	<p>6 Electrode connector (Pol.) For connecting polarizable electrodes, e.g. double Pt electrodes. Socket F.</p>

3 Water determination according to Karl Fischer (KFT)

Karl Fischer Titration is a method for volumetric water determination. Conditioning is carried out automatically both before and after the actual titration. The reagent dosing is controlled in such a way that a predefined endpoint is reached as quickly and as accurately as possible. The volume steps and the rate of reagent dosing are regulated by the difference between the current measured value and the predefined endpoint. This means that titration is performed more slowly in the control range and that smaller volumes are added. The titration is stopped at the endpoint either drift-controlled or after a waiting time. The volume dosed until the endpoint is used to calculate the water content of the sample.

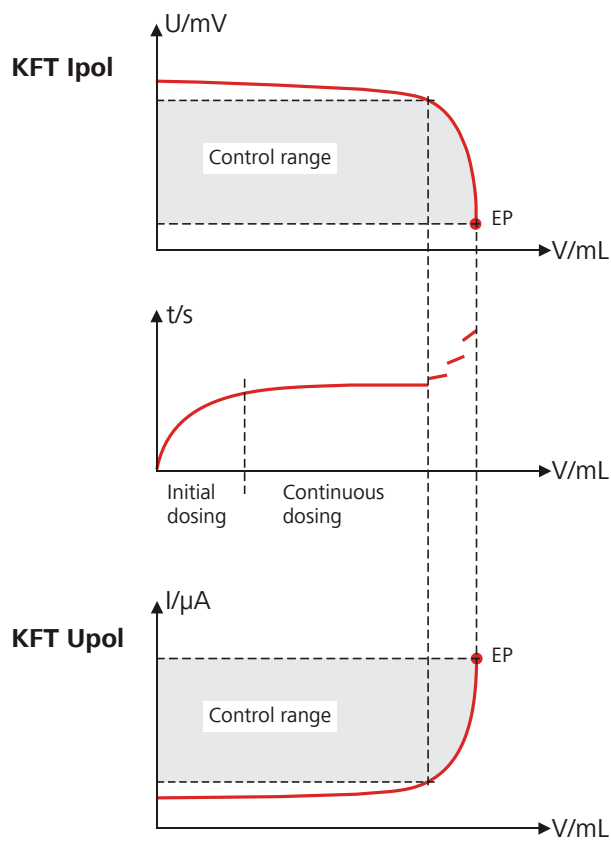


Figure 3 Reagent dosing for KFT

4 Installation

4.1 Setting up the instrument

4.1.1 Packaging

The instrument is supplied in protective packaging together with the separately packed accessories. Keep this packaging, as only this ensures safe transportation of the instrument.

4.1.2 Checks

Immediately after receipt, check whether the shipment has arrived complete and without damage by comparing it with the delivery note.

4.1.3 Location

The instrument has been developed for operation indoors and may not be used in explosive environments.

Place the instrument in a location of the laboratory which is suitable for operation and free of vibrations and which provides protection against corrosive atmosphere and contamination by chemicals.

The instrument should be protected against excessive temperature fluctuations and direct sunlight.

4.2 Connecting a sensor

Connecting a polarizable electrode

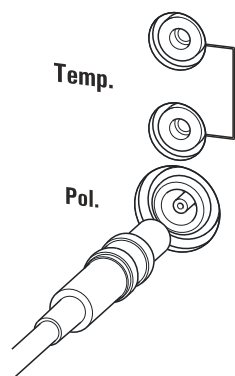


Figure 4 Connecting a polarizable electrode

**NOTICE**

The electrode cable is protected against accidental disconnection of the cable by means of a pull-out protection feature. If you wish to remove the plug, then you must first retract the outer plug sleeve.

4.3 Connecting a stirrer

You can connect the following stirrers:

- 801 Stirrer
- 803 Ti Stand
- 804 Ti Stand (requires rod stirrer)

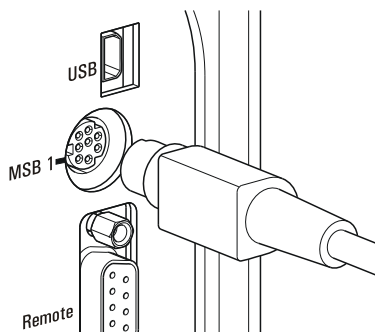


Figure 5 Connecting a stirrer

**CAUTION**

Make sure that the flat side of the plug matches the marking on the socket.

4.4 Connecting a balance

Balances are equipped with a serial RS-232 interface as a rule. To connect a balance, you require a 6.2148.030 RS-232/USB Box.

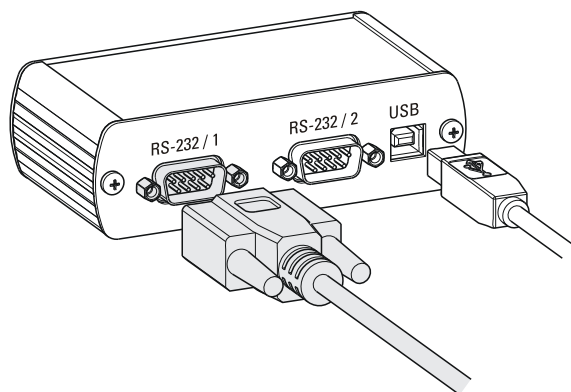


Figure 6 Connecting a balance

When a 6.2151.020 USB cable is used, then the 6.2148.030 RS-232/USB Box can be connected to the 870 KF Titrino plus by means of a USB hub or a 6.2151.100 adapter (see chapter 4.5, page 11).

Connect the 9-pin plug of the respective balance connecting cable to the **RS 232/1** connector. Consult the user manual of the balance in order to select the correct connecting cable.

The parameters for the RS-232 interface on the instrument must match those on the balance (see "Editing the COM1 settings", page 48). Additionally consult the user manual of the balance.

4.5 Connecting a keyboard, printer and other USB devices

The 870 KF Titrino plus has a USB (OTG) connector. Use the provided 6.2151.100 adapter USB MINI (OTG) - USB A for connecting USB devices as e.g. printers, keyboards or USB sticks, see the following figure.

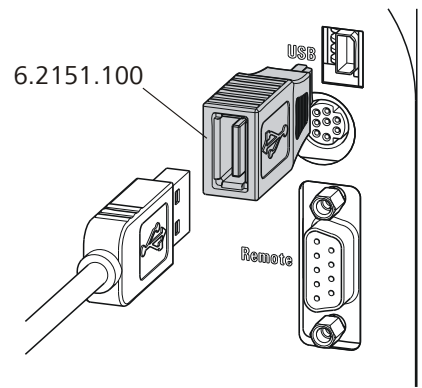


Figure 7 Connecting USB devices



CAUTION

Switch the instrument off before connecting or disconnecting a USB device or a USB stick.

The 870 KF Titrino plus can only recognize the device immediately after switching on.

The following devices can be operated **directly on the USB connector with the 6.2151.100 adapter**:

- USB sticks (for the backup or storing of methods)
- 6.2147.000 numerical USB keypad
- 6.2148.030 RS-232/USB Box (for connecting balances or for the RS-232 remote control)
- USB hub (with or without an own power supply)

The **6.2147.000 numerical USB keypad** serves for comfortable numerical input and for navigating in the dialog. In addition, it provides two USB connectors. Connect additional USB devices to the keypad.



NOTICE

Most of the USB devices need a so-called hub in order to work correctly.

A USB hub is a distributor to which several USB devices can be connected. USB hubs are available in specialty stores in a number of different models.

The USB (OTG) connector of the 870 KF Titrino plus has no such hub. The 6.2147.000 numerical USB keypad has a USB hub and two USB connectors.

The following devices can **only be connected to a 6.2147.000 numerical keypad or to a USB hub**:

- Printer (with USB connector, use the 6.2151.020 connecting cable)
- Barcode reader (with USB cable)
- Mouse (PC mouse with USB cable, for navigating in the dialog)

The following devices can **only be connected to a USB hub**:

- PC keyboard (with USB cable, for the comfortable input of letters and numbers)
- Keypad with numerical keypad (with USB cable)

If you wish to connect **several different instruments without own power supply**, then you must possibly use a USB hub with own power supply (*self powered*). The USB (OTG) connector of the 870 KF Titrino plus is not designed for supplying power to several devices with elevated electricity requirements.

Also observe the instructions in *chapter 9.4, page 71*.

Examples:

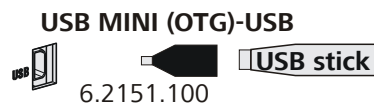


Figure 8 Connecting the USB stick

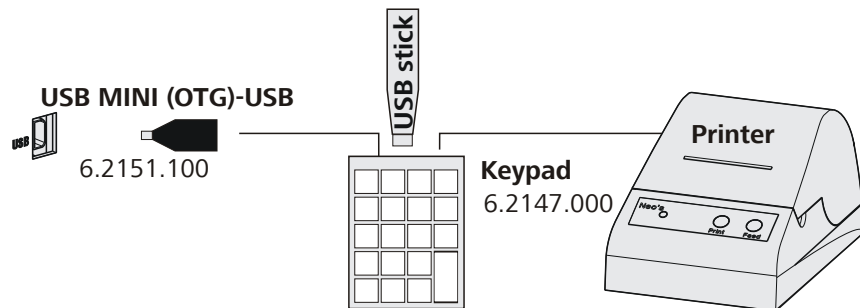


Figure 9 Connecting the 6.2147.000 USB keyboard with USB stick and printer

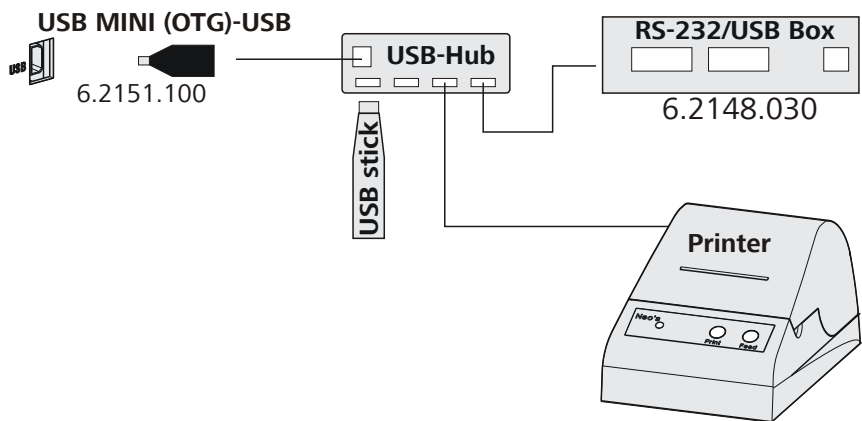


Figure 10 Connecting the USB hub with USB stick, printer and the 6.2148.030 RS-232/USB Box (for connecting balances).

4.6 Connecting instruments to the remote connector

The 870 KF Titrino plus can be integrated in an automation system with the aid of a remote cable.

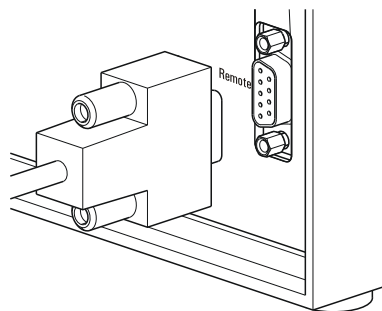


Figure 11 Connecting a remote cable

A variety of different connecting cables are available for connecting Metrohm instruments (e.g. sample changers) (see *Optional Accessories chapter*).

4.7 Attaching the exchange unit

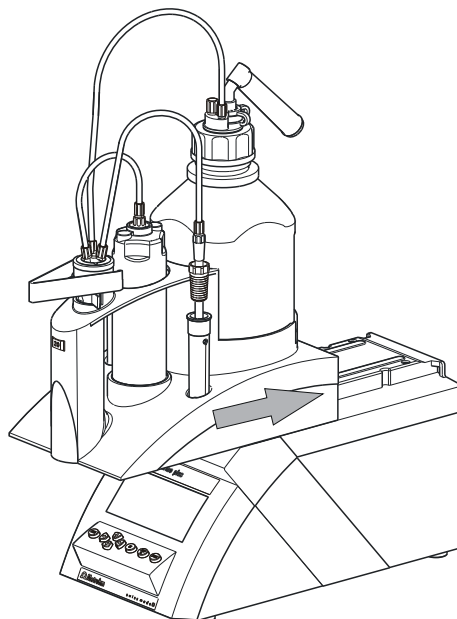


Figure 12 Attaching the exchange unit

To attach the exchange unit, proceed as follows:

- 1 Slide the exchange unit from the front onto the 870 KF Titrino plus and push all the way to the rear.

It must snap in audibly.



4.8 Connecting the instrument to the power grid



WARNING

Electric shock from electrical potential

Risk of injury by touching live components or through moisture on live parts.

- Never open the housing of the instrument while the power cord is still connected.
- Protect live parts (e.g. power supply unit, power cord, connection sockets) against moisture.
- Unplug the power plug immediately if you suspect that moisture has gotten inside the instrument.
- Only personnel who have been issued Metrohm qualifications may perform service and repair work on electrical and electronic parts.

Connecting the power cord

Accessories

Power cord with the following specifications:

- Length: max. 2 m
- Number of cores: 3, with protective conductor
- Instrument plug: IEC 60320 type C13
- Conductor cross-section 3x min. 0.75 mm² / 18 AWG
- Power plug:
 - according to customer requirement (6.2122.XX0)
 - min. 10 A



NOTICE

Do not use a not permitted power cord!

1 Plugging in the power cord

- Plug the power cord into the instrument's power socket.
- Connect the power cord to the power grid.

5 Operation

5.1 Switching the instrument on and off

Switching on the instrument

Proceed as follows:



1. Press the red **[STOP]** key.
The instrument is initialized and a system test performed. This process takes some time.
- If a buret unit has been attached, then a request appears to carry out the **PREP** function:

```

Buret unit                                010-126
-----
! The buret unit should be
  prepared.
◆ Execute a PREP function.
-----
OK
  
```

All tubings and the cylinder are rinsed with the **PREP** (Preparing) function. The preparing of the buret unit is described in chapter "Preparing the buret unit (PREP)", page 34.

- Confirm the message with **[OK]**.
The display of this message can be deactivated in the system settings (see "PREP warning", page 42).

The main dialog is displayed:

```

>Menu                                     ready
Method                                   KFT Ipol-Blank
ID1
ID2
Sample size                               1.0
Unit                                       9
  
```

Switching off the instrument

The instrument is switched off with the **[STOP]** key. The fact that the key needs to be pressed down for an extended time prevents accidental switch off.



Proceed as follows:

- 1 ■ Keep the red **[STOP]** key pressed down for at least 3 s.
A progress bar is displayed. If the key is released during this time, then the instrument will not be switched off.

5.2 Fundamentals of operation

5.2.1 The keypad

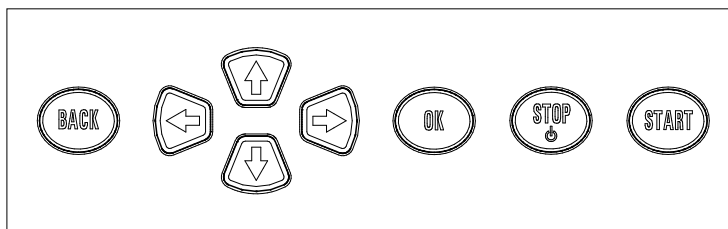
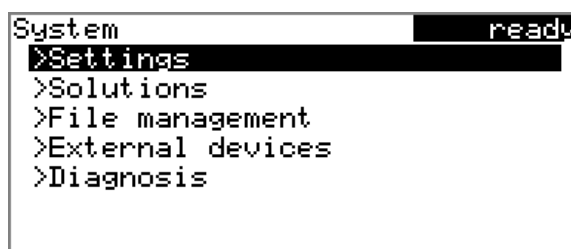


Figure 13 Keypad 870 KF Titrino plus

BACK	Apply the input and exit the dialog.
↑ ↓	Move the selection bar either up or down by one line at a time. Select the character to be entered in the text editor.
← →	Select the character to be entered in the text and number editor. Select the individual functions in the function bar.
OK	Confirm the selection.
STOP	Stop an ongoing method run or a manual function. Switch the instrument on or off.
START	Start a method run or a manual function.

5.2.2 Structure of the dialog windows



The current dialog title is displayed on the left-hand side of the title bar. The current status of the system is displayed in the upper right-hand corner:

ready The instrument is in normal status.

cond.busy	The working medium is being conditioned.
cond.ok	The working medium is conditioned.
busy	A method has been started.

Some dialogs have a so-called function bar on the bottom line. The functions contained therein can be selected with the arrow keys [←] or [→] and executed with [OK].

```
Solution list          ready
not defined          EU
Reagent 1           *IEU
Reagent 2           EU
Edit New Delete
```

5.2.3 Navigating in the dialog

The selection bar is displayed in inverted style. Use the arrow keys [↑] and [↓] to move the selection bar upward or downward one line at a time. If a dialog text is marked with "> ", then additional settings are available in a subordinate dialog. Use [OK] to access this dialog.

Example: System settings

```
System                ready
>Settings
>Solutions
>File management
>External devices
>Diagnosis
```

Use the [BACK] key to return to the next higher level.

5.2.4 Entering text and numbers

```
Name
[ ]
[ ]BCDEFGHIJKLMNOPQRSTUVWXYZ
[ ]abcdefghijklmnopqrstuvwxyz
[ ]0123456789,-p°! #&'()*+./
[ ]AAAÉfNöóUúäääåçéèëíîÏÖöøÙÚ
Accept Cancel Clear [+ -]
←-| |→
```

In the editing dialog for text input or numerical input, select the individual characters with the arrow keys. Use [OK] to apply the character in the input field. The following functions are available:



Editing function	Description
Accept	The modification is applied and the editing dialog is exited.
Cancel	The editing dialog is exited without applying the modification.
Clear	The content of the input field is deleted completely.
[←]	The character left of the cursor is deleted (back-space).
←	Text editor only The cursor within the input field is shifted to the left by one character each time that [OK] is pressed.
→	Text editor only The cursor within the input field is shifted to the right by one character each time that [OK] is pressed.
[BACK]	The modification is applied and the editing dialog is exited.

The **[BACK]** key has the same function as **Accept**.

A commercially available USB keyboard can be connected to make it easier to enter text and numbers. The assignment of the keys on the PC keyboard is described in *chapter 9.4.2, page 72*.

5.2.5 Selecting from a selection list

Unit
g
mg
µg
mL
µL
pieces
>User-defined

In a selection list, select the individual entries with the arrow keys [↑] and [↓]. Accept the selection with **[OK]** or **[BACK]**.

5.3 Methods

5.3.1 Method templates

The 870 KF Titrino plus contains method templates which are already configured except for a few parameters.

The following method templates can be selected:

KFT Ipol	Method with adjustable polarization current. The blank value is not taken into account for the calculation.
Titer Ipol	Titer determination with adjustable polarization current.
Blank Ipol	Blank value determination with adjustable polarization current.
KFT Ipol-Blank	Method with adjustable polarization current. The blank value is taken into account for the calculation.
KFT Upol	Method with adjustable polarization voltage. The blank value is not taken into account for the calculation.
Titer Upol	Titer determination with adjustable polarization voltage.
Blank Upol	Blank value determination with adjustable polarization voltage.
KFT Upol-Blank	Method with adjustable polarization voltage. The blank value is taken into account for the calculation.

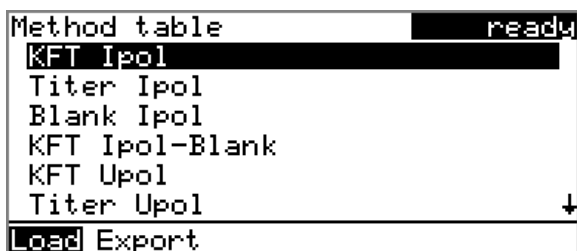
5.3.2 Loading a method

To load a method, proceed as follows:

1 Open the method table

- In the main dialog, select **Method** and press **[OK]**.

The method table with the stored templates opens:



2 Select a method

- Select the desired method.

3 Load the method

- In the function bar, select **Load** and press **[OK]**.

The method is now loaded and is displayed in the main dialog under **Method**.

5.3.3 Saving a method

If you change method parameters, they are saved automatically. It is not possible to save a method under a different name.

5.3.4 Exporting a method

The methods can be exported to a connected USB flash drive.



NOTICE

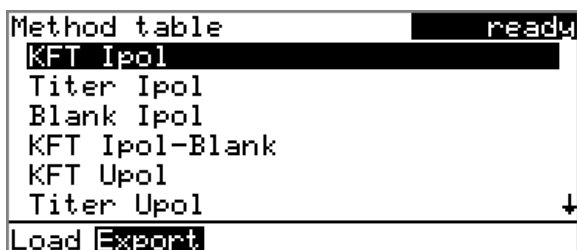
This function is possible only if a USB flash drive is connected as an external storage medium.

To export a method, proceed as follows:

1 Opening the method table

- In the main dialog, select **Method** and press **[OK]**.

The method table with the stored templates opens:



2 Selecting the method

- Select the desired method.

3 Exporting the method

- In the function bar, select **Export** and press **[OK]**.

The method is being exported. The directory structure on the USB flash drive is listed in *chapter 6.3, page 45*.

5.4 Sample data

You can enter the sample data (identification, sample size, etc.) in a variety of ways:

- Directly in the main dialog.
- Automatic request immediately after the start of the determination (*see chapter 5.4.2, page 24*).

You can also send the sample size and the unit from a connected balance in any case. With some balances, the sample identification and method can be also sent (*see chapter 9.3, page 70*).

5.4.1 Entering sample data in the main dialog

For a sample, you can enter the sample data directly in the main dialog, even while the determination is running (*see chapter 5.6, page 28*).

Menu		ready
Method	KFT Ipol-Blank	
ID1		
ID2		
Sample size	1.0	
Unit	g	

ID1

Sample identification.

Entry	max. 10 characters
Default value	empty

ID2

Sample identification.

Entry	max. 10 characters
Default value	empty



Sample size

Sample size.

Input range	–999999999 - 999999999
Default value	1.0

Unit

Unit of the sample size.

Selection	g mg µg mL µL pieces User-defined
Default value	g

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.

5.4.2 Requesting sample data at the start of the determination

The sample data can be 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 when you reweigh your samples.

```
KFT Ip01             hold
Sample size         1.0
Press [START] key to continue
```

The corresponding parameters must be activated under **Start conditions** for this purpose. If the parameter **Hold at request** is activated, then the run will be paused and must be continued with **[START]** after the input of the sample data. 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 **[START]**, even if the titration is already completed. This ensures that the sample data is available for calculations.

5.5 Carrying out a determination

The sample size can be entered in the following ways when a determination is carried out:

- Enter manually on the instrument.
- Send automatically from a connected balance. For this purpose, check the manual for the balance.

Proceed as follows to carry out a determination:

1 Loading the method

- See Chapter "Loading a method", Page 21.

2 Starting conditioning

- Press **[START]**.

Conditioning starts. **Conditioning not OK** is displayed until the endpoint is reached. The working medium is titrated to the endpoint. This is indicated by **Conditioning OK**. The status is kept stable.

```

KFT Ip01                                cond.ok
Conditioning OK
++Drift          1.7 µL/min
Stirrer
  
```

The stirring rate can be modified with the **Stirrer** function. The following dialog is opened by pressing **[OK]**:

```

Stirrer                                cond.ok
Stirrer  on  Rate  8
Off Stir- Stir+
  
```

The stirring rate can be reduced with **Stir-** and increased with **Stir+**. **Off** switches the stirrer off. **On** is now displayed instead. This can be used to switch the stirrer back on. This dialog is exited with **[BACK]**.



3 Adding sample



NOTICE

Calculate the amount of the sample in such a way that a titrant consumption of 10...90% of the cylinder volume will result.

- If **Conditioning OK** is displayed, press **[START]**.
Conditioning is stopped. The request for adding the sample will be displayed for 8 s.
The sample must be added during this time.

```

KFT Ipol                               busw
Add sample                               6 s
Stirrer
  
```

- Add the sample.

Afterward, the request for the sample size appears:

```

KFT Ipol                               hold
Sample size                             1.0
Press [START] key to continue
  
```

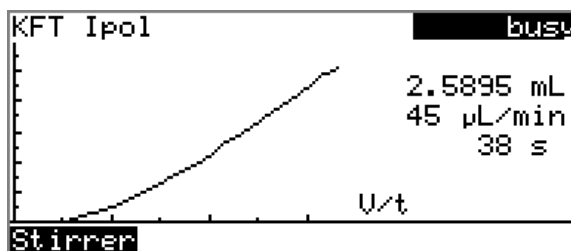
4 Entering the sample size

- Press **[OK]**.
The editing dialog opens.
- Enter the sample size and apply with **Accept** or **[BACK]**.

5 Starting the titration

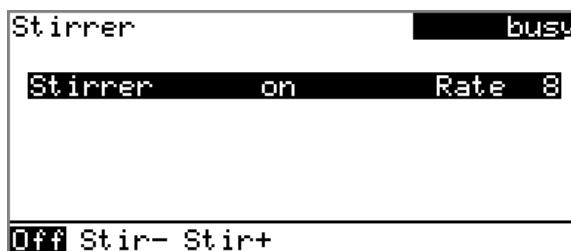
- Press **[START]**.

The titration starts and the curve is displayed:



The axes are scaled automatically.

The stirring rate can be modified during titration with the **Stirrer** function. The following dialog is opened by pressing **[OK]**:



The stirring rate can be reduced with **Stir-** and increased with **Stir+**. **Off** switches the stirrer off. **On** is now displayed instead. This can be used to switch the stirrer back on. This dialog is exited with **[BACK]**.

After the completion of the titration, the results dialog is displayed. Conditioning is restarted automatically.



6 Canceling the conditioning

- Press **[STOP]**.

Conditioning is canceled and the dosing cylinder is filled.

Canceling a determination manually

A determination can be canceled at any time with the **[STOP]** key.



5.6 Live modifications

5.6.1 Editing the sample data of the running determination

The sample data can be entered or modified in the main dialog while a determination is running. In calculations always the sample data entered at the end of the titration in the main dialog is used.

Proceed as follows to edit the sample data:

1 Displaying the main dialog

- Press [BACK].

The main dialog is displayed. The determination continues to run in the background.

2 Editing the sample data

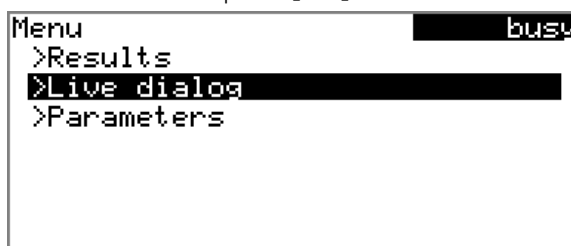
- Edit the sample data and apply with **Accept** or [BACK].

3 Displaying the live dialog

- Press [BACK].

or

- Select **Menu** and press [OK].



- Select the menu item **Live dialog** and press [OK].

The live dialog is displayed once again.



NOTICE

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.

Make sure that the editing dialogs are closed before the determination is finished.

5.6.2 Editing the live parameters

Certain method parameters can be edited while a determination is being carried out. The only parameters that can be modified are those that can be selected. Nevertheless, all of the parameters are visible. The modified parameters are taken into account at once. If you modify, for instance, the start conditions after the start volume has been dosed, then these modifications will not be taken into account until the next determination.

Proceed as follows to edit the parameters:

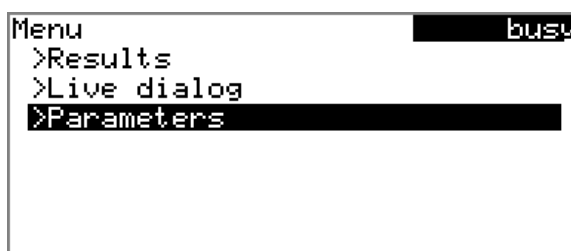
1 Displaying the main dialog

- Press **[BACK]**.

The main dialog is displayed. The determination continues to run in the background.

2 Opening the main menu

- Select **Menu** and press **[OK]**.



3 Editing the method parameters

- Select the menu item **Parameters** and press **[OK]**.
- Change the desired parameters accordingly.

4 Displaying the live dialog

- Select the menu item **Live dialog** in the main menu and press **[OK]**.

or

- Press **[BACK]** in the main dialog.

The live dialog is displayed once again.



5.7 Results

Menu ▶ Results

After the completion of the titration, the results dialog is displayed:

Results	cond.ok
Water	5.75 %
EP1	2.5975 mL
Regular stop	
Curve Recalc Statistics	

The calculated result and the endpoint volume are shown in the overview.

Curve

Display the curve of the current determination.

Recalculate

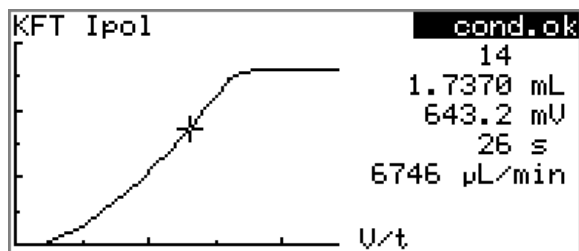
Recalculate the current determination. The procedure will be executed immediately.

Statistics

Display the statistical overview of a determination series (*see chapter 5.8, page 31*).

Displaying the curve

The curve of the current determination can be displayed with the **Curve** function.



The arrow keys [←] and [→] can be used to move to the individual measuring points. A cross hair is used to show the current position on the curve. The data (volume, measured value, time, etc.) for the respective measuring point is indicated on the right-hand side.

Recalculating



NOTICE

Recalculation cannot be undone.

All of the results are recalculated with the **Recalculate** function. This is necessary if, for example, the calculation, the titer or the sample size has been modified.

5.8 Statistics

Menu ► Results ► Statistics

The statistical overview of a determination series can be displayed in the **Results** dialog with the **Statistics** function.



NOTICE

This function is visible only if statistics has been activated.

```

Statistics ready
Water
  Mean(3) 5.78 %
    s abs 0.031 %
    s rel 0.54 %
Statistics 3/3
Details Reset Increase

```

The mean value (**Mean**), the absolute and the relative standard deviation (**s abs** and **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** line shows how many determinations have already been carried out and how many determinations are to be carried out in total. All three determinations were carried out in this example.

Details

Display additional data.

Reset

Delete all statistics data.

Increase

Add a further determination to the determination series.



Displaying statistical details

Additional data from the determination series can be displayed with the **Details** function.

Details		ready
	Result	Sample size
1	5.75 %	0.4526 g
2	5.81 %	0.4486 g
3	5.77 %	0.4509 g

On/Off

The result and the sample size of each determination are shown.

On/Off

Remove the selected determination from the statistics. The line will then be marked with an asterisk (*), the statistics will be recalculated automatically.

Deleting statistical data

All statistical data is deleted with the **Reset** function. The statistics data is deleted automatically in the following cases:

- When all of the determinations of the determination series have been carried out and a new determination has been started afterwards.
- When a new method is loaded.

Adding a determination to a determination series

You can use the function **Increase** to add 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.

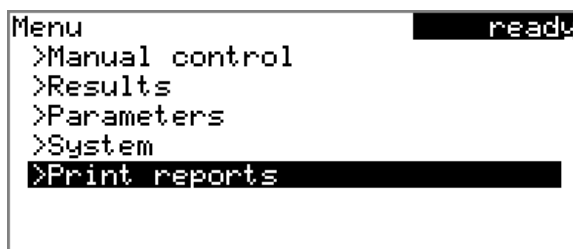
5.9 Printing a report manually

Menu ► Print reports

Proceed as follows to print a report manually:

1 Opening the main menu

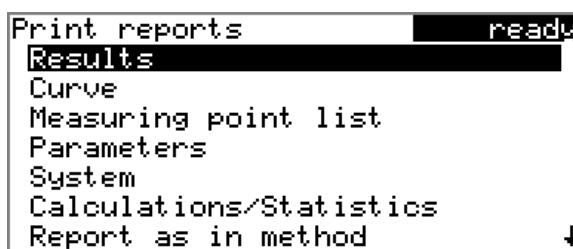
- In the main dialog, select **Menu** and press **[OK]**.



2 Opening the print dialog

- Select the menu item **Print reports** and press **[OK]**.

The dialog window with the available reports opens:



3 Selecting the report

- Select the desired report and press **[OK]**.

The report is printed out.

The following reports can be printed out manually:

Results	Result report with determination properties, sample data, calculated results, etc.
Curve	Curve report. The width of the curve is defined in the system settings (see "Graphics width", page 47).
Measuring point list	Measuring point list report.
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.



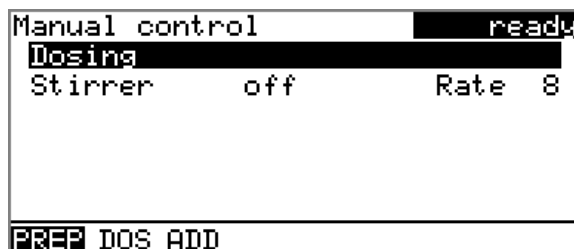
PC/LIMS	Machine-readable report with all of the data for a determination. This report can be saved as a TXT file to a connected USB flash drive or sent to a terminal program or a LIMS via an RS-232 interface. The definition is made in the system settings (see "PC/LIMS report", page 47).
Report as in method	The reports that are defined in the method will be printed out.

5.10 Manual control

Menu ► Manual control

The following functions are available in the manual control:

- Dosing
- Stirring



The available subfunctions are listed for each function in the function bar.



NOTICE

The **Stirrer** function can only be selected if a stirrer is connected.

5.10.1 Dosing

The following dosing functions are available in the manual control:

Prepare the buret unit (PREP)	Rinse the cylinder and tubings of the buret unit (see chapter 9.1.2, page 69).
Continuous dosing (DOS)	Dose while the [START] key is pressed.
Dose a fixed volume (ADD)	Dose a specified volume.

Preparing the buret unit (PREP)

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

Proceed as follows:

1 Open the manual control

- In the main dialog, select **Menu** and press **[OK]**.
The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

Manual control opens.

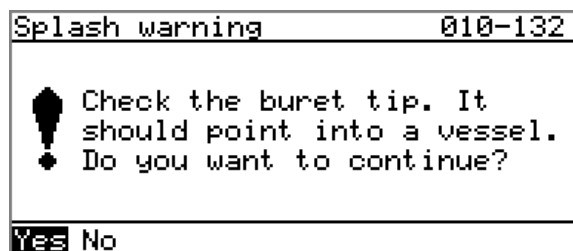
2 Select the dosing function

- Select the **Dosing** item.



- In the function bar, select **PREP** and press **[OK]**.

The following message is displayed:



3 Start the preparing



CAUTION

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

- Select **Yes** and confirm the message with **[OK]**.

Preparing is carried out.

Continuous dosing (DOS)

Continuous dosing will be carried out with the **DOS** function for as long as you keep the **[START]** key pressed down.



Proceed as follows:

1 Open the manual control

- In the main dialog, select **Menu** and press **[OK]**.
The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

Manual control opens.

2 Select the dosing function

- Select the **Dosing** item.

Manual control	ready
Dosing	
Stirrer	off Rate 8
PREP DOS ADD	

- In the function bar, select **DOS** and press **[OK]**.

Dosing	ready
Dosing rate max. mL/min	
Filling rate max. mL/min	
Press [START] key	

3 Configure the dosing function



NOTICE

- The dosing and filling rates should be decreased for viscous liquids.
- The maximum dosing and filling rates depend on the cylinder volume (*see chapter 9.1.1, page 69*).

- Enter the dosing rate.
- Enter the filling rate.

4 Start dosing

- Press **[START]**.

The status changes to **busy**, the dosed volume is displayed. When the volume of one cylinder has been dosed, the dosing cylinder will be refilled automatically.

5 Fill the cylinder

- Press **[STOP]** or **[BACK]**.

The dosing cylinder is filled. If you start the filling with **[BACK]**, then the dialog will also be exited.

Dosing a particular volume (ADD)

You can dose a particular volume with the **ADD** function.

Proceed as follows:

1 Open the manual control

- In the main dialog, select **Menu** and press **[OK]**.
The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

Manual control opens.

2 Select the dosing function

- Select the **Dosing** item.

```
Manual control          ready
Dosing
Stirrer      off      Rate 8
PREP DOS ADD
```

- In the function bar, select **ADD** and press **[OK]**.

```
Dosing          ready
Volume         10 mL
Dosing rate    max. mL/min
Filling rate   max. mL/min
Press [START] key
```



3 Configure the dosing function



NOTICE

- The dosing and filling rates should be decreased for viscous liquids.
- The maximum dosing and filling rates depend on the cylinder volume (see chapter 9.1.1, page 69).

- Enter the desired volume.
- Enter the dosing rate.
- Enter the filling rate.

4 Start dosing

- Press **[START]**.

The status changes to **busy**, the dosed volume is displayed. When the volume of one cylinder has been dosed, the dosing cylinder will be refilled automatically.

5 Fill the cylinder

- Press **[STOP]** or **[BACK]**.

The dosing cylinder is filled. If you start the filling with **[BACK]**, then the dialog will also be exited.

5.10.2 Stirring

You can control a connected stirrer manually.

Proceed as follows:

1 Opening the manual control

- In the main dialog, select **Menu** and press **[OK]**.
The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

Manual control opens.

2 Setting the stirring rate

- Select the **Stirrer** item.

```

Manual control      ready
Dosing
Stirrer  off      Rate 8

```

```

On Stir- Stir+

```

- In the function bar, select **Stir-** or **Stir+**.
The stirring rate will be increased or decreased by one step each time the **[OK]** key is pressed.
The algebraic sign changes the direction in which the stirring is done. When viewing the stirrer from above, this means:
 - "+": counterclockwise rotation
 - "-": clockwise rotation

3 Switching on the stirrer

- In the function bar, select **On** and press **[OK]**.

The stirrer is started and stirs at the rate which has been set. **Off** is now displayed in the function bar.

4 Switching off the stirrer

- In the function bar, select **Off** and confirm with **[OK]**.

The stirrer is stopped.



6 System settings

6.1 Basic settings

Menu ► System ► Settings

This chapter contains a description of general instrument settings.

User name

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

Entry	max. 12 characters
Default value	empty

Instrument name

A instrument name can be entered here for the report. This parameter will only be printed if a designation has been defined.

Entry	max. 10 characters
Default value	empty

Serial number

Serial number of the instrument. This is printed as a part of the instrument identification in the report header.

Program version

Version number of the instrument software. This is printed as a part of the instrument identification in the report header.

Time

Current time. Only valid numbers can be entered.

Format: hh:mm:ss

Date

Current date. Only valid numbers can be entered.

Format: YYYY:MM:DD

Language

Setting the dialog language. An additional language can be selected besides English.

**NOTICE**

In order to ensure that a second language can be selected, it must first be installed. This installation must be carried out by specialist personnel. In chapter *Language files, page 50*, you will find details regarding the installation of a second language.

Dialog type

The user dialog can be limited for routine operations. One can operate normally with methods in the limited dialog. However, no settings can be made or methods deleted.

The resetting of the dialog will take effect as soon as you exit the main menu.

The limitation of the dialog results in the following:

- The menu items **System** and **Parameters** are not shown in the main menu.
- Methods can only be loaded, but not deleted, exported or created.

**NOTICE**

If the limited dialog for routine operation is activated, then the expert dialog cannot be activated during ongoing operation. To change the dialog type, the 870 KF Titrino plus must be switched off and then back on again. The expert dialog can be forced as soon as the instrument is started up again. Then it is possible to enter whatever settings one wishes, e.g. the changing of the dialog type. If the instrument is switched off again without changing the dialog type, then the routine dialog will remain activated.

Forcing the expert dialog:

- Switch on the instrument.
- Wait for the display of the instrument logo with the lettering **easy, safe, precise**.
- Press the **[STOP]** key once again and hold it down while also briefly pressing the **[BACK]** key.
- Release both keys once again.

Selection	Expert Routine
Default value	Expert

Expert

Complete dialog.



Routine

Limited dialog for routine operations.

Contrast

The contrast of the display can be adjusted with the arrow keys [←] and [→].

- [←]: the contrast will be decreased by one step each time the key is pressed.
- [→]: the contrast will be increased by one step each time the key is pressed.

Input range	150 - 240
Default value	212



NOTICE

Alternatively, the contrast can also be modified in the following manner:

Keep the red **[STOP]** key pressed down. As soon as the progress bar appears, also press the arrow key [↓] or [↑] repeatedly.

This method will, however, cause the contrast to be modified by several steps.

Beep

If this parameter is activated, then a short beep will sound in the following cases:

- When a key is pressed.
- At the end of the determination.
- When the system remains conditioned without interruption for 10 seconds.

Selection	on off
Default value	on

PREP warning

If this parameter is activated, then the recommendation will be made to carry out the function **PREP** (Preparing):

- After the instrument is switched on.
- Each time a buret unit is attached.

All tubing and the cylinder are rinsed with this function (*see chapter 9.1.2, page 69*).

Selection	on off
Default value	on

6.2 Managing solutions

6.2.1 General

Menu ► System ► Solutions

Solutions can be used in intelligent buret units or in non-intelligent buret units. Intelligent buret units have a built-in data chip on which the data for the reagent is stored. This data is automatically read out during attachment and entered in the solution list.

Solution list	read
not defined	EU
Reagent 1	*IEU
Reagent 2	EU

Edit New Delete

The name and the type are specified for each solution in the solution list. The asterisk (*) on the right-hand side indicates that this buret unit is attached (only for intelligent buret units). An unlimited number of solutions in buret units with data chip can be added to the solution list. The number of solutions in buret units without data chip is limited to 10 items.

Meaning of the type:

- **EU**: exchange unit without data chip
- **IEU**: exchange unit with integrated data chip

not defined is the standard solution. It can be used to carry out determinations without having configured a solution. If you carry out a titer determination with the titration parameter **Solution = not defined**, then the result will be saved as titer of this solution. If you carry out a titration with the titration parameter **Solution = not defined**, then the data of this solution will be used for the calculation. The titer and the concentration can be edited, but this standard solution can neither be renamed nor deleted.

Edit

Edit the data of the selected solution, see following chapter.

New

Add a new solution to the list, see following chapter.

Delete

Delete the selected solution from the list.



6.2.2 Editing the solution data

Name

The designation of the solution is used for unambiguous identification.

Entry	max. 24 characters
Default value	empty

Type

The model of the buret unit is displayed.

Cylinder volume

Cylinder volume of the buret unit in mL. The cylinder volume is automatically read out with intelligent buret units.

Selection	1 5 10 20 50
Default value	20

Concentration

Concentration of the solution.

Input range	-999999999 - 999999999
Default value	1.000

Concentration unit

Unit of the concentration.

Selection	μmol/mL mmol/L mol/L g/L mg/L mg/mL μg/L ppm % mEq/L User-defined
Default value	mol/L

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. A blank entry can be generated this way as well.

Titer

Titer of the solution.

Input range	-999999999 - 999999999
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
Default value	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. A blank entry can be generated this way as well.

Date titer det.

Date of the last titer determination.

Monitoring

Activating and deactivating the titer monitoring.

Selection	on off
Default value	off

Time interval

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

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

Input range	1 - 999 d
Default value	999 d

6.3 File management

Menu ► System ► File management

**NOTICE**

This menu item is visible only if a USB flash drive has been connected as an external storage medium.

Methods can be imported and deleted from a USB flash drive in this dialog. Only methods located in the **Files** directory are displayed in the list (see "Directory structure on the USB flash drive", page 46).

A backup of the system can be created (all data and settings). Similarly, an existing backup can be reloaded.

Import

Import the selected method.

Delete

Delete the selected method.

Backup

Create a backup of all data and settings on the USB flash drive.



NOTICE

Only **one** backup can be created on the same USB flash drive.
If a backup is already stored on the flash drive, then this will be over-written as soon as the function is performed once again.

Restore

Load the backup from a connected USB flash drive.

Directory structure on the USB flash drive

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



Figure 14 Directory structure on the USB flash drive

Backup

All of the files of the backup are stored in this directory. The directory is created as soon as a backup is created for the first time.

Files

Exported methods are stored in this directory. The directory is created as soon as a backup is exported for the first time.

Only methods located in this directory can be imported.

pc_lims_report

PC/LIMS reports are stored in this directory as TXT files. The directory is created as soon as a PC/LIMS report is printed for the first time.

6.4 Configuring external devices

Menu ► 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 an RS-232 interface. The 6.2148.030 RS-232/USB Box is required for this purpose.

Selection	COM2 USB Stick
Default value	USB Stick

COM2

The report is sent via the serial COM2 interface. The interface parameters set in the dialog **COM2 settings** are used (see "Editing the COM2 settings", page 49).

USB Stick

The report will be saved as a TXT file on the USB flash drive in the folder **pc_lims_report**.

Printer

If a printer is connected, then the printer type needs to be defined 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	Citizen (ESC-POS) Custom (ESC-POS) Epson Epson (ESC-POS) HP DeskJet HP LaserJet Seiko (ESC-POS)
Default value	HP DeskJet

Graphics width

Adjust the width of the curve to be printed out to the paper width of the printer to be used. The default value depends on the selected printer. The height of the curve is 2/3 of the width.

Input range	100 - 3000 Pixels
-------------	--------------------------

Keyboard layout

A commercially available USB keyboard can be connected to make it easier to enter text and numbers. Specify the country-specific keyboard layout.



Selection	English US French FR German CH German DE Spanish ES
Default value	English US

Balance

If you have connected a balance, then you must define the balance type here.

Selection	AND Mettler Mettler AT Mettler AX Ohaus Precisa Sartorius Shimadzu
Default value	Sartorius

The following table indicates the balance type that needs to be selected for the balance model:

Balance	Balance type
AND	AND
Mettler AB, AE, AG, AM, AJ, PE, PM, PJ, PR, XP, XS	Mettler
Mettler AT	Mettler AT
Mettler AX, MX, UMX, PG, AB-S, PB-S	Mettler AX
Ohaus Voyager, Explorer, Analytical Plus	Ohaus
Precisa	Precisa
Sartorius	Sartorius
Shimadzu BX, BW	Shimadzu

Editing the COM1 settings

Menu ▶ System ▶ External devices ▶ COM1 settings

The interface parameters for the connected balance are set under **COM1 settings**.

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 the data transfer protocol.

Selection	hardware software none
Default value	hardware



NOTICE

If communications problems occur, set the parameter **Handshake** to **software**, and make another attempt.

Editing the COM2 settings

Menu ▶ System ▶ External devices ▶ COM2 settings

The interface parameters for instruments connected to the **RS-232/2** connector of the RS-232/USB Box (e.g. PC) are set under **COM2 settings**. The parameters and input ranges are identical to those for the COM1 interface.



6.5 Instrument diagnosis

6.5.1 Loading program versions and language files

Menu ▶ System ▶ Diagnosis

New program versions or language files can be loaded from a USB flash drive. The corresponding file must be saved on the USB flash drive in a directory with the instrument number (e.g. 848 or 863).

You can distinguish between language files and program files by noting how the file name is constructed.

Program files

They are instrument-specific. The file name has the following structure:

5XXXyyyy.bin where

XXX = Instrument type (e.g. 848 for the 848 Titrino plus)

yyyy = Program version

Language files

They can be recognized by means of the two-digit language code in the file name. A language file contains the dialog texts for various instrument types. It is not instrument-specific. The file name has the following structure:

5848xxxxYY.bin where

xxxx = Version number

YY = Language, e.g. DE (German), FR (French), ES (Spanish)

Loading a file

Proceed as follows:

1 Connecting the USB flash drive

- Plug in the USB flash drive with the 6.2151.100 adapter (USB MINI (OTG) - USB A) at the instrument's USB port.
- Switch on the instrument.

2 Opening the update dialog

- Under **Menu ▶ System ▶ Diagnosis**, select the menu item **Software update**.
- Press **[OK]**.



```
Software update ready
Program version 58480011

Press [START] key to continue
```

3 Opening the file selection

- Press **[OK]**.

The selection list with the program and language files present on the USB flash drive opens.

4 Selecting the file

- Use the arrow keys to select the required file.
- Press **[OK]**.

5 Starting the update

- Press **[START]**.

The update process is started, it runs automatically. At the end of the process, the instrument will be switched off automatically and switched back on again. No user intervention is required.

6.5.2 Diagnosis functions

Electronic and mechanical functional groups in Metrohm instruments can and should be checked as part of regular maintenance by specialist personnel from Metrohm. Please ask your local Metrohm representative regarding the precise terms and conditions involved in concluding a corresponding maintenance agreement.



7 Parameters

7.1 Karl Fischer titrations (KFT)

7.1.1 Conditioning

Menu ▶ Parameters ▶ Conditioning

The conditions required for conditioning are defined under **Conditioning**.

Conditioning

If this parameter is activated, the first time the titration is started the working medium will be titrated to the endpoint with the specified control parameters. The status is kept stable. The actual method run does not begin until **[START]** has been pressed once more. Conditioning will be carried out again automatically after the titration.

Selection	on off
Default value	on

Start drift

Conditioning OK will be displayed as soon as this volume drift has been reached and the titration can be started.

Input range	1 - 999 µL/min
Default value	20 µL/min

Drift correction

The endpoint volume can be corrected for drift. This involves multiplying the volume drift by the drift correction time and then subtracting the resulting value from the endpoint volume. The drift correction time is the time interval between the end of the conditioning process and the end of the determination.

Selection	auto manual off
Default value	off

auto

The value of the current volume drift is automatically applied at the start of the titration.

manual

If the volume drift is known throughout a longer period of time, this can be entered manually.

off

No drift correction takes place.

Drift value

This parameter is visible only when **Drift correction = manual**.

Volume drift for manual drift correction.

Input range	0.0 - 99.9 µL/min
Default value	0.0 µL/min

Cond. stop volume

Maximum permissible volume that can be dosed during conditioning. Conditioning is stopped when the specified volume is dosed. If conditioning is continued by pressing **[START]** once again, then the titrant volume that has already been dosed will not be taken into account; i.e. the dosing starts again at zero. The stop volume should be adjusted to the size of the titration cell in order to prevent any overflow.

Input range	0.00000 - 9,999.99 mL
Default value	20.0000 mL
Selection	off

Cond. stop time

Maximum permissible time over which conditioning may take place. Conditioning is stopped when the specified time has elapsed.

Input range	0 - 999,999 s
Selection	off
Default value	off

7.1.2 Start conditions**Menu ▶ Parameters ▶ Start conditions**

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

Start volume

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

Input range	0.00000 - 9,999.99 mL
Default value	0.00000 mL

Dosing rate

Rate at which the start volume is dosed. The maximum dosing rate depends on the cylinder volume (*see chapter 9.1.1, page 69*).

Input range	0.01 - 166.00 mL/min
Selection	max.
Default value	max.



Pause

Waiting time, e.g. for the electrode to settle down after the start or a reaction time after the dosing of a start volume.

Input range	0 - 999,999 s
Default value	0 s

Request sample ID

Selection of the sample identification that is queried in the method run.

Selection	off ID1 ID2 ID1&ID2
Default value	off

Request sample size

If this parameter is activated, then the value for the sample size will be requested.

Selection	on off
Default value	on For the "Blank Ipol" and "Blank Upol" methods, the default value is off .

Request sample unit

If this parameter is activated, then the unit for the sample size will be requested.

Selection	on off
Default value	off

Hold at request

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

Selection	on off
Default value	on

7.1.3 Control parameters

Menu ▶ Parameters ▶ Control parameters

The control parameters for the endpoint are defined under **Control parameters**.

Endpoint at

Measured value for the endpoint.

Measuring mode I_{pol}:

Input range	-1,250.0 - 1,250.0 mV
Default value	250.0 mV
Selection	off

Measuring mode U_{pol}:

Input range	-125.00 - 125.00 µA
Default value	25.00 µA
Selection	off

Titration rate

Three predefined sets of parameters can be selected for the titration rate.

Selection	slow optimal fast user
Default value	optimal

slow

For samples with a low water content or samples which release their moisture only slowly.

optimal

For all standard titrations. The parameters have been optimized for the most frequent applications.

fast

For uncritical samples with high water content.

user

The individual titration parameters can be modified.

The settings of the individual titration rates are listed in *table 1, page 56*.

Dynamics

This parameter is visible only when **Titration rate = 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 volume increment defined under **Min. increment** 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 **Max. rate**.

Measuring mode I_{pol}:

Input range	0.1 - 1,250.0 mV
Default value	100.0 mV
Selection	off

*Measuring mode Upol:*

Input range	0.01 - 125.00 μA
Default value	10.00 μA
Selection	off

Max. rate

This parameter is visible only when **Titration rate = user**.

Rate at which dosing is carried out outside of the control range. The maximum dosing rate depends on the cylinder volume (*see chapter 9.1.1, page 69*).

Input range	0.01 - 166.00 mL/min
Selection	max.
Default value	max.

Min. increment

This parameter is visible only when **Titration rate = user**.

Minimum volume increment that is dosed at the 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 increment, the slower the titration.

Input range	0.1 - 99.90 μL
Selection	min.
Default value	min.

Table 1 Default values of the predefined titration rates for KFT

	Titration rate		
	slow	optimal	fast
Dynamics			
– I _{pol}	300.0 mV	100.0 mV	30.0 mV
– U _{pol}	40.00 μ A	10.00 μ A	5.00 μ A
Max. rate	1.00 mL/min	max.	max.
Min. increment	min. (= cylinder volume/10,000)	min. (= cylinder volume/10,000)	5.00 μ L

Stop criterion

The titration is canceled when the endpoint has been reached and this stop criterion has been fulfilled. If no stop criterion has been selected then the titration will not be canceled. The stop conditions (*see chapter 7.1.5, page 59*) always lead to a stop, even if the stop criterion has not been reached.

Selection	drift time rel. drift off
Default value	drift

drift

The titration is canceled when the stop drift has been reached.

time

The titration is canceled if the endpoint has been exceeded during a certain time period (**Delay time**).

rel. drift

The titration is canceled upon reaching the sum of the drift at the start of the titration and the relative stop drift.

off

The titration will not be canceled until the stop conditions are fulfilled.

Stop drift

This parameter is visible only when **Stop criterion = drift**.

The titration is canceled when the endpoint and the stop drift have been reached.

Input range	1 - 999 μL/min
Default value	20 μL/min

Delay time

This parameter is visible only when **Stop criterion = time**.

When the endpoint has been reached, the specified time is allowed to elapse after the last dosing and the titration is then stopped.

Input range	0 - 999 s
Default value	10 s

Relative stop drift

This parameter is visible only when **Stop criterion = rel. drift**.

The titration is canceled upon reaching the endpoint and the sum of the drift at the start of the titration and the relative stop drift.

Input range	1 - 999 μL/min
Default value	10 μL/min

7.1.4 Titration parameters

Menu ▶ Parameters ▶ Titration parameters

Under **Titration parameters**, the parameters influencing the run of the entire titration are defined.



Solution

Selection of the solution from the solution list. We always recommend selecting the solution. This ensures that the correct data (titer, concentration, etc.) is always used for the calculation. Solutions are defined under **System ▶ Solutions**.

For buret units with an integrated data chip, a check is made in the method run to verify whether the correct solution has been attached and whether the type of dosing drive matches. For buret units without an integrated data chip, the cylinder volume and the type of dosing drive are checked. The validity of the titer is checked for the selected solution at the start of the determination.

Selection	Selection of configured solutions not defined
Default value	not defined

not defined

No check takes place.

I(pol)

The polarization current is the current that is applied to a polarizable electrode during voltametric measurement. This parameter is available only with I(pol) determinations.

Input range	-125 - 125 μA (Increment: 1)
Default value	50 μA

U(pol)

The polarization voltage is the voltage applied to the polarizable electrode during an amperometric measurement. This parameter is available only with U(pol) determinations.

Input range	-1,250 - 1,250 mV (Increment: 10)
Default value	400 mV

Electrode test

In the case of polarizable electrodes, an electrode test can be carried out. A check is made that the electrode is properly connected and that no short-circuit is present. The electrode test is carried out when the determination is started. This parameter is available only with I(pol) and U(pol) determinations.

Selection	on off
Default value	off

Stirrer

The stirrer is switched on at the start of the determination when this parameter is activated.

Selection	on off
Default value	on

Stirring rate

Setting the stirring rate. It can be set in steps of -15 to $+15$. The default setting **8** corresponds to 1,000 rpm. The formula for calculating the rotational speed is specified in *chapter 9.2, page 70*. The optimum stirring rate can be tested in the manual control.

The algebraic sign of the stirring rate changes the stirring direction. When the stirrer is viewed from above, this means:

- "+": counterclockwise rotation
- "-": clockwise rotation

Input range	$-15 - 15$
Default value	8

Temperature

Manually entered titration temperature.

Input range	$-20.0 - 150.0$ °C
Default value	25.0 °C

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 during this time (*see chapter 7.1.5, page 59*). Entering an extraction time is recommended, for example, for samples that release water slowly or if a Karl Fischer oven is used.

Input range	0 - 999,999 s
Default value	0 s

7.1.5 Stop conditions

Menu ▶ Parameters ▶ Stop conditions

The conditions for canceling the titration are defined under **Stop conditions**, if this does not occur automatically. This could be the case if the endpoint set is not reached or if the stop criterion (*see "Stop criterion", page 56*) is not fulfilled.

Stop volume

The titration is canceled when the specified volume has been dosed since the start of the titration. This volume should be adjusted to the size of the titration vessel in order to prevent the contents from running over.



Input range	0.00000 - 9,999.99 mL
Default value	100.000 mL
Selection	off

Stop time

The titration is canceled when the specified time has elapsed following the termination of the start conditions.

Input range	0 - 999,999 s
Selection	off
Default value	off

Filling rate

Rate at which the dosing cylinder is filled after the titration. The maximum filling rate depends on the cylinder volume (*see chapter 9.1.1, page 69*).

Input range	0.01 - 166.00 mL/min
Selection	max.
Default value	max.

7.1.6 Calculation - Methods "Blank Ipol/Upol"

Menu ▶ Parameters ▶ Calculation

Calculation formula

EP1 * FCT

The calculation formula is predefined and cannot be edited.

The calculated result is saved for each measuring mode separately as variable **Blank (CV01)** or **Blank (CV02)** (*see page 63*).

Factor (FCT)

If a larger amount of solvent is used for determining the blank value than will be used afterwards for the sample, the endpoint volume has to be converted accordingly with this factor.

Input range	-999,999,999 - 9,999,999,999
Default value	1.0

Decimal places

Number of decimal places used to display the result.

Input range	0 - 5
Default value	2

Result unit

The result unit is displayed and saved along with the result. It cannot be changed.

 Selection **mL**

7.1.7 Calculation - Methods "Titer Ipol/Upol"

Menu ▶ Parameters ▶ Calculation

Calculation formula

$$(C00 * FCT) / EP1$$

The calculation formula is predefined and cannot be edited.

The calculated result (value and unit) is saved as titer of the solution used.

Depending on what you use to determine the titer of the reagent and which unit the sample size has, the **Factor (FCT)** parameter has to be adjusted. If you have selected the calculation formula and push the **[OK]** button, a table is shown with the conversion factors:

Table 2 Conversion table

Used standard	Sample size in ...	Factor (FCT)
Water standard 10 mg/g	g	Water content in mg/g (see certificate)
Water	g	1,000
Water	µL	Density of water in g/mL
Sodium tartrate dihydrate	g	156.6
Sodium tartrate dihydrate	mg	0.1566

Factor (FCT)

Conversion factor, see table above.

Input range	-999,999,999 - 9,999,999,999
Default value	1.0

Decimal places

Number of decimal places used to display the result.

Input range	0 - 5
Default value	4

Result unit

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



Selection	% ppm mg/mL g mg mL mg/piece User-defined
Default value	mg/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. A blank entry can be generated this way as well.

7.1.8 Calculation - Methods "KFT Ipol/Upol", "KFT Ipol/Upol-Blank"

Menu ▶ Parameters ▶ Calculation

Calculation formula for KFT Ipol/Upol

$$EP1 * TITER * FCT / (COO * DIV)$$

Calculation formula for KFT Ipol-Blank

$$(EP1 - CV01) * TITER * FCT / (COO * DIV)$$

Calculation formula for KFT Upol-Blank

$$(EP1 - CV02) * TITER * FCT / (COO * DIV)$$

The calculation formulas are predefined and cannot be changed.

Depending on which unit the sample size and the result have, the **Factor (FCT)** and **Divisor (DIV)** parameters have to be adjusted. If you have selected the calculation formula and push the **[OK]** button, a table is shown with the conversion factors:

Table 3 Conversion table

Result unit	Sample size in ...	Factor (FCT)	Divisor (DIV)
%	g	0.1	1
%	mg	100	1
%	mL	0.1	Density of the sample in g/mL
ppm	g	1,000	1
ppm	mL	1,000	Density of the sample in g/mL
mg/mL	g	Density of the sample in g/mL	1
mg/mL	mL	1	1
mg/piece	Piece	1	1

Factor (FCT)

Conversion factor, see table above.

Input range	-999,999,999 - 9,999,999,999
Default value	0.1

Divisor (DIV)

Conversion factor, see table above.

Input range	-999,999,999 - 9,999,999,999
Default value	1.0

Titer

Titer of the solution used. If a solution is selected in **Titration parameters**, the value and unit from the solution data in **System ▶ Solutions** is read out and displayed here. If the titer is manually changed here, the solution data is updated.

**NOTICE**

In the calculation formula, only the numerical value is taken into account. The calculation only delivers a correct result if the **unit** of the titer is **mg/mL**.

Input range	0.00000001 - 9,999,999,999
Default value	1.000

Blank (CV01)/Blank (CV02)

This parameter is only visible for the methods **KFT Ipol-Blank** and **KFT Upol-Blank**.

This value is calculated with the blank value determination (methods **Blank Ipol** and **Blank Upol**) and entered here. The value can also be modified manually.

Input range	-999,999,999 - 9,999,999,999 mL
Default value	0.0 mL

Decimal places

Number of decimal places used to display the result.

Input range	0 - 5
Default value	2

Result unit

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



Selection	% ppm mg/mL g mg mL mg/piece User-defined
Default value	%

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. A blank entry can be generated this way as well.

7.1.9 Statistics

Menu ▶ 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 this function is activated, then statistics calculations will be carried out for all of the defined results.

Selection	on off
Default value	off For the "Titer Ipol" and "Titer Upol" methods, the default value is on .

Number of determinations

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

If an additional determination has to be added to the determination series, because one determination has been incorrect, for example, then this can be accomplished in the statistical overview (*see chapter 5.8, page 31*).

Input range	2 - 20
Default value	3

7.1.10 Reports

Menu ▶ Parameters ▶ Reports

The reports that will be printed out automatically in connection with a determination are defined under **Reports**.

Results

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

Selection	on off
Default value	off

Curve

Curve report. The width of the curve is defined in the system settings (see "Graphics width", page 47).

Selection	on off
Default value	off

Calculations/Statistics

Output of the calculation formulas for the individual results. Results are specified with full accuracy. This makes recalculation with an external program possible. If Statistics has been activated, then 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

Selection	on off
Default value	off

Measuring point list

Output of the measuring point list.

Selection	on off
Default value	off

Parameters

All of the parameters of the current method are printed out in the parameter report.

Selection	on off
Default value	off

PC/LIMS

The PC/LIMS report is a machine-readable report with all of the data important for a determination. The PC/LIMS report can be saved as a TXT file on a USB storage medium or sent via an RS-232 interface to a LIMS. The output location is defined in the system settings (see "PC/LIMS report", page 47).

The file name of the TXT file is constructed as follows: *PC_LIMS_Report-ID1-YYYYMMDD-hhmmss.txt*.

Selection	on off
Default value	off



8 Troubleshooting

8.1 Karl Fischer titration

Problem	Cause	Remedy
The drift is very high during conditioning.	<i>The titration cell is leaking.</i>	<ul style="list-style-type: none"> Check the seals and the septum. Replace if necessary. Replace the molecular sieve.
The drift becomes greater after each titration.	<i>The sample releases water very slowly.</i>	<ul style="list-style-type: none"> Adjust the method. Add solubility promoter. Increase the temperature (possibly using a KF oven). See technical literature.
	<i>A side reaction is taking place.</i>	<ul style="list-style-type: none"> Use special reagents. Adjust the method (increase/decrease the temperature, external extraction). See technical literature.
	<i>The pH value is no longer in the optimum range.</i>	Add buffer (see technical literature).
The titration will not be finished.	<i>The titration cell is leaking.</i>	<ul style="list-style-type: none"> Check the seals and the septum. Replace if necessary. Replace the molecular sieve.
	<i>The minimum increment is too low.</i>	Define Titration rate = user and increase the minimum volume increment (Min. increment) (see chapter 7.1.3, page 54).
	<i>The stop criterion is unsuitable.</i>	Adjust the control parameters (see chapter 7.1.3, page 54): <ul style="list-style-type: none"> Increase the stop drift. Select a short delay time.
<i>See also: The drift becomes greater after each titration.</i>		

Problem	Cause	Remedy
The sample is over-titrated.	<i>The increments at the end of the titration are too high.</i>	<ul style="list-style-type: none"> Define Titration rate = user and reduce the dosing rate (Max. rate) (see chapter 7.1.3, page 54). The following experiment provides a clue for the optimum dosing rate: During conditioning, display the drift and add sample without starting the titration. Select a value below the highest drift as dosing rate. Stir faster.
	<i>The amount of methanol in the working medium is too low.</i>	<ul style="list-style-type: none"> Replace the working medium. Reduce the amount of solubility promoter, if working with solvent mixtures, see technical literature.
	<i>The electrode may be covered.</i>	Wipe off the electrode with ethanol or a suitable solvent.
The solution becomes darker after each titration.		Replace the working medium.
	<i>The electrode may be covered.</i>	Wipe off the electrode with ethanol or a suitable solvent.
	<i>The electrode has a short circuit.</i>	<ol style="list-style-type: none"> Check the Pt wires. Activate the electrode check.
The endpoint is reached too quickly.	<i>The dosing rate outside the control range is too high.</i>	Define Titration rate = user and reduce the dosing rate (Max. rate) (see chapter 7.1.3, page 54).
The titration times with volumetric titration are constantly longer.	<i>The buffer capacity of the solvent can be exhausted for two-component reagents.</i>	Replace the working medium.

8.2 Miscellaneous

Problem	Cause	Remedy
No report is printed.	<i>The printer is not recognized by the instrument.</i>	<ul style="list-style-type: none"> Switch the 870 KF Titrino plus off and then back on again. Use a USB hub and connect the printer to the USB hub.



Problem	Cause	Remedy
	<i>The printer model is not compatible.</i>	Use a printer which fulfills the required specifications (see chapter 9.4.4, page 73).
The USB keyboard or the PC mouse does not function.	<i>The keyboard or mouse is not recognized by the instrument.</i>	<ul style="list-style-type: none"> ▪ Switch the 870 KF Titrino plus off and then back on again. ▪ Use a USB hub and connect the keyboard and mouse to the USB hub.
	<i>The keyboard or the mouse is not compatible.</i>	Use a model which fulfills the required specifications (see chapter 9.4, page 71).
The display is no longer readable.	<i>The contrast is set incorrectly.</i>	Adjust the contrast correctly (see chapter 6.1, page 40).
Mettler XP balances send "R" or "O ----" as ID1.	<i>The automatic calibration of the balance is activated.</i>	Deactivate the automatic calibration.
Message 020-511 "Action not possible" is displayed.	<i>The USB flash drive is no longer connected.</i>	<ol style="list-style-type: none"> 1. Connect the USB flash drive. 2. Switch the instrument off and then back on again.
	<i>The USB flash drive is full.</i>	<ul style="list-style-type: none"> ▪ Use a different USB flash drive. ▪ Delete files with the aid of a PC.

9 Appendix

9.1 Exchange unit

9.1.1 Maximum dosing and filling rate

The maximum dosing rate and maximum filling rate for the exchange unit depend on the cylinder volume:

Cylinder volume	Maximum rate
1 mL	3.00 mL/min
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Independent of the cylinder volume, values ranging from 0.01 to 166.00 mL/min can always be entered. When the function is carried out the rate will be, if necessary, decreased automatically to the highest possible value.

9.1.2 Parameters for the preparing (PREP)

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

Preparing is carried out with the following, non-alterable settings:

- The entire cylinder volume is dosed twice with the maximum dosing rate.



9.2 Stirring rate

The stirring rate can be adjusted in steps from -15 to $+15$.

The approximate rotational speed for the internal magnetic stirrer (depends on the product version) can be calculated with the following formula:

$$\text{Rotational speed/min (r/min)} = 125 \cdot \text{Stirring rate}$$

Example:

Configured stirring rate: 8

Rotational speed in revolutions per minutes = $125 \cdot 8 = 1,000$

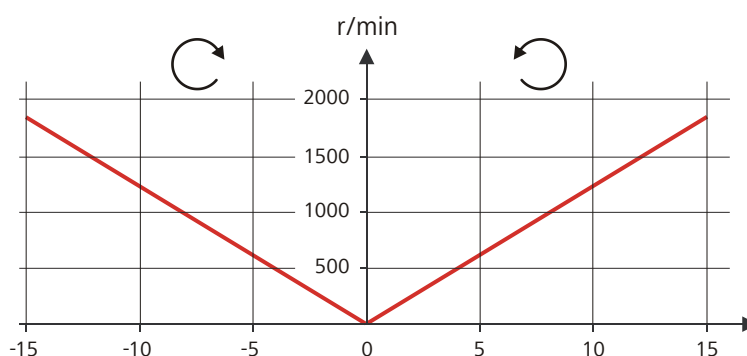


Figure 15 Rotational speed depending on the stirring rate

The information on the separately connectable 802 propeller stirrer can be found in the "802 Stirrer" manual.

9.3 Balance

The sample size and the associated unit can be sent from a connected balance. The sample size is transmitted as a number with up to ten characters (including algebraic sign and decimal point).

Sample size and unit are sent as a single character string. They are separated by a space character. The string is terminated with the ASCII characters **CR** and **LF**.

If the balance sends a negative sample size (e.g. when you are reweighing a sample), then the algebraic sign is adopted. The algebraic sign is, however, ignored for the calculations.

**NOTICE**

With some balances, the sample identification and the method can be sent in addition to the sample size.

Make sure that the balance does not send the sample size until the end.

Mettler AX

For the Mettler AX balance, the fields that contain the sample identification or the method must be designated as follows:

- Designation for the field with the method name: **METHOD**
- Designation for the field with sample identification 1: **ID1**
- Designation for the field with sample identification 2: **ID2**

9.4 USB devices**NOTICE**

USB peripheral devices that are to be connected must support either the *USB 1.0/1.1 (Full Speed)* or the *USB 2.0 (High Speed)* standard. The maximum data transfer rate is however in any case 12 MBit/s.

Keyboards, PC mice and barcode readers are so-called HID devices (**H**uman **I**nterface **D**evice) and can be connected via a USB hub only.

Printers should also be connected via a USB hub. Depending on the manufacturer or printer type a direct connection is however possible.

9.4.1 6.2147.000 numerical USB keypad

The **[Num Lock]** key must be pressed for navigating in the dialog. The arrow keys are effective in conjunction with it.

The respective editing dialog must be opened for the numerical input.

Table 4 Key assignment

Key of the 870 KF Titrino plus or function in the editing dialog	Key on the numerical USB keypad
[BACK]	[Home]
[↑] [↓]	[↑] [↓]
[←] [→]	[←] [→]



Key of the 870 KF Titrino plus or function in the editing dialog	Key on the numerical USB keypad
[OK]	[Enter]
[+-]	[BS] (backspace)
Clear	[Del]
Accept	[Home]

9.4.2 Key assignment of a USB keyboard

A commercially available USB keyboard can be connected to make it easier to enter text and numbers.

The respective editing dialog must be opened for the text input and numerical input.

Table 5 Key assignment

Key of the 870 KF Titrino plus or function in the editing dialog	Key on the USB keyboard
[BACK]	[Esc]
[↑] [↓]	[↑] [↓]
[⇐] [⇒]	[←] [→]
[OK]	[↵] (enter key) or [Enter] on the numerical keypad
[STOP]	[Ctrl] + [S]
[START]	[Ctrl] + [G]
[+-]	[←] (backspace)
Clear	[Delete]
Cancel	[Ctrl] + [Q]
Accept	[Esc]



NOTICE

The lettering of the USB keyboard may differ from above lettering, depending on the country-specific keyboard used.

9.4.3 PC mouse

In order to make navigating in the dialog of the 870 KF Titrino plus easier, a PC mouse can be connected.

Table 6 Mouse functions

Key of the 870 KF Titrino plus	Mouse function
[OK]	Left mouse button
[BACK]	Right mouse button
[↑] [↓] [←] [→]	Mouse movement vertical/horizontal
[↑] [↓]	Scroll wheel vertical

9.4.4 Printer

The range of USB printers available is extremely varied and constantly changing. The following points must be taken into account when selecting a printer:

- USB interface necessary
- Printer language: HP-PCL, Canon BJI Commands, Epson ESC P/2 or ESC/POS



NOTICE

Inexpensive printers are often designed solely for use with a PC and may not be equipped with one of the printer languages listed above. Such models are not suitable for this reason.

9.5 System initialization

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.



CAUTION

All user data (methods, solutions, etc.) are deleted if a system initialization is carried out. Afterwards, the instrument will have the factory settings again.

We recommend creating a backup of the system at regular intervals in order to avoid data losses.



After a system initialization the program versions and language files do not have to be reloaded. Only the selection of the dialog language may have to be reset in the system settings.

Proceed as follows for the system initialization:

1 Switching off the instrument

- Keep the red **[STOP]** key pressed down for at least 3 s.

A progress bar is displayed. If the key is released during this time, then the instrument will not be switched off.

2 Switching on the instrument

- Keep the red **[STOP]** key pressed down for approx. 10 s.

The dialog for confirmation of the initialization is displayed for 8 s. The initialization must be confirmed during this time.

```
System reset request detected.  
>> Press [BACK] key twice  
to confirm !  
>> Time remaining: 8 sec
```

3 Confirming the initialization



NOTICE

If the request is not confirmed within 8 s, then the procedure will be canceled.

- Press **[BACK]** twice.

Initialization is started. The process takes approximately 80 s. The instrument will be automatically restarted after successful initialization.

9.6 Remote interface

9.6.1 Pin assignment of the remote interface

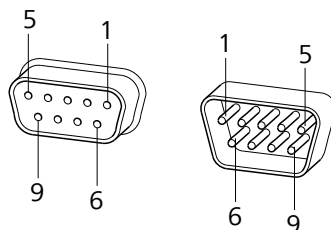


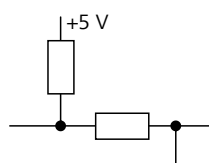
Figure 16 Pin assignment of remote socket and remote plug

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

Table 7 Inputs and outputs of the remote interface

Pin No.	Assignment	Function
1	Output 0	Ready/EOD
2	Output 1	-
3	Output 2	Titration
4	Output 3	Cond OK
5	Output 4	Error
6	0 volt (GND)	
7	+5 volts	
8	Input 0	Start
9	Input 1	Stop

Inputs



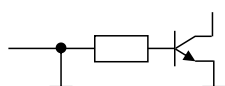
approx. 5 k Ω Pull-up

$t_p > 100$ ms

active = low, inactive = high



Outputs



Open Collector

$t_p > 200 \text{ ms}$

active = low, inactive = high

$I_C = 20 \text{ mA}$, $V_{CE0} = 40 \text{ V}$

+5 V: maximum load = 20 mA

9.6.2 Status diagram of the remote interface

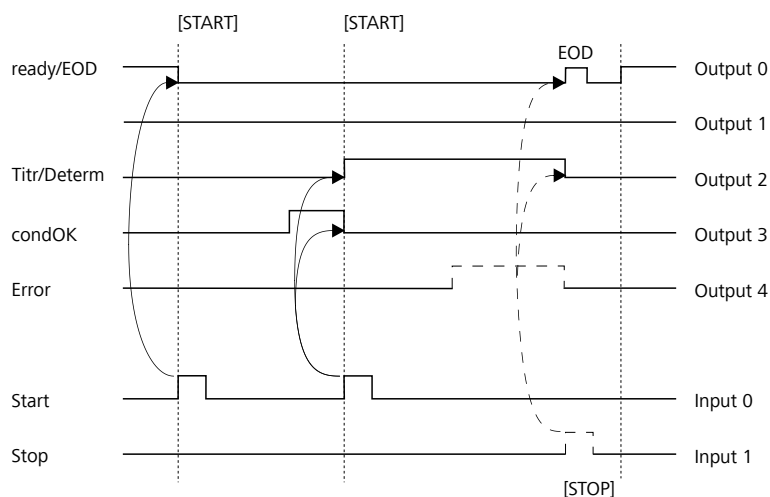


Figure 17 Remote status diagram

EOD = End of Determination

9.7 Remote control via an RS-232 connection

The 870 KF Titrino plus can be remote controlled via an RS-232 connection. For this, a **6.2148.030 RS-232/USB Box** is necessary. Connect the RS-232/USB Box to the USB interface of the instrument.

The RS-232/USB Box has two connectors for RS-232 instruments. The RS-232 remote control functions only through the connector **RS-232/2**. The connector RS-232/1 is designed for connection with a balance. Connect the **RS-232/2** connector of the RS-232/USB Box to a serial interface (COM interface marked with the symbol **IOIOI**) of a PC. Use a **6.2134.040 connection cable**.

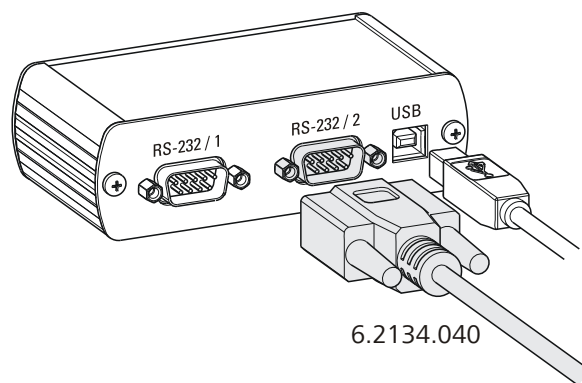


Figure 18 Connecting the RS-232/USB Box to the PC

Interface parameters

We recommend the following parameters for the RS-232 interface **COM2**:

- Baud rate: **19200**
- Data bits: **8**
- Stop bits: **1**
- Parity: **none**
- Handshake: **software**

On the 870 KF Titrino plus, adjust the interface parameters under **Menu ▶ System ▶ External devices ▶ COM2 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 acknowledgements of the instrument will also be transferred with **CR LF** as terminator.

The instrument does not send spontaneous messages.

9.7.1 Commands and variables

Command	Function	Comment
\$G	Start/Continue	Corresponds to the key [START] or [Continue]
\$S	Stop	Corresponds to the key [STOP]
\$H	Hold	Hold the method run



Command	Function	Comment
\$D	Scan instrument status	Acknowledgements: <i>Ready;0, Busy;0, Hold;0 or Cond;0</i> (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 confirmed 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(OK), \$A(CANCEL)	Confirm message	Confirm the message with [OK] or [Cancel]
\$A(YES), \$A(NO)	Confirm message	Confirm the message with [Yes] or [No]
\$L(method name)	Load method	The method name has to be known and unique.
\$Q(variable)	Request variable value	Examples for variables: <i>EP1, R1, C00</i> . List of variables, see below.

Variable	Comment
C00	Sample size
EP1	Volume of the endpoint EP1
CI#	Sample identification (# = 1...2)
R1	Result
CV01	Common variable (blank value at KFT lpol)
CV02	Common variable (blank value at KFT Upol)
SMN1	Mean value of result R#
TITER	Titer of selected solution

Variable	Comment
CONC	Concentration of selected solution
FCT	Factor
DIV	Divisor
MCV	End volume, i.e. total dosed volume at the end of the titration
EM1	Measured value of the endpoint EP1
ED1	Time at the endpoint EP1
MSV	Start volume
DD	Duration of the entire determination

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

9.8 Arithmetic algorithms in the 870 KF Titrino plus

Numerical format

The software of the 870 KF Titrino plus calculates in accordance with the widespread standard IEEE 754 (IEEE Standard for Binary Floating-Point Arithmetic for Microprocessor Systems). This means that 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 be able 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, this will be depicted in the calculation report in "double precision" with 5.029999999999999E+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 off; 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, i.e. away from zero.

Examples:

2.33 yields **2.3**

2.35 yields **2.4**

2.47 yields **2.5**

-2.38 yields **-2.4**

-2.45 yields **-2.5**

Statistics

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

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

The following convention applies to the subsequent formulas:

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

Mean value:

$$\bar{x}_k = \frac{1}{n} \cdot \sum_{i=1}^n R_{k,i}$$

Absolute standard deviation:

$$S abs_k = + \sqrt{\frac{\sum_{i=1}^n (R_{k,i} - \bar{x}_k)^2}{n-1}}$$

Relative standard deviation (in %):

$$S rel_k = 100 \cdot \frac{S abs_k}{\bar{x}_k}$$

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 three decimal places according to the above rounding-off process:

- **1234.568 mg/L.**

If the same result is expressed in "g/L" (**1.23456789158763 g/L**), and is also rounded off to three decimal place, this yields

- **1.235 g/L.**

I.e. you obtain the lowest losses in accuracy with rounding when 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 PC calculation programs may exhibit deviations. This can be explained by the different binary numerical formats used by these computers.



NOTICE

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



10 Technical specifications

10.1 Measuring inputs

The measuring cycle is 100 ms for all measuring modes.

10.1.1 Polarizer

One measuring input (**Pol.**) for polarizable electrodes.

<i>Measuring mode</i> <i>I_{pol}</i>	Determination with adjustable polarization current.
<i>Polarization current</i>	-120 - +120 μ A (increment: 1 μ A) -125 - -121 μ A / +121 - +125 μ A: non-guaranteed values, dependent on reference voltage +2.5 V
<i>Measuring range</i>	-1,200 - +1,200 mV
<i>Resolution</i>	0.1 mV
<i>Measuring accuracy</i>	\pm 0.2 mV (\pm 1 digit, without sensor error, under reference conditions)
<i>Measuring mode</i> <i>U_{pol}</i>	Determination with adjustable polarization voltage.
<i>Polarization voltage</i>	-1,200 - +1,200 mV (increment: 10 mV) -1,250 - -1,210 mV / +1,210 - +1,250 mV: non-guaranteed values, dependent on reference voltage +2.5 V
<i>Measuring range</i>	-120 - +120 μ A
<i>Resolution</i>	0.01 μ A
<i>Measuring accuracy</i>	-

10.2 Dosing drive

<i>Resolution</i>	10,000 steps per cylinder volume
<i>Exchange unit</i>	
<i>Cylinder volume</i>	<ul style="list-style-type: none"> ▪ 1 mL ▪ 5 mL ▪ 10 mL ▪ 20 mL ▪ 50 mL
<i>Accuracy</i>	Fulfills ISO/DIN standard 8655-3

10.3 Interfaces

<i>USB (OTG) connector</i>	For connecting USB devices.
<i>MSB connector</i>	For connecting a stirrer.
<i>Remote connector</i>	For connecting instruments with a remote interface.

10.4 Power connection

<i>Supply voltage</i>	100 - 240 V ($\pm 10\%$)
<i>Frequency</i>	50 - 60 Hz
<i>Power consumption</i>	45 W
<i>Fuse</i>	2 × 2.0 ATH, electronic overload protection

10.5 Ambient temperature

<i>Nominal function range</i>	+5 - +45 °C (at a maximum of 85% humidity)
<i>Storage</i>	-20 - +60 °C
<i>Transport</i>	-40 - +60 °C



10.6 Reference conditions

<i>Ambient temperature</i>	+25 °C (± 3 °C)
<i>Relative humidity</i>	$\leq 60\%$
<i>Operating temperature status</i>	Instrument in operation at least 30 min
<i>Validity of the data</i>	After adjustment

10.7 Dimensions

<i>Material of housing</i>	Poly(butylene terephthalate) (PBT)
<i>Material of display cover</i>	Glass
<i>Width</i>	142 mm
<i>Height</i>	164 mm
<i>Depth</i>	310 mm
<i>Weight</i>	2,950 g

11 Accessories

Up-to-date information on the scope of delivery and optional accessories for your product can be found on the Internet. You can download this information using the article number as follows:

Downloading the accessories list

- 1** Enter <https://www.metrohm.com/> into your Internet browser.
- 2** Enter the article number (e.g. **Variable Produktnummer**) into the search field.
The search result is displayed.
- 3** Click on the product.
Detailed information regarding the product is shown on various tabs.
- 4** On the **Included parts** tab, click on **Download the PDF**.
The PDF file with the accessories data is created.



NOTICE

Once you have received your new product, we recommend downloading the accessories list from the Internet, printing it out and keeping it together with the manual for reference purposes.



Index

A

Adapter
Connect 11

B

Backup 45
Balance 70
 Connect 11
 Interface parameters 48
Balance type 48
Buret unit
 Prepare (PREP) 34

C

Calculation
 KFT 60, 61, 62
 Numerical format 79
 Rounding-off process 80
Conditioning
 KFT 52
Connect
 Power grid 16
Contrast 42
Control parameters
 KFT 54
Curve 30

D

Determination
 Cancel 27
 Carry out 25
 Result 30
Diagnosis 51
Dialog language 40
 Load 50
Dialog type 41
Directory structure 46
Dosing
 Continuous (DOS) 35
 Fixed volume (ADD) 37
Dosing rate
 Maximum 69

E

Electrode
 Connect 9
Electrode connector
 Polarizable electrode 7
Electrostatic charge 4
End of Determination EOD 76

Exchange unit
 Attach 15
Expert dialog 41

F

Filling rate
 Maximum 69

G

Graphics width 47

I

Initialization 73
Instrument
 Switch off 17
 Switch on 17
Instrument diagnosis 50

K

Keyboard
 Connect 11
 Key assignment 71, 72
Keyboard layout 47
KFT 1, 8
 Parameters 52

L

Language 40
Language file
 Load 50
Live modifications 28
Live parameters 29

M

Manual control
 Dosing 34
 Stirring 38
Method 21
 Delete 45
 Export 22
 Import 45
 Load 21
 Save 22
MSB
 Connector 7

N

Navigate 19
Numerical input 19

O

Operation
 General 18

P

Parameters
 KFT 52
 Modify live 29
PC/LIMS report 47
Pin assignment 75
Power connection 16
PREP
 Parameters 69
Preparing
 Parameters 69
Print 32
Printer 47, 73
 Connect 11
Program crash 73
Program version
 Update 50

R

Recalculate 30
Remote
 Connector 7
 Interface 75
 Pin assignment 75
 Status diagram 76
Remote cable
 Connect 14
Remote control 76
Report
 Print manually 32
 Select 64
Result 30
 Recalculate 31
 Rounding-off process 80
Result report
 Define 64
Routine dialog 42
RS-232
 Interface parameters 49
RS-232 connection 76

S

Safety instructions 3
Sample data
 Enter 23
 Modify live 28

Sample size		
Send from a balance	70	
Sensor		
Connect	9	
Sensor connector		
Polarizable electrode	7	
Service	3	
Solution	43	
Add	43	
Delete	43	
Edit solution	43	
Start conditions		
KFT	53	
Statistics	31, 64	
Stirrer		
Connect	10	
Stirring rate	70	
Stop conditions		
KFT	59	
Supply voltage	3	
Switch off	17	
Switch on	17	
System initialization	73	
System settings	40	
T		
Temperature sensor		
Connect	9	
Text input	19	
Titration mode		
KFT	1	
Titration parameters		
KFT	57	
U		
Update		
Dialog language	50	
Program version	50	
USB	71	
Numerical keypad	71	
PC keyboard	72	
PC mouse	73	
Printer	73	
USB (OTG)		
Connector	7	
USB device		
Adapter	11	
Connect	11	
USB flash drive		
Directory structure	46	
User name	40	
W		
Water determination according to Karl Fischer	8	