870 KF Titrino plus

870 KF Titrino plus

Manual

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1 Introduction

1.1 Instrument description

The 870 KF Titrino plus is an instrument used for volumetric water 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 on a connected USB stick. This function makes it possible for you to copy methods quickly and easily from one instrument to another.

1.1.1 Titration and measuring modes

The following titration and measuring modes are supported:

- **KFT**
  Volumetric water determination according to Karl Fischer.
  Measuring modes:
  - **Ipol** (voltametric measurement with adjustable polarization current)
  - **Upol** (amperometric measurement with adjustable 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 Stick 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.

The present instrument is suitable for processing chemicals and flammable samples. The usage of the 870 KF Titrino plus therefore requires that the user has basic knowledge and experience in the handling of 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 have to be followed by the user in order to ensure safe operation of the instrument.

1.2.1 Symbols and conventions

The following symbols and styles are used 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 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 a possible damage of instruments or instrument parts.

ℹ	**Note**
	This symbol marks additional information and tips.

1.3 Safety instructions

1.3.1 General notes on safety

⚠ **Warning**

This instrument may only be operated in accordance with the specifications in this documentation.

This instrument has 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.

Mains voltage

⚠ **Warning**

An incorrect mains voltage can damage the instrument.

Only operate this instrument with a mains 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.

Always pull the mains cable out of the mains connection socket before connecting or disconnecting electrical appliances on the rear panel 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. laboratory flue).
- Keep all sources of flame far from the workplace.
- Clean up spilled fluids and solids immediately.
- Follow the safety instructions of the chemical manufacturer.

1.3.5 Recycling and disposal
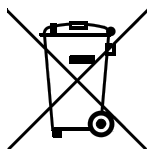
This product is covered by European Directive 2002/96/EC, WEEE – Waste from Electrical and Electronic Equipment.

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

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

2 Overview of the instrument
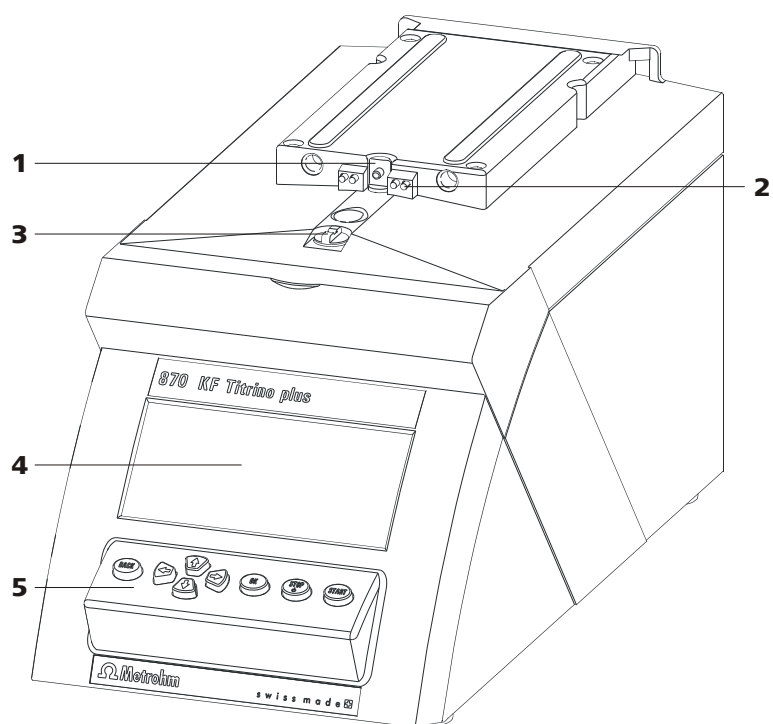
Figure 1   Front 870 KF Titrino plus

| **1** | **Piston rod** | **2** | **Contact pins** |
| | Of the dosing drive. | | For the data chip. |

| **3** | **Coupling** | **4** | **Display** |
| | For switching the flat stopcock. | | |

| **5** | **Keypad** | | |
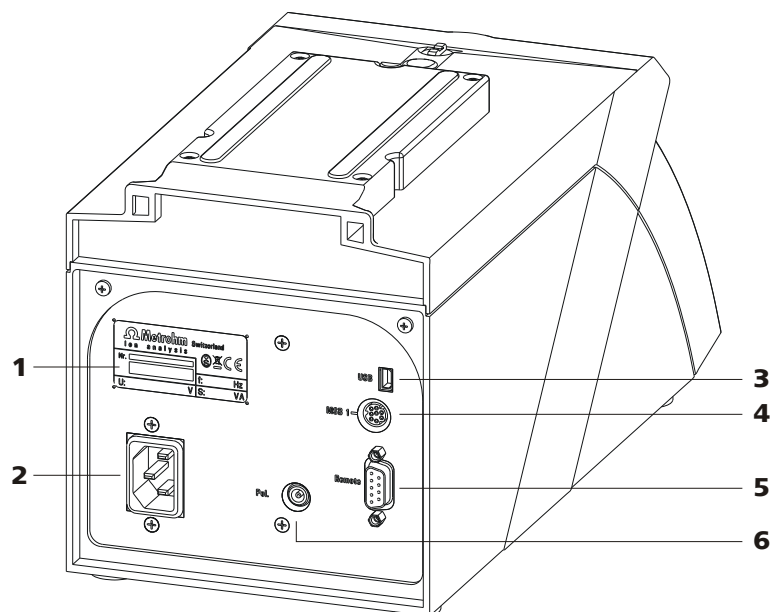
Figure 2   Rear 870 KF Titrino plus

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

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.
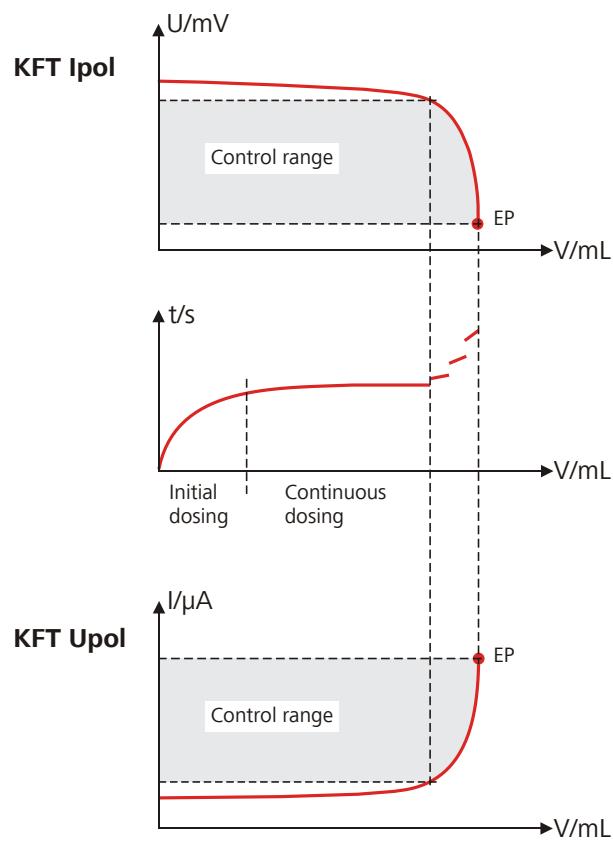
Figure 3   Reagent dosing for KFT

4 Installation

4.1 Setting up the instrument

4.1.1 Packaging

The instrument is supplied in highly protective special 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 suitable for operation and free of vibrations, if possible protected from corrosive atmospheres 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
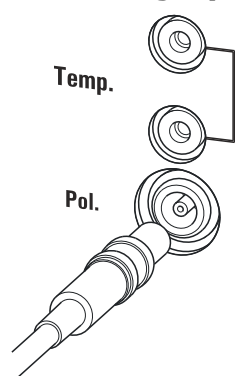
Figure 4   Connecting a polarizable electrode

> **ℹ Note**
>
> 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)
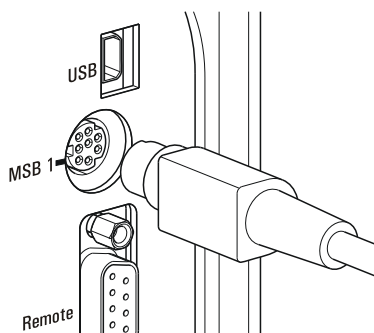
Figure 5   Connecting a stirrer

> **! 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.
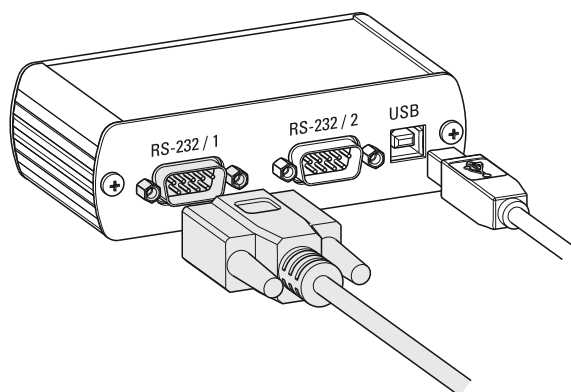
Figure 6   Connecting a balance

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 47)*. Additionally consult the user manual of the balance.

4.5 Connecting 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.
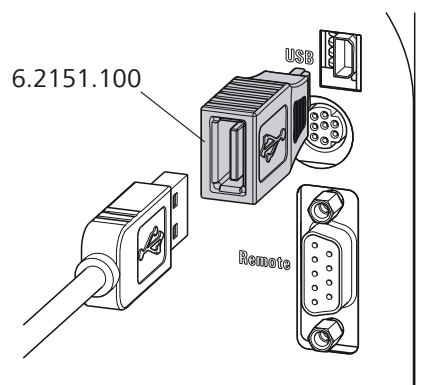
Figure 7   Connecting USB devices

> **Caution**
>
> Switch the instrument off before connecting or disconnecting a USB device or a USB stick.
>
> The 870 KF Titrino plus can recognize the device immediately after switching on.

The following devices can directly be operated 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.

> **Note**
>
> 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 a **variety of 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 10.4, page 71*.

Examples:

USB MINI (OTG)-USB

6.2151.100
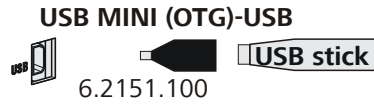
Figure 8   Connecting the USB stick
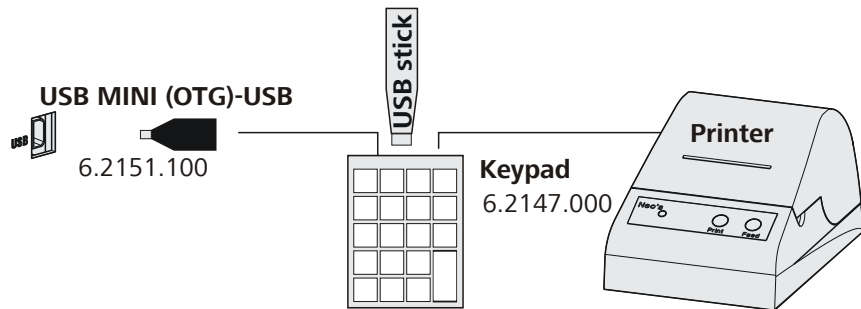
Figure 9   Connecting the 6.2147.000 USB keyboard with USB stick and printer
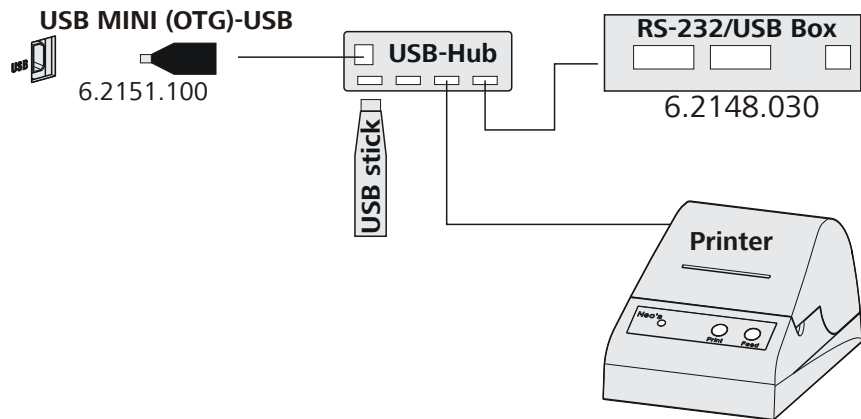
Figure 10   Connecting the USB hub with USB stick, printer and the 6.2148.030 RS-232/USB Box (for connecting balances).

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.
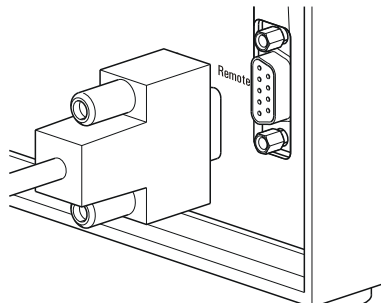
Figure 11   Connecting a remote cable

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
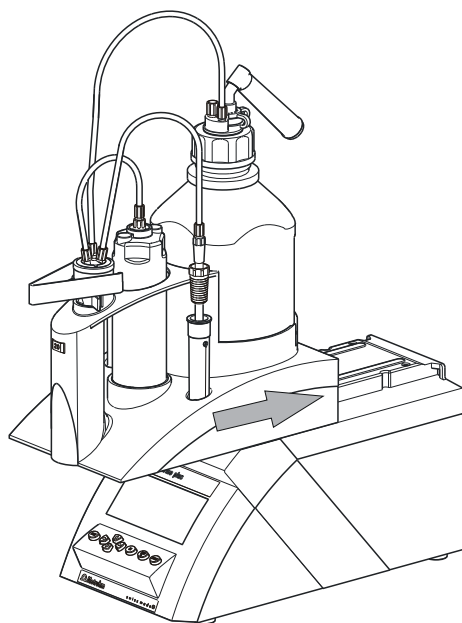
Figure 12   Attaching the exchange unit

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.

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 switched off in the system settings *(see "PREP warning", page 41)*.

The main dialog is displayed:

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

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
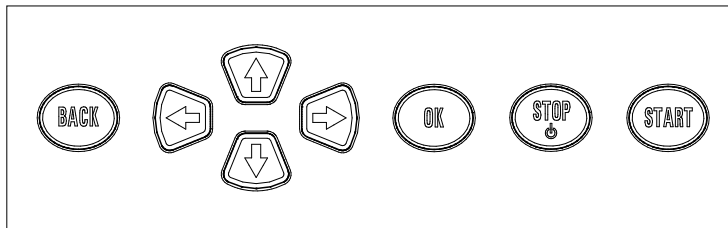
Figure 13   Keypad 870 KF Titrino plus

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/off.
START	Start a method run or a manual function.

5.2.2 Structure of the dialog windows
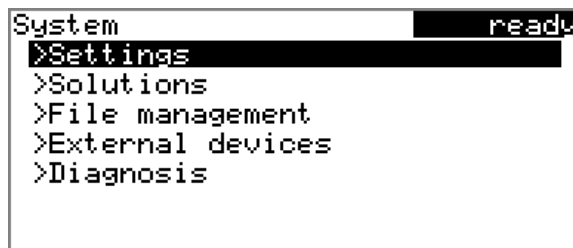
The current dialog title is displayed on the left-hand side of the title line. The current status of the system is displayed in the upper right-hand corner.

ready	The instrument is in normal state.

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

_
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789,-µ°! #$&'()*+./
ÄÅÆÉÍÑÖÓÜÜÄÀÄÇÉÉÈÍÍÑÖÓÓÜÜ
Accept Cancel Clear [+-]
+-| |-+
```

In the editing dialog for text or numerical input you can 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.
Delete	The contents of the input field is deleted completely.
`[←]`	The character left of the cursor is deleted (backspace).
`←|`	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 10.4.2, page 71*.

5.2.5 Selecting from a selection list

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:

```
Method table              ready
KFT Ipol
Titer Ipol
Blank Ipol
KFT Ipol-Blank
KFT Upol
Titer Upol                    ↓
Load Export
```
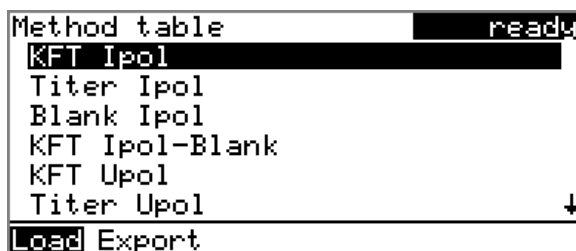
2 Select a method

■ 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 the method parameters are changed, then these will be saved automatically. It is not possible to save a method under a different name.

5.3.4   Exporting a method

Methods can be exported to a connected USB stick.

ℹ️ **Note**

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

To export 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:

```
Method table              ready
KFT Ipol
Titer Ipol
Blank Ipol
KFT Ipol-Blank
KFT Upol
Titer Upol                    ↓
Load Export
```
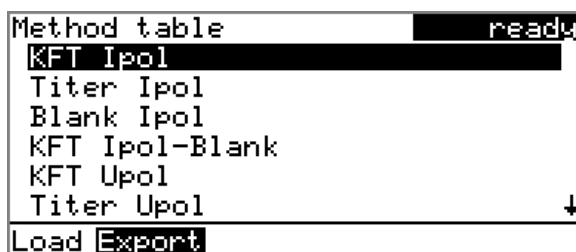
2 **Select a method**

- Select the desired method.

3 **Export the method**

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

The method is exported. The directory structure on the USB stick is listed in *chapter 6.3, page 44*.

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 23)*.

You can also send the sample size and the unit from a connected balance in any case. The sample identification and the method can be additionally sent with some balances *(see Chapter 10.3, 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 27)*.

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

```

ID1

Sample identification.

Input	**max. 10 characters**
Default value	**empty**

ID2

Sample identification.

Input	**max. 10 characters**
Default value	**empty**

Sample size

Sample size.

Range	**−999999999 ... 9999999999**
Default value	**1.0**

Unit

Unit of 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 time of determination start

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 inquiry is requisite for reweighing.

```
KFT Ipol                    hold
Sample size                  1.0

Press [START] key to continue
```

The corresponding parameters must be switched on under **Start conditions** for this purpose. If the **Hold at request** parameter is switched on, then the run will be paused and must be continued with **[START]** after the sample data has been entered. If the parameter **Hold at request** is switched off, 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 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. Consult the user manual for the balance for this purpose.

The following instructions describe how to enter the sample size on the 870 KF Titrino plus.

1 **Load the method**

- ▪ *See Chapter Loading a method, Page 20.*

2 **Start conditioning**

- ▪ Press **[START]**.

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

```
KFT Ipol                 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 Add the sample

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

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

```
KFT Ipol                busy

  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 Enter the sample size

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

5 Start the titration

- Press **[START]**.

The titration starts and the curve is displayed:

```
KFT Ipol                    busy
                      2.5895 mL
                      45 µL/min
                           38 s
                    U/t
Stirrer
```
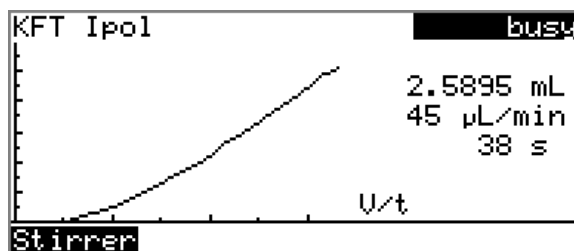
The axes are scaled automatically.

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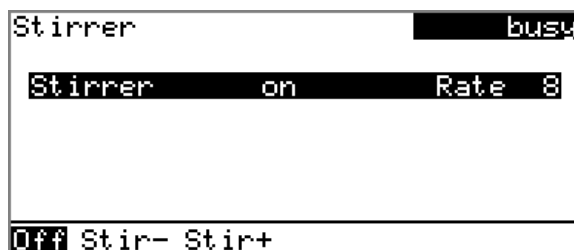
```
Stirrer                     busy

 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]**.

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

```
Results              cond.ok
 Water               5.75 %
 EP1               2.5975 mL
 Regular stop



Curve Recalc Statistics
```

6 **Cancel 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 **Display the main dialog**

■ Press **[BACK]**.

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

2 **Edit the sample data**

■ Edit the sample data and accept with **Accept** or **[BACK]**.

3 **Display the live dialog**

■ Press **[BACK]**.

or

■ Select **Menu** and press **[OK]**.

```
Menu                        busy
 >Results
 >Live dialog
 >Parameters


```

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

The live dialog is displayed once again.

> **ℹ**   **Note**
> _____
>
> If the determination is finished while the editing dialog is opened (e.g. of the sample size), then this will be closed automatically and the result 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   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 e.g. 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   Display the main dialog

▪ Press **[BACK]**.

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

2   Open the main menu

▪ Select **Menu** and press **[OK]**.

```
Menu                    busy
 >Results
 >Live dialog
 >Parameters
```
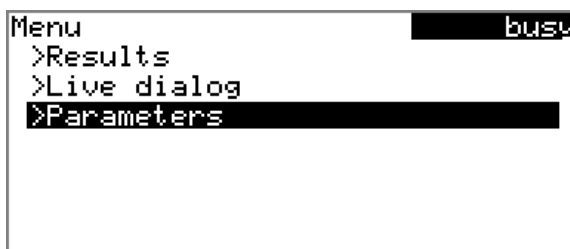
3   Edit the method parameters

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

4   Display 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.

Recalc

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

Statistics

Display the statistical overview of a determination series *(see Chapter 5.8, page 30)*.

Displaying the curve

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

```
KFT Ipol              cond.ok
                            14
                    1.7370 mL
                     643.2 mV
                         26 s
                   6746 µL/min

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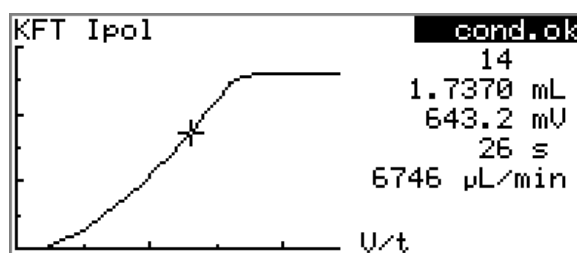
The arrow keys **[⇐]** and **[⇒]** can be used to move to the individual measuring points. A cross hair is used to show the current position on the curve. The data (volume, measured value, time, etc.) for the respective measuring point is indicated on the right-hand side.

Recalculating

> **ℹ** **Note**
> _____
>
> Recalculation cannot be undone.

All of the results are recalculated with the **Recalc** 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.

> **ℹ** **Note**
> _____
>
> This function is visible only if statistics has been switched on.

```
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 was calculated is displayed in parentheses. There are three of these in this example. The **Statistics** line shows how many determinations have already been carried out and how many determinations are to carried out in total. All three determinations were carried out in this example.

Details

Display additional data.

Reset

Delete all statistical 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 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

In case that, for example, a determination was faulty and had to be removed from the statistics, an additional sample can be added to a determination series with the **Increase** function. The second number in the **Statistics** line will be increased automatically by one.

5.9 Printing a report manually

Menu ▶ Print reports

To print a report manually, proceed as follows:

1 Open the main menu

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

```
Menu                          ready
 >Manual control
 >Results
 >Parameters
 >System
 >Print reports
```
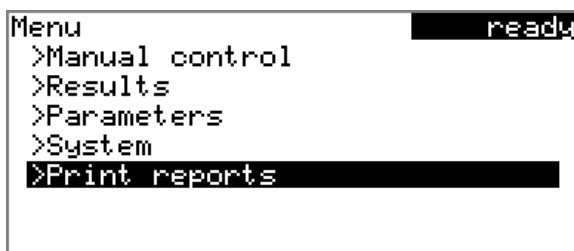
2 **Open the print dialog**

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

The dialog window with the available reports opens:

```
Print reports                 ready
 Results
 Curve
 Measuring point list
 Parameters
 System
 Calculations/Statistics
 Report as in method        ↓
```
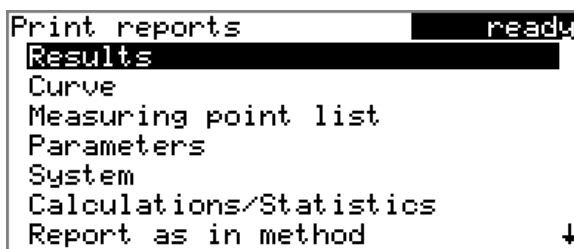
3 **Select a report**

 ▪ 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 46)*.
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 when there are multiple determinations. The individual determinations with the respective sample size will be printed out for each result, along with the mean value and the absolute and the relative standard deviation.

Report as in method	The reports that are defined in the method will be printed out.
PC/LIMS	Machine-readable report with all of the data for a determination. This report can be saved as a TXT file on a connected USB stick or sent to a terminal program or to a LIMS via an RS-232 interface. The definition is made in the system settings *(see "PC/LIMS report", page 46)*.

5.10 Manual Control

Menu ▶ Manual control

The following functions are available in the manual control:

- Dosing
- Stirring

```
Manual control              ready
 Dosing
 Stirrer       off       Rate  8




PREP DOS ADD
```
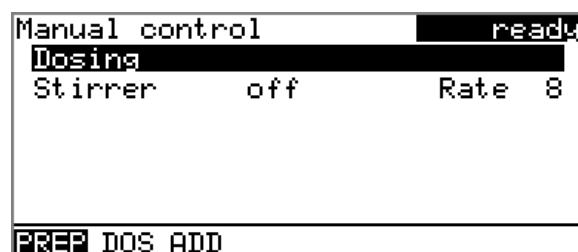
The available subfunctions are listed for each function in the function bar.

> **ℹ Note**
>
> 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 buret unit (PREP)	Rinse the cylinder and tubings of the buret unit *(see Chapter 10.1.2, page 69)*.
Continuous dosing (DOS)	Dose while the **[START]** key is pressed.
Dose 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.

```
Manual control            ready
Dosing
Stirrer      off        Rate   8



PREP DOS ADD
```

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

The following message is displayed:

```
Splash warning           010-132


    Check the buret tip. It
    should point into a vessel.
    Do you want to continue?

Yes No
```

3 **Start the preparing**

> **Caution**
>
> Make sure that the buret tip is directed into a vessel that can accommodate the 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

> **i**   **Note**
>
> - The dosing and filling rate should be decreased for viscous liquids.
> - The maximum dosing and filling rate depends on the cylinder volume *(see Chapter 10.1.1, 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 a cylinder volume has been added, 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**

> **ℹ** **Note**
>
> - The dosing and filling rate should be decreased for viscous liquids.
> - The maximum dosing and filling rate depends on the cylinder volume *(see Chapter 10.1.1, 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 a cylinder volume has been added, 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

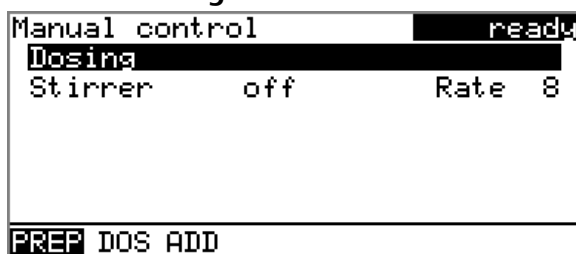You can control a connected stirrer manually.

Proceed as follows:

1 **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]**.
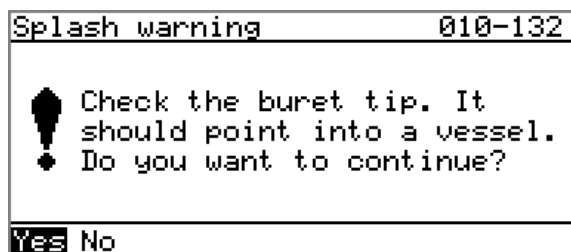
Manual control opens.

2 Set the stirring rate

- Select the **Stirrer** item.

```
Manual control          ready
 Dosing
 Stirrer     off      Rate  8



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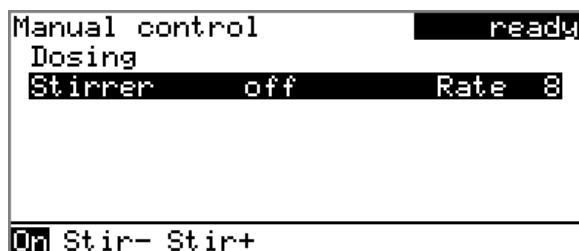
- In the function bar, select **Stir−** or **Stir+**.
  The stirring rate will be increased or decreased by one step each
  time the **[OK]** key is pressed.
  The algebraic sign changes the direction in which the stirring is
  done. When the stirrer is viewed from above, this means:
  - "+": counterclockwise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

3 Switch 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 Switch off the stirrer

- In the function bar, select **Off** and press **[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.

Input	**max. 12 characters**
Default value	**empty**

Instrument name

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

Input	**max. 10 characters**
Default value	**empty**

Serial number

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

Program version

Version number of the instrument software. This is printed as a component 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. In addition to English a further language can be selected.

> **Note**
>
> A second language must be installed in advance in order to be able to select it here. The installation may only be carried out by competent personnel.

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 does not take effect until the main menu is exited.

The limitation of the dialog has the following effects:

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

> **Note**
>
> If the limited dialog is activated for routine operations, then the expert dialog cannot be switched on during running operations. 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 at the time the instrument is started. 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.

Range	**150 … 240**
Default value	**212**

ℹ **Note**

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 switched on, then a short beep will be heard in the fol-
lowing cases:

- When a key is pressed.
- At the end of the determination.
- If the system has been conditioned uninterruptedly for 10 s.

Selection	**on | off**
Default value	**on**

PREP warning

If this parameter is switched on, then the recommendation to carry out the
PREP (preparing) function will be displayed in the following cases:

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

This function causes all tubings and the cylinder to be rinsed *(see Chapter
10.1.2, 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        ready
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.

Input	**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.

Range	**−999999999 ... 9999999999**
Default value	**1.000**

Concentration unit

Units used to specify 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.

Range	**−999999999 ... 9999999999**
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

Switching the titer monitoring on and off.

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.

Range	**1 ... 999 d**
Default value	**999 d**

6.3 File management

Menu ▸ System ▸ File management

> **ℹ️ Note**
>
> This menu item is visible only when a USB stick has been connected as an external storage medium.

Methods can be imported and deleted from a USB stick in this dialog. Only methods located in the **Files** directory are displayed in the list *(see "Directory structure on the USB stick", page 45)*.

A backup copy can be made of the system (all data and settings). Similarly, an existing backup copy can be stored.

Import

Import the selected method.

Delete

Delete the selected method.

Backup

Create a backup copy of all data and settings on the USB stick.

> **Note**
>
> Only **one** backup copy can be created on the same USB stick.
>
> If a backup copy has already been stored on the stick, then it will be overwritten when this function is carried out again.

Restore

Load the backup copy from a connected USB stick.

Directory structure on the USB stick

A directory with the instrument number is generated on the USB stick. The structure within the directory appears as follows:
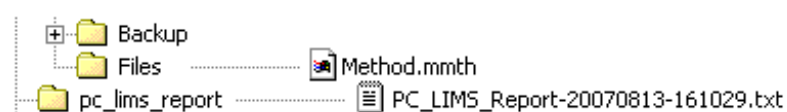
Figure 14   Directory structure on the USB stick

Backup	All of the files of the backup copy are stored in this directory. The directory will be created the first time a backup copy is saved.
Files	Exported methods will be stored in this directory. The directory will be created the first time a method is exported.
	Only methods being located in this directory can be imported.
pc_lims_report	PC/LIMS reports are stored in this directory as a TXT file. The directory will be created the first time a PC/LIMS report is printed out.

6.4 Configuring external devices

Menu ▸ System ▸ External devices

PC/LIMS report

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

- as a TXT file on a USB stick.
- 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 48)*.

USB Stick
The report will be saved as a TXT file on the USB stick 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 standard value depends on the selected printer. The height of the curve is 2/3 of the width.

Range	**100 ... 3000 Pixels**

Keyboard layout

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

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

Balance

If a balance has been connected, then the balance type needs to be defined 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	Type of balance
AND	AND
Mettler AB, AG, AM, PM, XP, XS	Mettler
Mettler AT	Mettler AT
Mettler AX, MX, UMX, PG, AB-S	Mettler AX
Ohaus Voyager, Explorer, Analytical Plus	Ohaus
Precisa	Precisa
Sartorius	Sartorius
Shimadzu BX, BW	Shimadzu

Editing the COM1 settings

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

Baud rate

Transfer rate in characters per second.

Selection	**1200**	**2400**	**4800**	**9600**	**19200**	**38400**	**57600**	**115200**
Default value	**9600**

Data bits

Number of data bits.

Selection	**7**	**8**
Default value	**8**

Stop bits

Number of stop bits.

Selection	**1 | 2**
Default value	**1**

Parity

Type of parity testing.

Selection	**even | none | odd**
Default value	**none**

Handshake

Type of data transfer protocol.

Selection	**hardware | software | none**
Default value	**hardware**

> **Note**
>
> In case of communication problems, try the software handshake (**software**).

Editing the COM2 settings

Under **COM2 settings** the interface parameters for devices connected to the **RS-232/2** connector of the RS-232 USB Box are set (e.g. PC). The parameters and input ranges are the same as 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 stick. The corresponding file must be saved on the USB stick 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 whereas

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 whereas

xxxx =   Version number

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

Loading a file

Proceed as follows:

1   Connect the USB stick

■   Plug in the USB stick with the 6.2151.100 adapter (USB MINI (OTG) - USB A) at the USB port on the instrument.
■   Switch on the instrument.

2   Open 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   Open the file selection

■   Press **[OK]**.

The selection list with the program and language files available on the USB stick is opened.

4   Select the file

■   Select the required file with the arrow keys.
■   Press **[OK]**.

5 Start the update

- Press **[START]**.

The update process is started, it runs automatically. At the end of the process, the instrument is automatically switched off and then 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 agent 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

Under **Conditioning**, the conditions required for conditioning are defined.

Conditioning

If this parameter is switched on, then 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.

Range	**1 ... 999 µL/min**
Default value	**20 µL/min**

Drift correction

The endpoint volume can be corrected by taking the drift value into account. For this, the volume drift is multiplied with the drift correction time and this value is then subtracted from the endpoint volume. The drift correction time is the time interval between the end of conditioning and the end of the determination.

Selection	**auto	manual	off**
Default value	**off**

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

manual
If the volume drift is known throughout a prolonged period of time, then 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.

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.

Range	**0.00000 ... 9999.99 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.

Range	**0 ... 999999 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.

Range	**0.00000 ... 9999.99 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 10.1.1, page 69)*.

Range	**0.01 ... 166.00 mL/min**
Selection	**max.**
Default value	**max.**

Pause

Waiting time, e.g. in case of a slow response of the electrode after the start or reaction time after the dosing of a start volume.

Range	0 ... 999999 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 switched on, then the value for the sample size will be queried.

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

Request sample unit

If this parameter is switched on, then the unit for the sample size will be queried.

Selection	on | off
Default value	off

Hold at request

If this parameter is switched on, then the method run will be paused during the query. 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

Under **Control parameters**, the control parameters for the endpoint are defined.

Endpoint at

Measured value for the endpoint.

Measuring mode Ipol:

Range	**−1250.0 ... 1250.0 mV**
Default value	**250.0 mV**
Selection	**off**

Measuring mode Upol:

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 55*.

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 the control range, dosing is carried out continuously, and the dosing rate is defined under **Max. rate**.

Measuring mode Ipol:

Range	**0.1 ... 1250.0 mV**
Default value	**100.0 mV**
Selection	**off**

Measuring mode Upol:

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 10.1.1, page 69)* .

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 decisive influence on the titration rate and thus also on the accuracy. The smaller the selected minimum increment, the slower the titration.

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			
– Ipol	300.0 mV	100.0 mV	30.0 mV
– Upol	40.00 µA	10.00 µA	5.00 µA
Max. rate	1.00 mL/min	maximum	maximum
Min. increment	minimum (= cylinder volume/10000)	minimum (= cylinder volume/10000)	5.00 µL

Stop criterion

The titration is stopped 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 stopped. The stop conditions *(see Chapter 7.1.5, page 58)* 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 stopped when the stop drift has been reached.

time

The titration is stopped when the endpoint has been exceeded during a certain period of time (**Delay time**).

rel. drift

The titration is stopped when the sum of the drift at the start of the titration and the relative stop drift has been reached.

off

The titration will not be stopped until the stop conditions have been fulfilled.

Stop drift

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

Titration is stopped when the endpoint and the stop drift have been reached.

Range	**1 … 999 µL/min**
Default value	**20 µL/min**

Delay time

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

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

Range	**0 … 999 s**
Default value	**10 s**

Relative stop drift

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

The titration is stopped when the endpoint and the sum of the drift at the start of the titration and the relative stop drift have been reached.

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 sequence of the entire titration are defined.

Solution

Selection of the solution from the solution list. We recommend always 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 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 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 solution \| 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 the voltametric measurement. This parameter is available only with I(pol) determinations.

| 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.

| Range | **−1250 ... 1250 mV** (Increment: **10**) |
| Default value | **400 mV** |

Electrode test

For 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

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

| 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 1000 U/min. The formula for calculating the rota-

tional speed is specified in *chapter 10.2, page 69*. The optimum stirring rate can be tested in the manual control.

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

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

Range	**−15 ... 15**
Default value	**8**

Temperature

Manually entered titration temperature.

Range	**−20.0 ... 150.0 °C**
Default value	**25.0 °C**

Extraction time

Minimum duration of the titration. The titration will not be stopped during the extraction time, even if the endpoint has already been reached. The titration is however stopped if a stop condition is fulfilled during this time *(see Chapter 7.1.5, page 58)*. The entering of an extraction time is e.g. recommended with samples that release water slowly or if a Karl Fischer oven is used.

Range	**0 ... 999999 s**
Default value	**0 s**

7.1.5 Stop conditions

Menu ▶ Parameters ▶ Stop conditions

Under **Stop conditions**, the conditions for stopping a titration are defined, if this does not occur automatically. This could be the case when the endpoint set is not reached or if the stop criterion *(see "Stop criterion", page 55)* is not fulfilled.

Stop volume

The titration is stopped 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.

Range	**0.00000 ... 9999.99 mL**
Default value	**100.000 mL**
Selection	**off**

Stop time

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

Range	**0 ... 999999 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 10.1.1, page 69)*.

Range	**0.01 ... 166.00 mL/min**
Selection	**max.**
Default value	**max.**

7.1.6   Calculations - 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 as a variable **Blank CV01** or **Blank CV02** for each measuring mode separately *(see page 62)*.

Factor (FCT)

If a larger amount of solvent is used for determining the blank value than is later used for the sample, then this factor must be used to convert the endpoint volume accordingly.

Range	**−999999999 ... 9999999999**
Default value	**1.0**

Decimal places

Number of decimal places used to display the result.

Range	**0 ... 5**
Default value	**2**

Result unit

The result unit is displayed and saved together with the result. It cannot be modified.

Selection	**mL**

7.1.7 Calculations - 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 the titer of the solution used.

The **Factor (FCT)** parameter must be adjusted according to what is used to determine the titer of the reagent and which unit the sample size has. If the calculation formula is selected and the **[OK]** key is pressed, then a table with the conversion factors will be displayed:

Table 2   Conversion table

Standard used	Sample size in …	Factor (FCT)
Water Standard 10 mg/g	g	Water content in mg/g (see certificate)
Water	g	1000
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.

Range	**–999999999 ... 9999999999**
Default value	**1.0**

Decimal places

Number of decimal places used to display the result.

Range	**0 ... 5**
Default value	**4**

Result unit

The result unit is displayed and saved together 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 Calculations - Methods "KFT Ipol/Upol", "KFT Ipol/Upol–Blank"

Menu ▶ Parameters ▶ Calculation

Calculation formula for KFT Ipol/Upol

EP1*TITER*FCT/(C00*DIV)

Calculation formula for KFT Ipol–Blank

(EP1–CV01)*TITER*FCT/(C00*DIV)

Calculation formula for KFT Upol–Blank

(EP1–CV02)*TITER*FCT/(C00*DIV)

The calculation formulas are predefined and cannot be modified.

The **Factor (FCT)** and **Divisor (DIV)** parameters need to be adjusted, depending on the unit used for the sample size and the result. If the calculation formula is selected and the **[OK]** key is pressed, then a table with the conversion factors will be displayed:

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	1000	1
ppm	mL	1000	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	pieces	1	1

Factor (FCT)

Conversion factor, see table above.

Range	**−999999999 ... 9999999999**
Default value	**0.1**

Divisor (DIV)

Conversion factor, see table above.

Range	**−999999999 ... 9999999999**
Default value	**1.0**

Titer

Titer of the solution used. As soon as a solution has been selected under **Titration parameters**, the value and the unit will be read out from the solution data under **System ▸ Solutions** and displayed here. If the titer is changed here manually, then the solution data will be updated.

> **ℹ** **Note**
>
> Only the numerical value is taken into account in the calculation formula. The calculation will then provide a correct result only if the **unit** of the titer is **mg/mL**.

Range	**0.00000001 ... 9999999999**
Default value	**1.000**

Blank (CV01/2)

This parameter is visible only with 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.

Range	**−999999999 ... 9999999999 mL**
Default value	**0.0 mL**

Decimal places

Number of decimal places used to display the result.

Range	**0 ... 5**
Default value	**2**

Result unit

The result unit is displayed and saved together 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 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 switched on under **Statistics** and it is defined how many determinations the series contains.

Statistics

If this funtion is switched on, then statistics calculations will be carried out for all of the defined results.

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

Number of samples

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

If an additional determination must be added to the determination series, because one determination was incorrect, for example, then this can be accomplished in the statistical overview *(see Chapter 5.8, page 30)*.

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 46)*.

Selection	**on**	**off**
Default value	**off**

Calculations/Statistics

Output of the calculation formulas for the individual results. The results are printed with the maximum resolution. This makes recalculation with an external program possible. The following data is printed out in addition when statistics is switched on:

- 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 with 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 46)*.

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 Handling and maintenance

8.1 Quality Management and validation with Metrohm

Quality Management

Metrohm offers you comprehensive support in implementing quality management measures for instruments and software. Further information on this can be found in the brochure **«Quality Management with Metrohm»** available from your local Metrohm agent.

Validation

Please contact your local Metrohm agent for support in validating instruments and software. Here you can also obtain validation documentation to provide help for carrying out the **Installation Qualification** (IQ) and the **Operational Qualification** (OQ). IQ and OQ are also offered as a service by the Metrohm agents. In addition, various application bulletins are also available on the subject, which also contain **Standard Operating Procedures** (SOP) for testing analytical measuring instruments for reproducibility and correctness.

Maintenance

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 agent regarding the precise terms and conditions involved in concluding a corresponding maintenance agreement.

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i **Note**

You can find information on the subjects of quality management, validation and maintenance as well as an overview of the documents currently available at *www.metrohm.com/com/* under **Support**.

9 Troubleshooting

9.1 Karl Fischer titration

Problem	Cause	Remedy
The drift is very high during conditioning.	*The titration cell is leaking.*	▪ Check seals and septum. If necessary, replace. ▪ Replace molecular sieve.
The drift becomes greater after each titration.	*The sample releases water very slowly.*	▪ Adjust the method. ▪ Add solubilizer. ▪ Increase the temperature (possibly using a KF oven). ▪ See technical literature.
	A side reaction is taking place.	▪ Use special reagents. ▪ Adjust the method (increase/decrease the temperature, external extraction). ▪ See technical literature.
	The pH value is not in the optimum range anymore.	Add buffer, see technical literature.
The titration will not be finished.	*The titration cell is leaking.*	▪ Check seals and septum. If necessary, replace. ▪ Replace molecular sieve.
	The minimum increment is too low.	Define **Titration rate** = **user** and increase the minimum volume increment (**Min. increment**) *(see Chapter 7.1.3, page 53)*.
	The stop criterion is unsuitable.	Adjust the control parameters *(see Chapter 7.1.3, page 53)*: ▪ Increase the stop drift. ▪ Select a short delay time.
	See also: The drift increases after each titration.	

Problem	Cause	Remedy
The sample is over-titrated.	*The increments at the end of the titration are too high.*	▪ Define **Titration rate** = **user** and reduce dosing rate (**Max. rate**) *(see Chapter 7.1.3, page 53)*. 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.
	The amount of methanol in the working medium is too low.	▪ Replace the working medium. ▪ Reduce the amount of solubilizer, if working with solvent mixtures, see technical literature.
	The electrode may be covered.	Wipe off the electrode with ethanol or a suitable solvent.
The solution becomes darker after each titration.		Replace the working medium.
	The electrode may be covered.	Wipe off the electrode with ethanol or a suitable solvent.
	The electrode has a short circuit.	1. Check the Pt wires. 2. Switch on the electrode test.
The endpoint is reached too quickly.	*The dosing rate outside the control range is too high.*	Define **Titration rate** = **user** and reduce the dosing rate (**Max. rate**) *(see Chapter 7.1.3, page 53)*.
The titration times with volumetric titration are constantly longer.	*With two-component reagents the buffer capacity of the solvent can be exhausted.*	Replace the working medium.

9.2   Miscellaneous

Problem	Cause	Remedy
No report is printed.	*The printer is not recognized by the instrument.*	▪ Switch the 870 KF Titrino plus off and on again. ▪ Use a hub on the USB connector and connect the printer to the hub.

Problem	Cause	Remedy
	The printer model is not compatible.	Use a printer which fulfills the required specifications *(see Chapter 10.4.4, page 73)*.
The USB keyboard or the PC mouse does not function.	*The keyboard or mouse is not recognized by the instrument.*	▪ Switch the 870 KF Titrino plus off and on again. ▪ Use a hub on the USB connector and connect the keyboard or mouse to the hub.
	The keyboard or the mouse is not compatible.	Use a model which fulfills the required specifications *(see Chapter 10.4, page 71)*.
The display is no longer readable.	*The contrast is set incorrectly.*	Adjust the contrast correctly *(see Chapter 6.1, page 39)*.
Mettler XP balances send "R" or "O ----" as ID1.	*The automatic calibration of the balance is switched on.*	Switch off the automatic calibration.
Message 020-511 "Action not possible" is displayed.	*The USB stick is no longer connected.*	1. Connect the USB stick. 2. Switch the instrument off and on again.
	The USB stick is full.	▪ Use a different USB stick. ▪ Delete files with the aid of a PC.

10 Appendix

10.1   Exchange unit

10.1.1   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.

10.1.2   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.

10.2   Stirring rate

The stirring rate can be adjusted in steps of −15 to +15.

The approximate rotational speed can be calculated with the following formula:

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

Example:

Stirring rate set: 8

Rotational speed in rpm = 125 · 8 = 1000
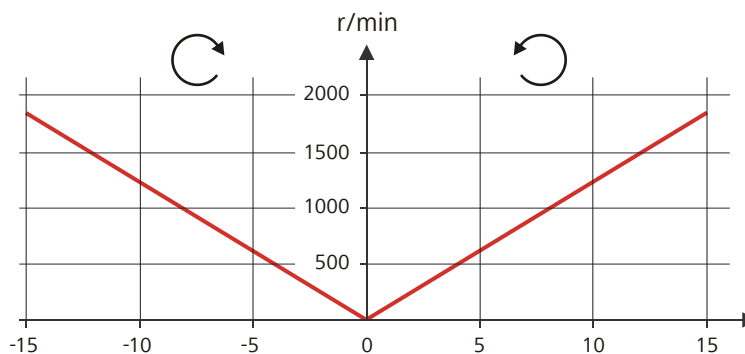
Figure 15   Rotational speed depending on stirring rate

10.3   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 reweighing), then the algebraic sign is adopted. The algebraic sign is however ignored for the calculations.

ℹ   **Note**

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**

10.4　USB devices

ℹ	**Note**

USB peripheral devices that are to be connected directly must support the USB 1.0/1.1 (Full Speed) or 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.

10.4.1　Numerical USB keypad 6.2147.000

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

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

Table 4　Keyboard assignment

Key of the 870 KF Titrino plus or function in the editing dialog	Key on the numerical USB keypad
[BACK]	**[Home]**
[⇧] [⇩]	**[↑] [↓]**
[⇦] [⇨]	**[←] [→]**
[OK]	**[Enter]**
[←−]	**[BS]** (backspace)
Delete	**[Del]**
Accept	**[Home]**

10.4.2　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 text and number inputs.

Table 5   Keyboard 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)
Delete	**[Delete]**
Cancel	**[Strg]** + **[Q]**
Accept	**[Esc]**

> **ℹ Note**
>
> The lettering of the USB keyboard can differ from above lettering, depending on the country-specific keyboard used.

10.4.3   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

10.4.4 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 BJL Commands, Epson ESC P/2 or ESC/POS

Note

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.

10.5 System initialization

In very rare instances, it could happen that a faulty file system (e.g. because of a program crash) will lead to an impairment of program functioning. The internal file system needs to 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 copy 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 system initialization:

1 Switch 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 Switch 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 Confirm the initialization

 Note

If the query is not confirmed within 8 s, then the procedure will be interrupted.

■ Press **[BACK]** twice.

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

10.6   Remote interface

10.6.1   Pin assignment of the remote interface
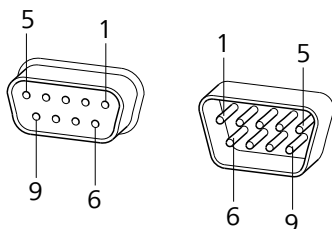
Figure 16   Pin assignment of remote socket and plug

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

Table 7   Inputs and outputs of the remote interface

Pin No.	Assigment	Function
1	Output 0	Ready/EOD
2	Output 1	-
3	Output 2	Titration
4	Output 3	Cond OK

Pin No.	Assigment	Function
5	Output 4	Error
6	0 Volt (GND)	
7	+5 volts	
8	Input 0	Start
9	Input 1	Stop

Inputs
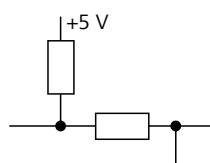
approx. 5 kΩ Pull-up

t_p > 100 ms

active = low, inactive = high

Outputs
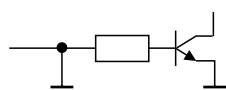
Open Collector

t_p > 200 ms

active = low, inactive = high

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

+5 V: maximum load = 20 mA

10.6.2   Status diagram of the remote interface
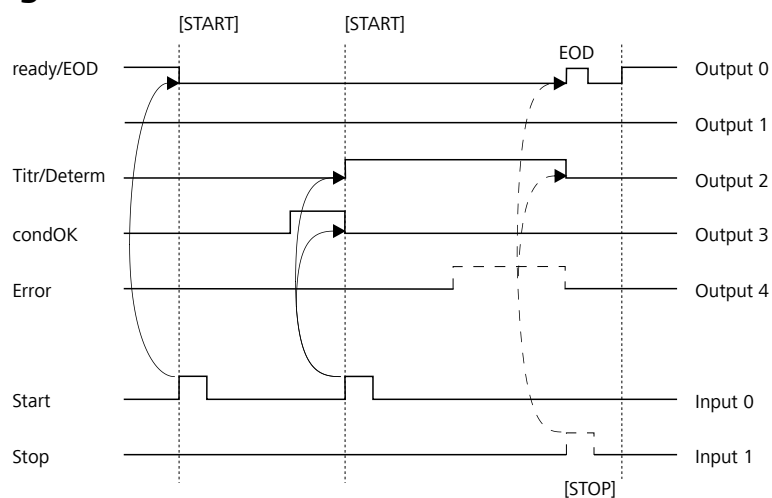
Figure 17   Remote status diagram

EOD = End of Determination

10.7 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 devices. The RS-232 remote control only works via the **RS-232/2** connector. The RS-232/1 connector is provided for a connection to a balance. Connect the **RS-232/2** connector of the RS-232/USB Box to a serial interface (COM1 or COM2, designated with the symbol **IOIO**) of a PC. Use a **6.2134.040 connection cable**.
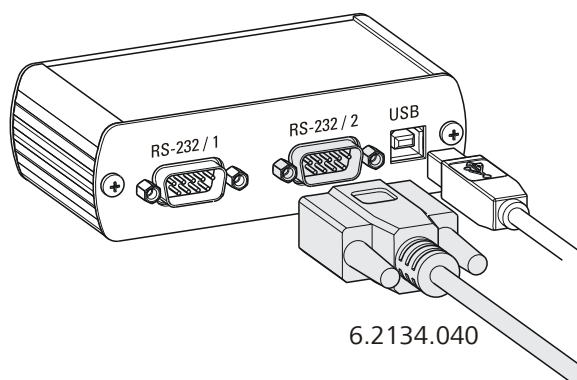
Figure 18   Connecting the RS-232/USB Box to the PC

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 the interface parameters are set under
Menu ▸ System ▸ External devices ▸ COM2 settings.

Transfer protocol

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

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

The instrument does not send spontaneous messages.

10.7.1 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
$D	Scan instrument status	Answers: *Ready;0* , *Busy;0* , *Hold;0* or *Cond;0* (0 = no message) If a message on the instrument requires the interaction of the user, the answer of the status scan displays the corresponding message number. Example: Busy;010-119 = "Check buret unit" The message can be quit with **[OK]** or **[Cancel]**, see below.
$A	Quit message	Confirm the message on the instrument with **[OK]** A mandatory status scan providing the message number must take place immediately before quitting the message, see above.
$A(OK), $A(CANCEL)	Quit message	Confirm the message with **[OK]** or **[Cancel]**
$A(YES), $A(NO)	Quit 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: *EP1*, *R1*, *C00*. List of variables, see below

Variable	Comment
C00	Sample size
EP1	Volume of the endpoint EP1
CI#	Sample identification (# = 1…2)
R1	Result

Variable	Comment
CV01	Common variable (blank value at KFT Ipol)
CV02	Common variable (blank value at KFT Upol)
SMN1	Mean value of result R#
TITER	Titer of selected solution
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').

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

11 Technical specifications

11.1 Measuring inputs

11.1.1 Polarizer

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

Measuring mode Ipol   Determination with adjustable polarization current.

  Polarization current   −120…120 µA (increment: 1 µA)
−125…−121 µA / +121…+125 µA: non-guaranteed values, dependent on reference voltage +2.5 V

  Measuring range   −1200…1200 mV

  Resolution   0.1 mV

  Measuring accuracy   ±0.2 mV
(±1 digit, without sensor error, under reference conditions)

Measuring mode Upol   Determination with adjustable polarization voltage.

  Polarization voltage   −1200…1200 mV (increment: 10 mV)
−1250…−1210 mV / +1210…+1250 mV: non-guaranteed values, dependent on reference voltage +2.5 V

  Measuring range   −120…120 µA

  Resolution   0.01 µA

  Measuring accuracy   –

11.2   Dosing drive

Resolution	10000 steps per cylinder volume
Exchange unit	
Cylinder volume	- 1 mL - 5 mL - 10 mL - 20 mL - 50 mL
Accuracy	Fulfills ISO/DIN standard 8655-3

11.3   Interfaces

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

11.4   Mains connection

Voltage	100…240 V
Frequency	50…60 Hz
Power consumption	45 W
Fuse	2 × 2.0 ATH, electronic overload protection

11.5   Safety specification

Design and testing	According to EN/IEC/UL 61010-1, CSA-C22.2 No. 61010-1 Protection class I, degree of protection IP40
Safety instructions	The documentation contains safety instructions which have to be followed by the user in order to ensure safe operation of the instrument.

11.6   Electromagnetic compatibility (EMC)

Emission   Standards fulfilled:
- EN/IEC 61326-1
- EN/IEC 61000-6-3
- EN 55022 / CISPR 22

Immunity   Standards fulfilled:
- EN/IEC 61326-1
- EN/IEC 61000-6-2
- EN/IEC 61000-4-2
- EN/IEC 61000-4-3
- EN/IEC 61000-4-4
- EN/IEC 61000-4-5
- EN/IEC 61000-4-6
- EN/IEC 61000-4-11
- EN/IEC 61000-4-14
- NAMUR

11.7   Ambient temperature

*Nominal function   +5…+45 °C
range*   (at a maximum of 85 % humidity)

Storage   −20…+60 °C

Transport   −40…+60 °C

11.8   Reference conditions

*Ambient tempera-   +25 °C ± 3 °C
ture*

Rel. humidity   ≤ 60 %

*Operating temper-   Instrument in operation at least 30 minutes
ature status*

Validity of the data   After adjustment

11.9   Dimensions

Material of housing	Polybutylene terephthalate (PBT)
Material of display cover	Glass
Width	142 mm
Height	164 mm
Depth	310 mm
Weight	2950 g

12 Conformity and warranty

12.1   Declaration of Conformity

This is to certify the conformity to the standard specifications for electrical appliances and accessories, as well as to the standard specifications for security and to system validation issued by the manufacturing company.

Name of commodity

870 KF Titrino plus

Titrator for volumetric water determination according to Karl Fischer.

This instrument has been built and has undergone final type testing according to the standards:

Electromagnetic compatibility

Emission:	EN/IEC 61326-1: 2006, EN/IEC 61000-6-3: 2004, EN 55022 / CISPR 22: 2006
Immunity:	EN/IEC 61326-1: 2006, EN/IEC 61000-6-2: 2005, EN/IEC 61000-4-2: 2001, EN/IEC 61000-4-3: 2002, EN/IEC 61000-4-4: 2004, EN/IEC 61000-4-5: 2001, EN/IEC 61000-4-6: 2001, EN/IEC 61000-4-11: 2004, EN/IEC 61000-4-14: 2004, NAMUR: 2004

Safety specifications

EN/IEC 61010-1: 2001, UL 61010-1: 2004, CSA-C22.2 No. 61010-1: 2004, protection class I

This instrument meets the requirements of the CE mark as contained in the EU directives 2006/95/EC (LVD), 2004/108/EC (EMC). It fulfils the following specifications:

EN 61326-1	Electrical equipment for measurement, control and laboratory use – EMC requirements
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use

This instrument meets the requirements of the ETL Listed Mark for the North American market. It conforms to the electrical safety standards UL 61010-1 and CSA-C22.2 No. 61010-1. This product is listed in Intertek's Directory of Listed Products.

Manufacturer

Metrohm Ltd., CH-9101 Herisau/Switzerland

Metrohm Ltd. is holder of the SQS certificate ISO 9001:2000 Quality management system for development, production and sales of instruments and accessories for ion analysis.

Herisau, 16 January, 2009

D. Strohm

Vice President, Head of R&D

A. Dellenbach

Head of Quality Management

12.2   Quality Management Principles

Metrohm Ltd. holds the ISO 9001:2000 Certificate, registration number 10872-02, issued by SQS (Swiss Association for Quality and Management Systems). Internal and external audits are carried out periodically to assure that the standards defined by Metrohm's QM Manual are maintained.

The steps involved in the design, manufacture and servicing of instruments are fully documented and the resulting reports are archived for ten years. The development of software for PCs and instruments is also duly documented and the documents and source codes are archived. Both remain the possession of Metrohm. A non-disclosure agreement may be asked to be provided by those requiring access to them.

The implementation of the ISO 9001:2000 quality management system is described in Metrohm's QM Manual, which comprises detailed instructions on the following fields of activity:

Instrument development

The organization of the instrument design, its planning and the intermediate controls are fully documented and traceable. Laboratory testing accompanies all phases of instrument development.

Software development

Software development occurs in terms of the software life cycle. Tests are performed to detect programming errors and to assess the program's functionality in a laboratory environment.

Components

All components used in the Metrohm instruments have to satisfy the quality standards that are defined and implemented for our products. Suppliers of components are audited by Metrohm as the need arises.

Manufacture

The measures put into practice in the production of our instruments guarantee a constant quality standard. Production planning and manufacturing procedures, maintenance of production means and testing of components, intermediate and finished products are prescribed.

Customer support and service

Customer support involves all phases of instrument acquisition and use by the customer, i.e. consulting to define the adequate equipment for the analytical problem at hand, delivery of the equipment, user manuals, training, after-sales service and processing of customer complaints. The Metrohm service organization is equipped to support customers in implementing standards such as GLP, GMP, ISO 900X, in performing Operational Qualification and Performance Verification of the system components or in carrying out the System Validation for the quantitative determination of a substance in a given matrix.

12.3   Warranty (guarantee)

Metrohm guarantees that the deliveries and services it provides are free from material, design or manufacturing errors. The warranty period is 36 months from the day of delivery; for day and night operation it is 18 months. The warranty remains valid on condition that the service is provided by an authorized Metrohm service organization.

Glass breakage is excluded from the warranty for electrodes and other glassware. The warranty for the accuracy corresponds to the technical specifications given in this manual. For components from third parties that make up a considerable part of our instrument, the manufacturer's warranty provisions apply. Warranty claims cannot be pursued if the Customer has not complied with the obligations to make payment on time.

During the warranty period Metrohm undertakes, at its own choice, to either repair at its own premises, free of charge, any instruments that can be shown to be faulty or to replace them. Transport costs are to the Customer's account.

Faults arising from circumstances that are not the responsibility of Metrohm, such as improper storage or improper use, etc. are expressly excluded from the warranty.

13 Accessories
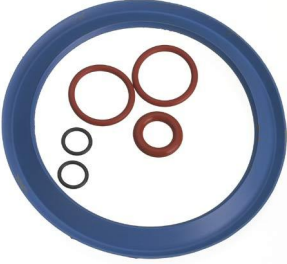
> **ℹ** **Note**
>
> Subject to change without notice.

13.1   Scope of delivery

2.870.0010 870 KF Titrino plus

Qty.	Order no.	Description
1	1.870.0010	**870 KF Titrino plus**
1	6.0338.100	**Double Pt-wire electrode**

Double Pt-wire electrode, Metrohm plug-in head G, for volumetric Karl Fischer titration and 684/737 Coulometer (cell with diaphragm).

Shaft material:	Glass
Measuring range:	−2000 ... 2000
Measuring unit:	mV
Temperature range, long-term (°C):	−20 ... 70

1	6.1244.040	**Set of seals**

Qty.	Order no.	Description
1	6.1403.040	**KF Adsorber tube**

Used with KF equipment. Including cover and O-ring.

Height (mm): 113
Outer diameter (mm): 8

| 1 | 6.1414.030 | **KF titration vessel lid** |

For volumetric KF titrations.

Material: PTFE
Material remark: Insert

| 1 | 6.1415.220 | **Titration vessel / 20-90 mL** |

Material: Clear glass
Height (mm): 80
Outer diameter (mm): 78
Volume (mL): 20 ... 90

| 1 | 6.1415.250 | **Titration vessel / 50-150 mL** |

Material: Clear glass
Height (mm): 80
Outer diameter (mm): 78
Volume (mL): 50 ... 150

Qty.	Order no.	Description
2	6.1448.010	**Septum 12 mm, 5 pieces**

Set of 5 items.

Material:	Silicone rubber
Height (mm):	2
Outer diameter (mm):	12

Qty.	Order no.	Description
2	6.1903.020	**Stirring bar / 16 mm**

Stirring Bar with magnetic core, PTFE coated, length 16 mm

Material:	PTFE
Outer diameter (mm):	4
Length (mm):	16

Qty.	Order no.	Description
2	6.1903.030	**Stirring bar / 25 mm**

Stirring Bar with magnetic core, PTFE coated, length 25 mm

Material:	PTFE
Outer diameter (mm):	5
Length (mm):	25

Qty.	Order no.	Description
1	6.2104.020	**Electrode cable / 1 m / F**

For connecting electrodes with Metrohm plug-in head G to Metrohm instruments (socket F).

Length (m):	1

Qty.	Order no.	Description
1	6.2147.000	**Numerical USB keypad**

Numerical USB keypad for Titrino plus, Dosimat plus, 862 Compact Titrosampler and 869 Compact Sample Changer. Incl. USB Hub with two connectors.

Qty.	Order no.	Description
1	6.2151.100	**Adapter USB MINI (OTG) - USB A**

For connecting USB instruments.

1	6.2412.000	**Glass weighing spoon**

Used with 6.1414.030 Titration vessel lid or 6.1455.31X, 6.1464.32X, 6.1465.320 Titration vessels. For Karl Fischer water determinations. Including protective tube.

Material:	Glass
Length (mm):	120

2	6.2730.010	**Screw nipple**

Made of PP. For 6.1448.010 Septum or for mounting 6.1403.040 Drying tube or 6.0338.100 Electrode in 6.1414.030 and 6.1414.040 KF Titration vessel lids. Used for KF titrations.

Material:	PP
Inner diameter (mm):	11.5
Length (mm):	23.5

1	6.2730.020	**Septum stopper**

With E.301.0041 O-ring. For 6.1448.010 Septum and 6.1414.030 Titration vessel lid. Used for KF applications.

Outer diameter (mm):	18
Length (mm):	30

Qty.	Order no.	Description
3	**6.2730.030**	**Stopper**

Nipple and E.301.0043 O-ring included. For 6.1414.030 Titration vessel lid. Used with KF Titrators, VA Stands, VA Computrace and IC Dilution technique.

Length (mm):	38

1	**6.2739.010**	**Wrench**

For exchange units.

Length (mm):	190

1	**6.2811.000**	**Molecular sieve**

Molecular sieve. Bottle containing 250 g. Pore size: 0.3 nm. Without moisture indicator. For Rancimats and Karl Fischer instruments.

1	**6.2122.0x0**	**Mains cable with C13 line socket IEC-60320-C13**

Cable plug according to customer requirements.

Switzerland:	Type SEV 12	6.2122.020
Germany, …:	Type CEE(7), VII	6.2122.040
USA, …:	Type NEMA/ASA	6.2122.070

1	**8.870.8003EN**	**Manual 870 KF Titrino plus**

Qty.	Order no.	Description
1	**8.870.8002EN**	**Installation and tutorial 870 KF Titrino plus**
1	**A.714.0004**	**Multimedia Guide 870 Titrino plus**

13.2 Optional accessories

Order no.	Description

2.141.0100 USB Thermal printer Neo's

Compact printer with USB interface, paper width 60 mm (40 characters). Including 6.2151.120 USB cable.

2.803.0010 803 TI Stand with stirrer and pump

Compact titration stand with magnetic stirrer and built-in pump for solvent addition and aspiration of the titration vessel contents. Suitable for Karl Fischer titrations with Titrandos. MSB connection. Including comprehensive accessories, solvent bottle and waste bottle.

Dimensions in mm (W/H/D):   106/ 101/ 220
Dimensions remark: Height with support rod: 412 mm

6.2148.030 RS-232/USB Box

Extends the Titrino plus by two RS 232 interfaces for the connection of e.g. balance, PC, LIMS. Requires 6.2151.030 Cable.

Order no.	Description

6.3026.150 **Exchange Unit 5 mL**

Exchange Unit with integrated data chip with 5 mL glass cylinder and light protection. PCTFE/PTFE flat stopcock, FEP tubing connection, anti-diffusion buret tip and standard amber glass reagent bottle.

    Volume (mL):   5

6.3026.210 **Exchange Unit 10 mL**

Exchange unit with integrated data chip with 10 mL glass cylinder and light protection. PCTFE/PTFE flat stopcock, FEP tubing connection, anti-diffusion buret tip and standard amber glass reagent bottle.

    Volume (mL):   10

6.3026.220 **Exchange Unit 20 mL**

Exchange unit with integrated data chip with 20 mL glass cylinder and light protection. PCTFE/PTFE flat stopcock, FEP tubing connection, anti-diffusion buret tip and standard amber glass reagent bottle.

    Volume (mL):   20

6.9988.703 **Validation Documentation for 870 (English)**

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