949 pH Meter

Manual

8.0949.8101EN / v2 / 2024-05-07

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Technical Communication
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This documentation has been prepared with great care. However, errors can never be entirely ruled out. Please send comments regarding possible errors to the address above.

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1 Introduction

1.1 Product description

The 949 pH Meter is designed for stationary use in laboratories. The device is ideally suited for fast and reliable pH measurements in the laboratory, and offers additional functions, such as mV measurement, ORP measurement, or temperature measurement. The 949 pH Meter is compatible with all analog Metrohm pH electrodes and can be calibrated quickly and reliably, thanks to predefined buffer tables.

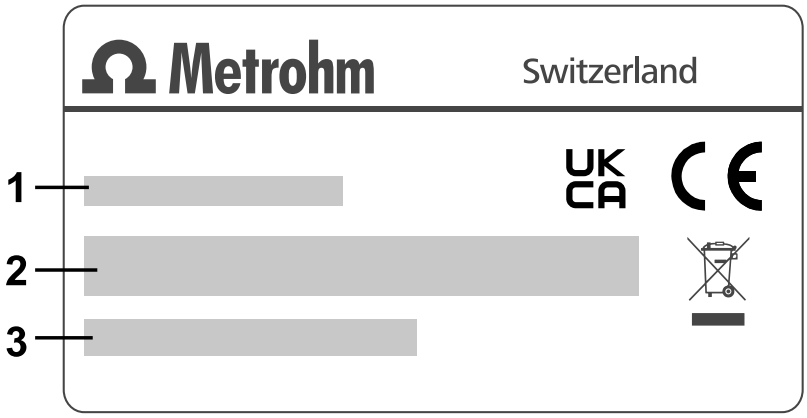
1.2 Product versions

The 949 pH Meter is available in the following versions:

Table 1 Product versions

Art. no.	Designation	Version feature
2.949.0210	949 pH Meter	With electrode holder and power supply unit
2.949.0220	949 pH Meter	With electrode holder, power supply unit, and Solitrode with fixed cable

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



1	**Metrohm article number**
2	**Barcode**
3	**Serial number**

1.3 Symbols and conventions

The following symbols and formatting may appear in this documentation:

*(5-**12**)*	**Cross-reference to figure legend** The first number refers to the figure number, the second to the instrument part in the figure.
1	**Instruction step** Perform the steps one after the other.
Method	**Dialog text**, **parameter** in the software
File ► New	Menu or menu item
[Continue]	**Button** or **key**
	**WARNING** This symbol draws attention to a possible life-threatening hazard or risk of injury.
	**WARNING** This symbol draws attention to a possible hazard due to electrical current.
	**WARNING** This symbol draws attention to a possible hazard due to heat or hot instrument parts.

	**WARNING** This symbol draws attention to a possible biological hazard.
	**WARNING** Warning of optical radiation
	**CAUTION** This symbol draws attention to possible damage to instruments or instrument parts.
	**NOTICE** This symbol highlights additional information and tips.

1.4 Displaying accessories

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

1 Searching for a product on the website

- Go to *https://www.metrohm.com*.
- Click on  .
- Enter the article number of the product (e.g. **2.1001.0010**) into the search field and press **[Enter]**.

The search result is displayed.

2 Displaying product information

- To display the products matching the search term, click on **Product models**.
- Click on the desired product.

Detailed information regarding the product is displayed.

3 Displaying accessories and downloading the accessories list

- To display the accessories, scroll down to **Accessories and more**.
  - The **scope of delivery** is displayed.
  - Click on **[Optional parts]** for the optional accessories.
- To download the accessories list, click on **[Download accessories PDF]** under **Accessories and more**.

NOTE

Metrohm recommends keeping the accessories list for reference purposes.

2 Safety

2.1 Intended use

This device is suitable for making measurements in chemicals and flammable samples. Therefore, the use of the 949 pH Meter requires the user to have basic knowledge and experience in handling toxic and caustic substances. Knowledge of the application of the fire prevention measures prescribed for laboratories is also mandatory.

2.2 Responsibility of the operator

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

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

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

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

2.3 Requirements for operating personnel

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

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

2.4 Safety instructions

2.4.1 General notes on safety

WARNING

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

This device left the factory in a flawless state in terms of technical safety. The following instructions must be observed carefully to preserve this status and ensure non-hazardous operation of the device.

2.4.2 Electrical safety

The electrical safety when working with the device 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.

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

Power supply unit

WARNING

Use the power supply unit only for its intended purpose. Inappropriate use or use of non-approved or incompatible power supply units may cause fires and result in the revocation of the guarantee or warranty.

If you think that the power supply unit has been damaged, have it checked by a service center. Do not use damaged power supply units.

Do not use the power supply unit outdoors.

2.4.3 Flammable solvents and chemicals

WARNING

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

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

3 Overview of the device

3.1 Connectors

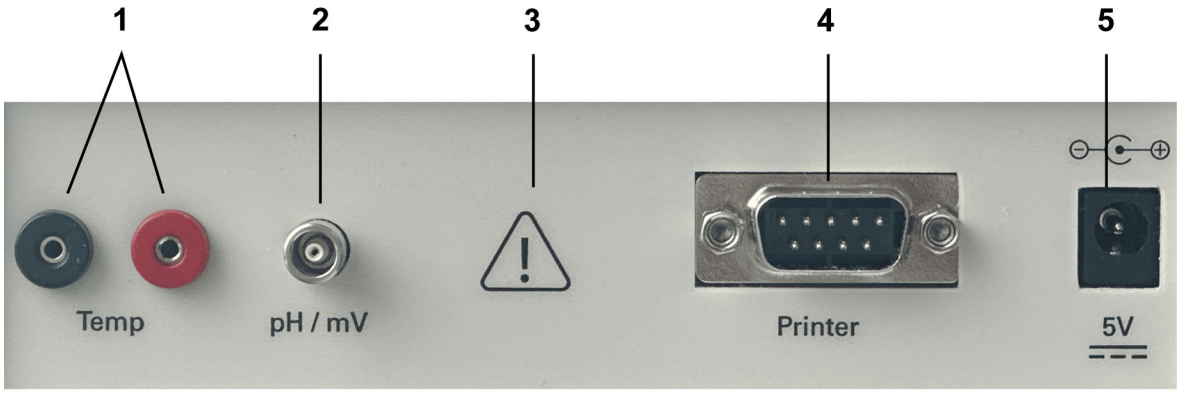


Figure 1 949 pH Meter – Connectors

1 **Temp connection socket** Pt1000 temperature sensor connector	**2** **pH/mV connection socket** Connector for pH electrodes and Redox electrodes
3 **Information symbol**	**4** **Printer connection socket** RS-232 connector for a printer or computer
5 **Power socket 5 V DC**	

3.2 Indicators and controls

3.2.1 Overview

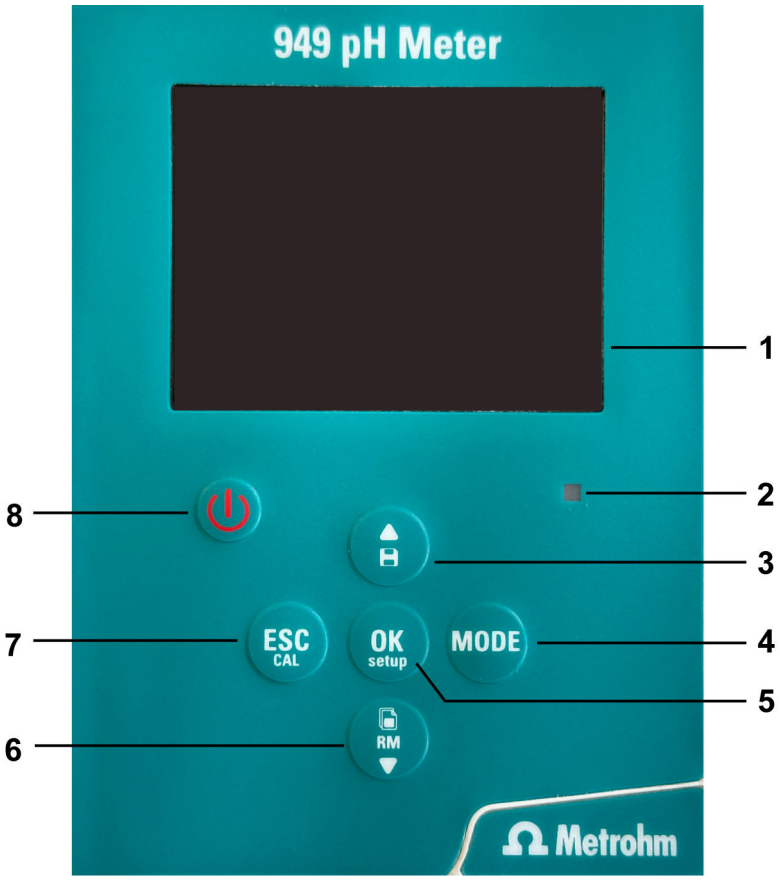


Figure 2 949 pH Meter – Indicators and controls

1	**Display**	**2**	**LED status display**
3	**Up direction button** Direction button for scrolling through submenus and between saved values, to change the values, to save and to print the values	**4**	**Mode button** Selection between the measurement parameters pH, mV, ORP (oxidation reduction potential)
5	**Enter button and Menu button** For opening the settings, selecting the function or the value, confirming the value during calibration	**6**	**Down direction button** Direction button for scrolling through submenus and between saved values, to change the values, to retrieve the saved values
7	**Cancel button and Calibration button** Return to *measuring mode*, start of calibration	**8**	**On/Off button** Switches the device on or off.

Table 2 Button icons

Icon	Button
	On/Off button
	Up direction button
ESC CAL	Cancel button and Calibration button
OK setup	Enter button and Menu button
MODE	Mode button
	Down direction button

3.2.2 Display

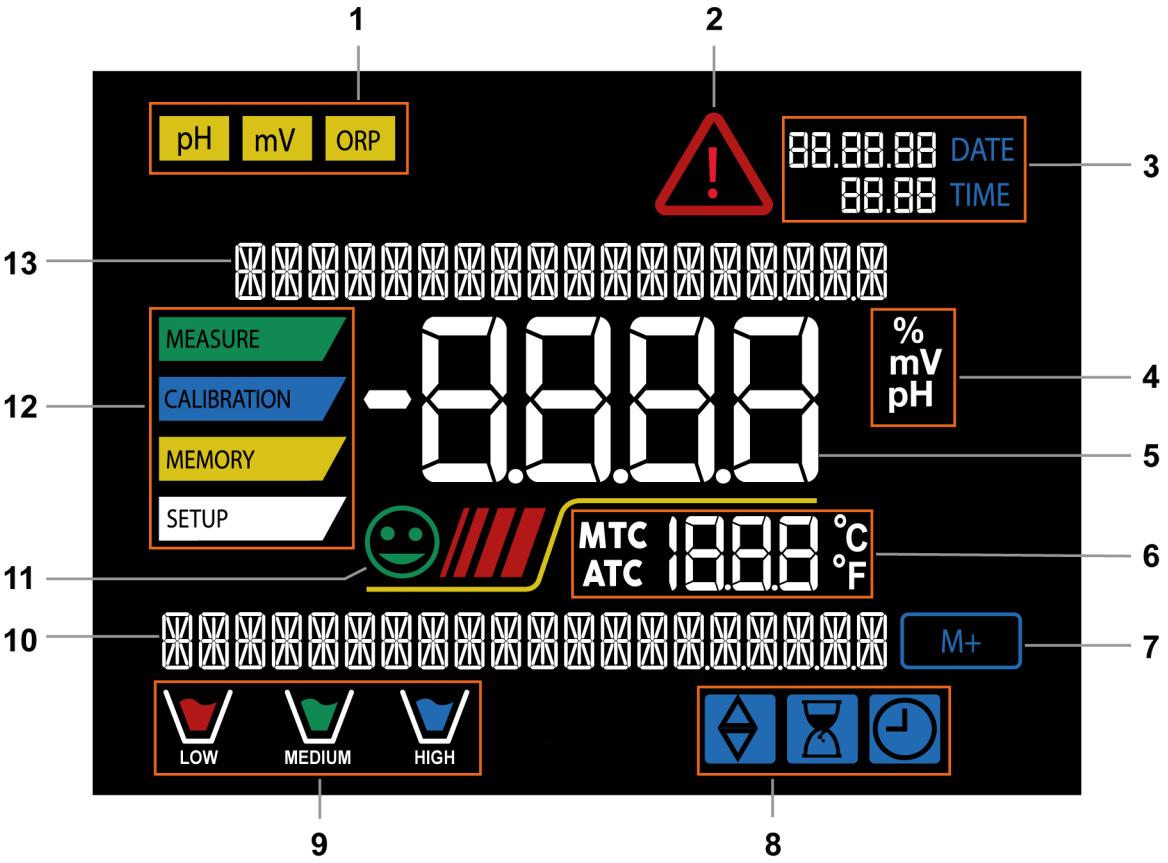


Figure 3 Display screen

1	**Measuring parameters**	**2**	**Error symbol**
3	**Date and time display**	**4**	**Measuring unit**

5	**Measured value**	**6**	**Temperature and type of compensation**
7	**Number of values stored**	**8**	**Information symbols**
9	**Electrode calibration range**	**10**	**Lower text field**
11	**Stability indicator**	**12**	**Operation mode**
13	**Upper text field**		

Table 3 Symbols on the display

Symbol	Meaning
	The values are automatically collected.
	A calibration time is set or reached.
	Use the  and  buttons for operation.
	The measurement is stable.
	The value is measured. The measured value is still unstable.
	Number of values stored for the respective measuring parameter
	There is an error message.

Table 4 Electrode calibration range

Symbol	Buffer pH value
	Acidic < 6.5
	Neutral 6.5 ~ 7.5
	Alkaline > 7.5

3.2.3 LED status display

2-color LED (red and green), which provides the user with important information about the device status:

Function	LED color	Description
On		On
Off		On

Function	LED color	Description
Standby		Flashes every 20 s
Stable measurement		Flashes every 3 s
Calibration error		Flashes every 1 s
Measurement error		Flashes every 3 s
Time for saving values		On and off in quick succession
Opening saving mode		GREEN and RED alternating, pause 5 s
Confirmation of the selection		On for 1 s
Time-controlled display		On

4 Installation

4.1 Unpacking and inspecting the instrument

4.1.1 Packaging

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

4.1.2 Checks

Inspect the delivery immediately upon receipt:

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

4.1.3 Application area

The 949 pH Meter has been developed for use in a laboratory.

CAUTION

Influence of weather conditions

Damage to devices as a result of direct sunlight or temperatures below freezing.

When you are not using the device, do not expose it to direct sunlight or to temperatures below 0 °C.

4.1.4 Setup location

Place the device on a flat, stable laboratory bench that is easily accessible from the front and the side. Metrohm recommends setting the device up at least 20 cm away from any parts above it or in its vicinity.

With this positioning of the device, there is no longer any residual risk of damage caused by manual handling of loads.

Ensure that the device and its surroundings are properly illuminated.

4.2 Plugging in the power cord

WARNING

Electric shock from electrical potential

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

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

CAUTION

- Use only the original power cord.
- Ensure that the electrical standards of the line on which the device is to be installed match the voltage and operating frequency of the device.

Plugging in the power cord

1 Plug the supplied power cord into the **5 V** power socket at the rear of the device.

2 Connect the power cord to the energy supply.

4.3 Connecting a printer

Plug the TX-900MH impact printer for report output into the **Printer** connection socket using an RS-232 cable.

NOTE

Use only the TX-900MH impact printer.

Contact your regional Metrohm representative for additional information.

5 Operation

5.1 Switching the device on and off

Switching on the device

1 Press the button.

The device switches to *measuring mode* with the last parameter used.

NOTE

During the start-up phase during its first use, the device will request the updating of the date and time *(see chapter 5.8, page 41)*.

Switching off the device

1 Press the ESC CAL button to access *measuring mode*.

2 Press the button.

The LED lights up red.

5.2 Operating the device

Measuring parameters

The current measuring parameter is shown on the top left of the display.

The following measuring parameters are available for selection:

Measuring parameters	Functions
pH	▪ pH value measurement ▪ Calibration ▪ Retrieve memory

Measuring parameters	Functions
mV	▪ Display of potential in mV ▪ Measurement of potential in mV ▪ Retrieve memory
ORP	▪ Measurement of oxidation reduction potential in mV ▪ Calibration ▪ Retrieve memory

Changing the measuring parameters

1 Press the MODE button to switch between the different measuring parameters.

NOTE

After the last parameter, the device automatically returns to the first parameter.

2 In the pH and ORP areas, press the ESC CAL button to start calibration of the active parameter.

Operation mode

The current operation mode is displayed on the left of the display.

NOTE

The change of operation mode is indicated by a flashing light on the display.

The following operation modes are available for selection:

Operation mode	Meaning
MEASURE	The device is in *measuring mode*.
CALIBRATION	The device is in *calibration mode* (automatic or manual).

Operation mode	Meaning
SETUP	The device is in *set-up* mode. The configuration menus can relate to the properties of the parameters, the data processing settings or the device settings.
MEMORY	The device is in *retrieve memory* mode. The saved values of the respective parameter are displayed.

Changing the operation mode

After switching on, the device is automatically in *measuring mode*.

1. Press the ESC CAL button to switch between *measuring mode* and *calibration mode*, respectively.

2. Press the OK setup button in *measuring mode* to switch to *set-up mode*.

3. In *measuring mode*, press the RM button to switch to *retrieve memory* mode for the required parameter.

   The most recently saved values appear on the display.

5.3 Temperature measurement

Automatic temperature compensation (ATC)

The sample temperature is measured directly using a Pt1000 temperature sensor. The temperature sensor can either be external or integrated in the electrode.

Manual temperature compensation (MTC)

If no temperature sensor is connected, then the temperature value has to be changed manually:

Setting the temperature manually

1. Keep the ▲ or RM buttons pressed for 3 seconds until the temperature value begins to flash.

2 Set the value with the and buttons.

3 Confirm the setting with the button.

5.4 Settings

1 Press the button in *measuring mode* to access the settings.

2 Use the and buttons to select the parameter to be edited.

3 Confirm the selection with the button.

The following configuration menus are available to choose from:

Designation	Meaning	Options
PH SETTINGS	pH settings	▪ Buffer selection ▪ Resolution ▪ Stability ▪ pH calibration data ▪ pH calibration time ▪ Reset pH settings ▪ pH temperature offset
ORP SETTINGS	ORP settings	▪ ORP calibration data ▪ ORP calibration time ▪ Resetting ORP settings ▪ ORP temperature offset
LOG SETTINGS	Data processing options	▪ Data collection ▪ Data deletion ▪ Data output ▪ Data printout
SETTINGS	Device settings	▪ Temperature unit ▪ Date and time ▪ Brightness ▪ Serial number ▪ Resetting device settings

5.5 pH parameters

5.5.1 Sensors

The 949 pH Meter can be used with combined pH sensors with or without an integrated temperature sensor.

Connecting the sensor

1 Plug the pH electrode into the **pH/mV** connection socket.

2 Plug the temperature sensor into the **Temp** connection socket.

5.5.2 pH settings

Opening the pH settings

1 Press the OK setup button in *measuring mode* to access the settings.

2 Press the OK setup button to access the **P1.0** pH settings.

3 Use the ▲ and RM ▼ buttons to select the setting to be edited.

4 Confirm the selection with the OK setup button.

The following submenus can be found in the pH settings:

Setting	Meaning	Selection	Default value
P1.1 CAL BUFFER SELECT	Buffer selection	METROHM | CUSTOM | USA | NIST	METROHM
P1.2 SELECT RESOLUTION	Resolution	0.1– 0.01	0.01
P1.3 STABILITY FILTER	Stability	LOW | MEDIUM | HIGH	MEDIUM
P1.6 CALIBRATION DATA	pH calibration data	VIEW | PRINT	

Setting	Meaning	Selection	Default value
P1.7 SET DUE CAL	pH calibration time	NO | HOURS | DAYS	NO
P1.8 RESET SETTINGS	Reset pH settings	YES | NO	NO
P1.9 TEMPERATURE CAL	pH temperature offset	YES | NO	

P1.1 Buffer selection

P1.1 is used to select the buffer family for the electrode calibration.

1 to 3 points can be calibrated.

- Press the ESC CAL button during calibration to exit the calibration and save the points calibrated up to that point.

The 949 pH Meter automatically detects *(see chapter 5.5.3, page 24)* 3 buffer families (**METROHM, USA, NIST**). A manual calibration *(see chapter 5.5.4, page 27)* (**CUSTOM**) with up to 2 calibration points can also be carried out with user-defined values.

- **METROHM** buffer: 4.00– 7.00[1)]– 9.00
- **USA** buffer: 1.68– 4.01– 7.00[1)]– 10.01– 12.45
- **NIST** buffer: 1.68– 4.00– 6.86[1)]– 9.18– 12.46

Default value: **METROHM**

[1)]Neutral point is always requested first.

The bottom left of the display shows a row of beakers in *measuring mode*. This row shows which buffers were used for the last automatic calibration and the last manual calibration.

P1.2 Resolution

P1.2 is used to select the resolution for the pH measurement.

- **0.1**
- **0.01**

Default value: **0.01**

P1.3 Stability

P1.3 is used to select the stability of the pH measurement.

Metrohm recommends waiting for the stability of the measurement indicated by the ☺ symbol. The /// symbol will appear on the display if the measurement is not stable.

- **LOW**: The  symbol is also shown if the measurement stability is poor. The measured values are within 1.2 mV.
- **MEDIUM**: Measured values are within 0.6 mV.
- **HIGH**: The  symbol is shown only if measurement stability is high. The measured values are within 0.3 mV.

Default value: **MEDIUM**

P1.6 pH calibration values

P1.6 is used to display or print the results of the last calibration performed.

VIEW

The following results are shown automatically on the display, one after the other:

- Date and time of calibration, beaker with buffers used
- Offset value of electrodes in mV
- 1st slope in % in the measuring range
- 2nd slope in % in the measuring range (is shown only for 3 calibration points)

NOTE

The 949 pH Meter accepts only calibrations with pH electrodes with a slope in an acceptance range between 80% and 120%. Calibration cannot be exits outside the acceptance range. The **SLOPE OUT OF RANGE** error message appears on the display.

PRINT

The following results are printed out:

- Model number and serial number
- Date and time of calibration
- Offset value of electrodes in mV
- pH range with relative slope

NOTE

- Use only the original printer specified by the manufacturer.
- Ensure that the printer is connected and switched on.
- Ensure that the paper roll and the cassette are inserted correctly.

Additional information can be found in the manual for the printer.

P1.7 pH calibration time

P1.7 is used to set the time until the next calibration. The **P1.7** setting is important for GLP protocols. No default value is set for the calibration time.

1 Selecting the unit

- Use the and buttons to select **HOURS** or **DAYS**.
- Confirm the selection with the button.

A number appears in the middle of the display. The number defines the days or hours that elapse between 2 calibrations.

2 Setting the time

- Use the and buttons to change the number.
- Confirm the setting with the button.

As soon as a calibration time has been set, the symbol will appear on the display in *measuring mode*.

As soon as the set calibration time is reached, the 949 pH Meter prevents further measurements and the and symbols flash on the display.

The **MAKE A NEW CAL** message prompts the user to recalibrate the pH sensor.

3 Starting the calibration

Press the button to start the calibration.

P1.8 Resetting pH settings

P1.8 is used to reset all pH settings to the default values.

1 If the 949 pH Meter does not work perfectly or calibrates incorrectly, select **YES** with the and buttons.

2 Confirm the selection with the button.

NOTE

All saved data is retained when resetting the pH settings.

P1.9 pH temperature offset

All devices of the 949 pH Meter type are precalibrated for a correct temperature measurement. If the temperature sensor malfunctions, there may be a difference between the measured temperature and the actual temperature.

P1.9 is used to perform an offset alignment of the temperature of up to ±5 °C:

1 Use the and buttons to correct the temperature offset value.

2 Confirm the setting with the button.

5.5.3 Automatic calibration

Automatic calibration is depicted using 3-point calibration with Metrohm buffers (7.00/4.00/9.00) as an example.

Calibrating the 1st point

1 In *measuring mode* in the **pH** area, press the button to access *calibration mode*.

The **1ST POINT PH 7.00** message appears on the display. The message means that the 949 pH Meter requires the neutral value as the 1st calibration point.

2 Remove the vessel from the electrode.

3 Screw open the closure of the filler opening on the electrode.

4 Rinse the electrode with distilled water.

5 Immerse the electrode in the pH 7.00 buffer solution.

The **WAIT FOR STABILITY** message appears on the display and the symbol flashes.

6 As soon as buffer 7.00 is detected and the symbol appears, press the button.

The measured value flashes on the display. The symbol at the bottom left means that the 949 pH Meter is calibrated in the neutral range.

The 949 pH Meter is ready to detect the 2nd calibration point.

Next to the **2ND POINT PH** message, all buffers that the 949 pH Meter can automatically detect will appear in turn.

NOTE

The **CHANGE BUFFER** message prompts the user to change the buffer solution.

Calibrating the 2nd point

1. Remove the electrode from the buffer solution.
2. Rinse the electrode with distilled water.
3. Immerse the electrode in the pH 4.00 buffer solution.

   The **WAIT FOR STABILITY** message appears on the display and the symbol flashes.
4. As soon as buffer 4.00 is detected and the symbol appears, press the OK setup button.

   The measured value will appear on the display and briefly after that, the slope.

   The symbol will appear next to the symbol. The symbol means that the 949 pH Meter is calibrated in the acidic range.

The 949 pH Meter is ready to detect the 3rd calibration point.

All of the buffers that the 949 pH Meter can detect automatically will appear next to the **3RD POINT PH** message.

NOTE

The **CHANGE BUFFER** message prompts the user to change the buffer solution.

Calibrating the 3rd point

1 Remove the electrode from the buffer solution.

2 Rinse the electrode with distilled water.

3 Immerse the electrode in the pH 9.00 buffer solution.

The **WAIT FOR STABILITY** message appears on the display and the //// symbol flashes.

NOTE

When changing from an acidic pH value to an alkaline pH value, it may take a few seconds longer to achieve stability.

4 As soon as buffer 9.00 is detected and the ☺ symbol appears, press the OK setup button.

The measured value will appear on the display and briefly after that, the 2nd slope.

The symbol will appear next to the and symbols. The symbol means that the 949 pH Meter is calibrated in the alkaline range.

After completing the 3rd calibration point, the 949 pH Meter automatically returns to *measuring mode*.

- For a 1-point calibration, press the ESC CAL button after completing the 1st calibration point.
- For a 2-point calibration, press the ESC CAL button after completing the 2st calibration point.

NOTE

The calibration of the electrodes is important for the quality and trueness of the measurement. Check that the buffers used are new and uncontaminated, and are at the same temperature.

CAUTION

Before proceeding with the calibration procedures of the sensors, carefully read the safety data sheets for the following substances used:

- Buffer solutions
- Storage solution for pH electrodes
- Electrolyte for pH electrodes

5.5.4 Manual calibration

Manual calibration is depicted using 2-point calibration pH 6.79 and pH 4.65 (DIN19267) as an example.

Opening the menu

1. Open the pH settings.
2. Use the and buttons to select the **P1.1** setting.
3. Confirm the selection with the button.
4. Use the and buttons to select **CUSTOM**.
5. Confirm the selection with the button.
6. Press the button twice to return to *measuring mode* in the pH area.

Calibrating the 1st point

1. Press the button to access *calibration mode*.
2. Rinse the electrode with distilled water.
3. Immerse the electrode in the first pH buffer solution (e.g. pH 6.79).

The **WAIT FOR STABILITY** message appears on the display and the symbol flashes.

4 As soon as the symbol appears and the pH value flashes, enter the correct value with the and buttons (e.g. 6.79).

NOTE

- The **ADJUST VALUE** message prompts the user to adjust the value.
- Check the buffer value in relation to the temperature.

The **WAIT FOR STABILITY** message appears on the display and the symbol flashes.

5 As soon as the symbol appears again, confirm the 1st calibration point with the button.

The measured pH value will flash on the display. The symbol appears with the color code of the 1st buffer.

Calibrating the 2nd point

1 Remove the electrode from the buffer solution.

2 Rinse the electrode with distilled water.

3 Immerse the electrode in the next pH buffer solution (e.g. pH 4.65).

The **WAIT FOR STABILITY** message appears on the display and the symbol flashes.

4 As soon as the symbol appears and the pH value flashes, enter the correct value with the and buttons (e.g. 4.65).

NOTE

The **ADJUST VALUE** message prompts the user to adjust the value.

The **WAIT FOR STABILITY** message appears on the display and the /// symbol flashes.

5 As soon as the ☺ symbol appears again, confirm the 2nd calibration point with the OK setup button.

The measured value will flash on the display and briefly after that, the slope.

Next to the ▼ symbol, the ▼ symbol will appear with the color code of the 2nd buffer.

After completing the 2rd calibration point, the 949 pH Meter automatically returns to *measuring mode*.

- For a 1-point calibration, press the ESC CAL button after completing the 1st calibration point.

NOTE

If manual temperature measurement is used, then update the temperature value before calibrating the 949 pH Meter *(see chapter 5.3, page 18)*.

5.5.5 pH measurement

Measuring the pH value

1 In *measuring mode*, press the MODE button repeatedly until **pH** appears at the top left of the display.

2 Plug the electrode into the **pH/mV** connection socket.

NOTE

If no electrode with an integrated temperature sensor or with an external Pt1000 temperature sensor is used, Metrohm recommends manually updating the temperature value *(see chapter 5.3, page 18)*.

3 Remove the vessel from the electrode.

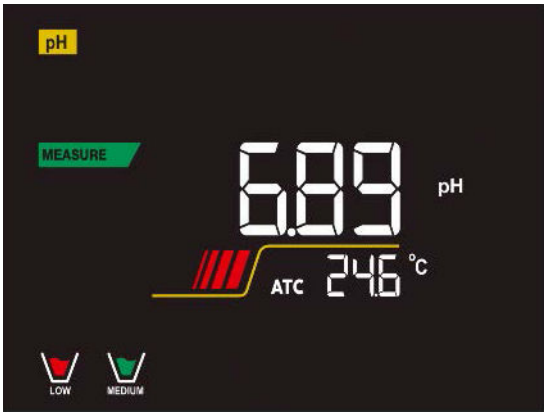
4 Screw open the closure of the filler opening on the electrode.

5 Rinse the electrode with distilled water.

6 Immerse the electrode in the sample.

NOTE

If the //// symbol appears on the display, then the measurement is not stable yet. The measurement is not correct until the ☺ symbol appears.



Example of an unstable measurement

Example of a stable measurement

Storing the electrode

1 Rinse the electrode with distilled water after the measurement.

2 Place the electrode in the recommended storage solution (6.2323.000 for electrolyte c(KCl) = 3 mol/L).

The 949 pH Meter is suitable for precision measurements. The 949 pH Meter also offers the option of always being able to see the calibration values or to set an expiry date.

5.6 ORP parameters

5.6.1 Sensors

ORP sensors can be used with the 949 pH Meter to measure the oxide reduction potential.

Plugging in sensors

1 Plug the Redox electrode into the **pH/mV** connection socket.

2 If required, plug the temperature sensor into the **Temp** connection socket.

5.6.2 ORP settings

Opening the ORP settings

1 Press the OK setup button in *measuring mode* to access the settings.

2 Use the and RM buttons to select the **P2.0** ORP parameters.

3 Confirm the selection with the OK setup button.

4 Use the and RM buttons to select the setting to be edited.

5 Confirm the selection with the OK setup button.

The following submenus can be found in the ORP settings:

Setting	Meaning	Selection	Default value
P2.6 CALIBRATION DATA	ORP calibration data	VIEW | PRINT	
P2.7 SET DUE CAL	ORP calibration time	NO | HOURS | DAYS	NO
P2.8 RESET SETTINGS	Resetting ORP settings	YES | NO	NO
P2.9 TEMPERATURE CAL	ORP temperature offset	YES | NO	NO

P2.6 ORP calibration data

Information about the last calibration performed is displayed or printed under **P2.6**.

VIEW

The following results are shown automatically on the display, one after the other:

- Date and time of calibration
- Offset value of electrodes in mV
- Calibration temperature

PRINT

The following results are printed out:

- Model number and serial number
- Date and time of calibration
- Offset value of electrodes in mV
- Calibration temperature

NOTE

- Use only the original printer specified by the manufacturer.
- Ensure that the printer is connected and switched on.
- Ensure that the paper roll and the cassette are inserted correctly.

Additional information can be found in the manual for the printer.

P2.7 ORP calibration time

P2.7 is used to set the time until the next calibration. The **P2.7** setting is important for GLP protocols. No default value is set for the calibration time.

1 Selecting the unit

- Use the and buttons to select **HOURS** or **DAYS**.
- Confirm the selection with the button.

A number appears in the middle of the display. The number defines the maximum number of days or hours that may elapse between 2 calibrations.

2 Setting the time

- Use the and buttons to change the number.
- Confirm the setting with the button.

As soon as a calibration time has been set, the symbol will appear on the display in *measuring mode*.

As soon as the set calibration time is reached, the 949 pH Meter prevents further measurements and the and symbols flash on the display.

NOTE

The **MAKE A NEW CAL** message prompts the user to recalibrate the ORP sensor.

3 Starting the calibration

Press the button to start the calibration.

P2.8 Resetting ORP settings

All ORP settings can be reset to the default values in **P2.8**.

1 If the 949 pH Meter does not work perfectly or calibrates incorrectly, select **YES** with the and buttons.

2 Confirm the selection with the button.

NOTE

All saved data is retained when resetting the ORP settings.

P2.9 ORP temperature offset

All devices of the 949 pH Meter type are precalibrated for a correct temperature measurement. If the temperature sensor malfunctions, there may be a difference between the measured temperature and the actual temperature.

P2.9 is used to perform an offset alignment of the temperature of up to ±5 °C:

1 Use the and buttons to correct the temperature offset value.

2 Confirm the setting with the button.

5.6.3 Automatic calibration

It is possible to perform an offset adjustment of the sensor with an automatic calibration at a predefined point. The 949 pH Meter automatically detects the **Redox solution 250 mV / 25 °C**. Contact your regional Metrohm representative to purchase the
Redox solution 250 mV / 25 °C.

The 949 pH Meter can correct the sensor by ±75 mV with an offset alignment.

Automatic calibration with the 250 mV Redox solution

1 In *measuring mode*, ORP press the button to access *calibration mode*.

The **POINT ORP 250** message appears on the display. The message means that the 949 pH Meter needs 250 mV as a calibration point.

2 Rinse the electrode with distilled water.

3 Immerse the electrode in the 250 mV Redox solution.

The **WAIT FOR STABILITY** message appears on the display and the symbol flashes.

NOTE

The symbol is replaced by the symbol as soon as the solution is detected and the signal is stable.

4 Press the OK setup button as soon as the ☺ symbol appears.

The measured value flashes on the display. The symbol appears at the bottom left. The symbol shows that the 949 pH Meter is calibrated.

The 949 pH Meter automatically returns to *measuring mode*.

CAUTION

Before proceeding with the calibration procedures of the sensors, carefully read the safety data sheets for the following substances used:

- Redox standard solutions
- Storage solution for ORP electrodes
- Electrolyte for ORP electrodes

5.7 Data processing

5.7.1 General

The 949 pH Meter can save data in the GLP format in the internal device memory.

- The 949 pH Meter can save up to 1,000 data points. No values are overwritten when the memory is full. The number of saved values for the respective parameter appears in *measurement mode* next to the M+ symbol.
- The values can be retrieved on the display.
- The values can be recorded manually or automatically at preset intervals.

Printing data with an external printer

- Order the TX-900MH impact printer separately.
- Plug the printer into the **Printer** connection socket on the rear of the 949 pH Meter using the RS-232 cable.
- Connect the power supply unit to the energy supply.
- Press the on/off button to switch on the printer.

Consult the printer manual for additional information.

NOTE

Use only the TX-900MH impact printer.

Contact your regional Metrohm representative for additional information.

The TX-900MH impact printer includes a USB connecting cable, a Y cable, and an RS-232 cable to connect it to the device.

5.7.2 Data processing settings

Opening Data processing settings

1. Press the OK setup button in *measuring mode* to access the settings.
2. Use the ▲ and RM ▼ buttons to select the **P8.0** data processing settings.
3. Confirm the selection with the OK setup button.
4. Use the ▲ and RM ▼ buttons to select the setting to be edited.
5. Confirm the selection with the OK setup button.

The following submenus can be found in the data processing settings:

Setting	Meaning	Selection	Default value
P8.1 LOG TYPE	Data collection	MANUAL | HOURS | MINUTES	MANUAL
P8.2 CLEAR DATA	Data deletion	YES | NO	NO
P8.3 SAVE DATA	Data output	MEMORY | PRINTER	MEMORY
P8.4 PRINT FORMAT	Data printout	SIMPLE | COMPLETE	SIMPLE

P8.1 Data collection

The type of data collection is defined in **P8.1**.

- **MANUAL**: Data is collected as soon as the button is pressed.
- **HOURS | MINUTES**: Define a frequency range for automatic data collection.

NOTE

The green LED will flash for 5 s as soon as a value has been manually or automatically saved.

P8.2 Deleting data

P8.2 is used to delete the saved data and empty the memory.

The number of the currently saved values appears next to the M+ symbol.

- Use the and buttons to select **YES** to delete the data.

P8.3 Outputting data

P8.3 is used to decide where the recorded data is output.

- **MEMORY**: The 949 pH Meter saves the collected data in the internal device memory. The total number of the currently saved values appears next to the M+ symbol.

NOTE

The 949 pH Meter can save up to 1,000 data points.

- **PRINTER**: The TX-900MH impact printer connected via the RS-232 cable prints out the data collected. Select which information is to be printed in the header in the **P8.4** menu.

Default value: **MEMORY**

P8.4 Printing data

P8.4 is used to select the information to be printed.

- **SIMPLE**: The device model, serial number, date and time of the last calibration are printed.
- **COMPLETE**: The calibration data is printed out in addition to the information from the **SIMPLE** print format. The calibration data appears in the **P1.6** (pH) and **P2.6** (ORP) calibration settings.

Default value: **SIMPLE**

NOTE

The data is printed out in the following cases:

- As soon as a printout of certain data for a certain parameter is started for the first time.
- As soon as a new calibration is performed.

5.7.3 Automatic data collection

Example: Automatically record the pH value in the internal device memory every 2 minutes.

1 Opening the settings

- Use the MODE button to change to the **pH** range.
- Press the OK setup button to access the settings.
- Open the **P8.0** memory settings.
- Confirm the selection with the OK setup button.
- Use the ↑ and RM buttons to select the **P8.1** memory setting.
- Confirm the selection with the OK setup button.

2 Setting the frequency range

- Use the ↑ and RM buttons to select **MINUTES**.
- Confirm the selection with the OK setup button.
- Use the ↑ and RM buttons to change the flashing number on the display to **2**.
- Confirm the setting with the OK setup button.

3 Opening the measuring mode

- Press the ESC CAL button twice to return to *measuring mode*.

The symbol appears at the bottom of the display and shows that an automatic data collection in a frequency range has been set.

4 Starting the data collection

Press the ↑ button to start the data collection.

- The symbol flashes on the display. The flashing symbol shows that saving is in progress.

5 Exiting the data collection

Press the button to exit the data collection.

NOTE

If automatic data collection is set, but not in operation, then the symbol will remain on the display.

NOTE

- As soon as the measuring parameter is changed, automatic data collection ends.
- Data collection ends automatically as soon as the total capacity of 1,000 data points is reached.

5.7.4 Manual data collection

Example: Save a pH value manually.

1 Opening the settings

- Use the MODE button to change to the **pH** range.
- Press the OK setup button to access the settings.
- Open the **P8.0** memory settings.

  Confirm the selection with the OK setup button.
- Use the and RM buttons to select the **P8.1** memory setting.
- Confirm the selection with the OK setup button.

2 Setting Manual data collection

- Use the and RM buttons to select **MANUAL**.
- Confirm the selection with the OK setup button.
- Press the ESC CAL button twice to return to *measuring mode*.

3 Saving data manually

Press the button as soon as a value needs to be saved.

5.7.5 Printing data

Example: Printing out the pH value and calibration data manually.

1 Opening the settings

- Use the MODE button to change to the pH range.
- Open the **P8.0** memory settings.
- Use the and RM buttons to select the **P8.1** memory setting.
- Confirm the selection with the OK setup button.

2 Selecting Manual data collection

- Use the and RM buttons to select **MANUAL**.
- Confirm the selection with the OK setup button.

3 Selecting printing

- Select the **P8.3** memory setting.
- Confirm the selection with the OK setup button.
- Use the and RM buttons to select **PRINTER**.
- Confirm the selection with the OK setup button.

4 Selecting the print format

- Select the **P8.4** memory setting.
- Confirm the selection with the OK setup button.
- Use the and RM buttons to select **COMPLETE**.
- Confirm the selection with the OK setup button.

5 Opening the measuring mode

- Press the ESC CAL button to return to *measuring mode*.

6 Printing data

Press the button to print the calibration data in GLP format.

NOTE

The values saved in the internal device memory cannot be printed out.

5.7.6 Retrieving the memory

1. In *measuring mode*, press the RM button for the required parameter to switch to *retrieve memory* mode.

   The most recently saved values appear on the display.

2. Go through the saved values with the ▲ and RM buttons.

   NOTE

   The number next to the M+ shows the number of the saved value.

3. Press the ESC CAL button to return to *measuring mode*.

5.8 Device settings

Opening the device settings

1. Press the OK setup button in *measuring mode* to access the settings.
2. Use the ▲ and RM buttons to select the **P9.0** device settings.
3. Confirm the selection with the OK setup button.
4. Use the ▲ and RM buttons to select the setting to be edited.
5. Confirm the selection with the OK setup button.

The following submenus can be found in the device settings:

Setting	Meaning	Selection	Default value
P9.1 TEMPERATURE UNIT	Temperature unit	°C | °F	°C
P9.2 DATE AND TIME	Date and time		
P9.4 BRIGHTNESS	Brightness	LOW | NORMAL | HIGH	NORMAL
P9.7 SERIAL NUMBER	Serial number		
P9.8 RESET SETTINGS	Resetting settings	YES | NO	NO

P9.1 Temperature unit

Select the temperature unit to be used in **P9.1**.

- **°C**: degrees Celsius
- **°F**: degrees Fahrenheit

Default value: **°C**

P9.2 Date and time

The date and time on the 949 pH Meter are changed under **P9.2**.

1 Use the and buttons to change the year.

2 Confirm the setting with the button.

3 Repeat steps 1 and 2 with the month and day and then with the hours and minutes.

The device switches to *measuring mode* with the parameter most recently used.

NOTE

The date, time and all GLP data are also retained in the event of a power failure.

P9.4 Brightness

P9.4 is used to set the screen brightness.

- **LOW**
- **NORMAL**
- **HIGH**

Default value: **NORMAL**

P9.7 Serial number

P9.7 displays the serial number of the 949 pH Meter.

P9.8 Resetting settings

P9.8 is used to reset all device settings to the default values.

1 If the 949 pH Meter does not work perfectly or if the wrong settings have been made, then select **YES** with the ▲ and ▼ buttons.

2 Confirm the selection with the OK setup button.

NOTE

All saved data is retained when resetting the device settings.

6 Maintenance

6.1 Care

The 949 pH Meter requires appropriate care. Excess contamination of the device may result in functional disruptions and a reduction in the service life of the mechanical and electronic components.

Remove spilled chemicals and solvents immediately. Above all, protect the plug connections on the rear of the instrument (in particular the power socket) from contamination.

CAUTION

The power plug should be unplugged immediately if aggressive media have found their way into the interior of the device to prevent serious damage to the device electronics. If such damage should occur, please inform your regional Metrohm service representative.

6.2 Maintenance by the regional Metrohm service representative

Maintenance of the 949 pH Meter is best carried out as part of annual service, which is performed by specialist personnel from Metrohm. A shorter maintenance interval may be necessary if you frequently work with caustic or corrosive chemicals.

The regional Metrohm service representative offers every form of technical advice for maintenance and service of all Metrohm devices.

6.3 Cleaning

Prerequisite:

- The instrument is switched off and disconnected from the energy supply.

Required accessories:

- Cleaning cloth (soft, lint-free)
- Deionized water or ethanol or isopropanol

1. Clean the surface with a damp cloth. Remove coarse contamination with ethanol.
2. Wipe the surface with a dry cloth.
3. Clean the connectors with a dry cloth.

7 Troubleshooting

7.1 General

If you experience problems during measurements, then you can search for the cause in the following places:

Application

Difficult sample matrices or interfering influences may render accurate measurements impossible (e.g. insufficient ionic strength, presence of interfering ions, etc.).

Metrohm will support you in choosing the appropriate analysis conditions and configuring the device method with **Application Bulletins** and **Application Notes**.

Buffer solutions / standard solutions

The precision of the measurements mainly depends on the correct calibration of the sensors. To do so, you should use clean and fresh buffer solutions or standard solutions.

A common cause of incorrect calibrations is, for example, the use of an old pH 10 or pH 12 buffer. The pH value of an old buffer may markedly deviate from the certified pH value of a new buffer as a result of the introduction of CO_2 from the air.

Sensors

The sensors are the most important component in the entire measuring system.

Please read the corresponding leaflets on how to handle sensors correctly.

Device

If the 949 pH Meter may possibly be the cause of a measuring problem, then start by checking all configuration settings and parameter settings.

The 949 pH Meter will use appropriate messages to notify you directly of problems during operation.

You can find an explanation of these messages in the **Messages** chapter *(see chapter 7.3, page 48)*.

7.2 Problems

The following list describes some general problems that might occur during measurements. Furthermore, the possible causes and solution approaches are described.

NOTE

Sensor treatment

Follow the instructions given in the respective leaflets for sensors cleaning and maintenance.

7.2.1 Troubleshooting

Problem	Cause	Remedy
Measured value setting is sluggish.	*The glass membrane or the diaphragm is contaminated.*	▪ Clean the electrode following the instructions in the leaflet.
No measuring signal.	*The sensor is not connected.*	▪ Connect the sensor.
	The sensor is defective.	▪ Replace the sensor.
	The cable is defective.	▪ Replace the cable.
	The electrode's reference system contains air.	▪ Repair the electrode following the instructions in the leaflet.
	The measuring input and/or the measuring channel is defective.	▪ Send the measuring instrument to your regional Metrohm service representative for checks and, if necessary, repair.
The measured value drift criterion is not fulfilled.	*The glass membrane or the diaphragm is contaminated.*	▪ Clean the electrode following the instructions in the leaflet.
	The pH value or the temperature of the measuring solution is not stable.	▪ Do not wipe the sensor with a cloth. ▪ Control the temperature of the measuring solution.
	The measurement takes place in an organic solution.	▪ Use the correct sensor.

Problem	Cause	Remedy
	A non-Metrohm power supply unit is connected.	▪ Use only the power supply unit provided during measurement operation.
The measured value is evidently wrong.	*The pH calibration is faulty.*	▪ Check and repeat the calibration. ▪ Check and/or replace the buffers. ▪ Check the buffer selection in the settings.
	The temperature specification is incorrect.	▪ Enter the correct measuring temperature.
	The glass membrane or the diaphragm is contaminated.	▪ Clean the membrane or the diaphragm following the instructions in the corresponding leaflet.
	The electrolyte is overaged.	▪ Replace the electrolyte.
	The sensor is defective.	▪ Replace the sensor.
The slope is insufficient during calibration.	*The glass membrane or the diaphragm is contaminated.*	▪ Clean the electrode following the instructions in the leaflet.
	The hydrated layer of the glass membrane is reduced by anhydrous solutions.	▪ Immerse the glass membrane in deionized water for 5 min to restore the hydrated layer.
	The buffer solutions are not OK.	▪ Replace the buffer solutions.
	The sensor is "worn out".	▪ Replace the sensor.

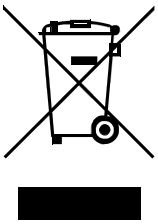
7.3 Messages

The following error messages may appear during calibration:

Error message	Meaning
NOT STABLE	The OK setup button was pressed during an unstable signal. Wait for the stability signal to confirm the calibration point.
WRONG BUFFER	The buffer is contaminated or is not a member of one of the detected buffer families.
SLOPE OUT OF RANGE	The slope of the calibration curve is outside the accepted range between 80% and 120%.

Error message	Meaning
CALIBRATION TOO LONG	The calibration has exceeded the time limit. Only the points calibrated up to that point are saved.

8 Recycling and disposal



Properly dispose of chemicals and of the product to reduce negative effects on the environment and public health. Local authorities, waste disposal companies or dealers provide more detailed information on disposal. Observe the WEEE EU directive (WEEE = Waste Electrical and Electronic Equipment) for the proper disposal of waste electronic equipment within the European Union.

9 Appendix

9.1 Saved buffer series

The temperature-dependent pH values of the important commercially available pH buffer solutions are stored in the device for automatic buffer recognition during pH calibration.

In addition to the Metrohm buffer solutions, other reference buffers are also included in the tables.

CAUTION

Buffer quality

The precision of pH measurements mainly depends on the correct calibration of the sensor. To do so, you should use clean and fresh buffer solutions. A common cause of incorrect calibration is, for example, the use of an old pH 10 or pH 12 buffer. The pH value of a buffer solution may markedly deviate from the certified pH value of a new buffer solution as a result of the introduction of CO_2 from the air.

The following tables provide an overview of the stored pH(T) series:

NOTE

pH values printed in **bold** are the values for the reference temperature of the respective buffer set.

pH values highlighted in *italics* are interpolated or extrapolated values.

The other pH values correspond to the manufacturer's specifications.

9.1.1 Metrohm

Table 5 Metrohm buffer solutions

Temp. (°C)	Metrohm pH 4.00	Metrohm pH 7.00	Metrohm pH 9.00
0	3.99	7.11	9.27
5	3.99	7.08	9.18
10	3.99	7.06	9.13
15	3.99	7.04	9.08
20	3.99	7.02	9.04
25	**4.00**	**7.00**	**9.00**
30	4.00	6.99	8.96
35	4.01	6.98	8.93
40	4.02	6.98	8.90
45	4.03	6.97	8.87
50	4.04	6.97	8.84

NOTE

Update

The values of the individual buffers with the corresponding temperatures are kept as up to date as possible.

However, they may be changed by the respective manufacturers.

9.1.2 NIST (according to DIN standard 19266, 2015)

Table 6 NIST buffer solutions

Temp. (°C)	NIST (according to DIN standard 19266, 2015-05) pH 1.68	pH 4.00	pH 6.86	pH 9.18	pH 12.45
0	1.67	4.01	6.98	9.46	13.43
5	1.67	4.01	6.95	9.40	13.21
10	1.67	4.01	6.92	9.33	13.00
15	1.67	4.00	6.90	9.28	12.81
20	1.68	4.00	6.87	9.23	12.63

Temp. (°C)	NIST (according to DIN standard 19266, 2015-05) pH 1.68	pH 4.00	pH 6.86	pH 9.18	pH 12.45
25	**1.68**	**4.01**	**6.86**	**9.18**	**12.45**
30	1.69	4.01	6.85	9.14	12.29
35	1.69	4.02	6.84	9.11	12.13
40	1.70	4.03	6.84	9.07	11.99
45	*1.70*	*4.04*	*6.83*	*9.04*	11.84
50	1.71	4.06	6.83	9.01	11.70

NOTE

Update

The values of the individual buffers with the corresponding temperatures are kept as up to date as possible.

However, they may be changed by the respective manufacturers.

The NIST buffers are identical to the buffer solutions that are used in Chinese pharmacopoeia.

9.1.3 USA

Table 7 Buffer solutions USA

Temp. (°C)	USA pH 1.68	pH 4.01	pH 7	pH 10.01	pH 12.45
0	1.67	4.01	7.12	10.32	13.43
5	*1.67*	4.01	*7.09*	*10.25*	13.21
10	1.67	4.01	7.06	10.18	13.00
15	*1.67*	*4.00*	*7.04*	*10.12*	12.81
20	1.68	4.00	7.02	10.06	12.63
25	**1.68**	**4.01**	**7.00**	**10.01**	**12.45**
30	1.69	4.01	6.99	9.97	12.29
35	*1.69*	*4.02*	*6.98*	*9.93*	12.13
40	1.70	4.03	6.97	9.89	11.99
45	*1.70*	*4.04*	*6.97*	*9.86*	11.84
50	1.71	4.06	6.97	9.83	11.70

NOTE

Update

The values of the individual buffers with the corresponding temperatures are kept as up to date as possible.

However, they may be changed by the respective manufacturers.

10 Technical specifications

pH	
Measuring range	-2 to 16
Resolution	0.1/0.01
Accuracy	±0.02
Calibration points	**AUTO:** 1–3 **CUSTOM:** 2 user values
Buffer recognition	METROHM, USA, NIST
Buffer display	Yes
Calibration report	Yes
Stability criterion	LOW, MEDIUM, HIGH
mV	
Measuring range	-1,000 to +1,900 mV
Resolution	1/0.1 mV
ORP	
Calibration points	1 calibration point = 250 mV
Temperature	
Measuring range	-10 to +110 °C
Resolution	0.1 °C
Accuracy	±0.5 °C
Temperature compensation ATC (Pt1000) and MTC	0 to +100 °C
Ambient conditions	
Nominal function range	0 °C to +45 °C, at max. 95% humidity, non-condensing
Storage	0 °C to +45 °C, at max. 95% humidity, non-condensing
Altitude	Max. 2,000 m above sea level
System	
GLP	Yes
Calibration monitoring	Yes
Internal memory	1,000 data points for each measuring parameter
Display	LCD (color) with background lighting
Brightness	Adjustable
IP protection	IP 54

Outputs	RS-232
Device voltage	5 V power supply unit
Power supply unit voltage	100–240 V
Noise level during normal operation	max. 80 dB
Nominal frequency range	50–60 Hz
Maximum power consumption	200 mA
Measurements	160 x 140 x 45 mm
Weight	380 g
Standards	EMC 2014/30/UE RoHS 2011/65/EU EN 61326-1 EN 61010-1