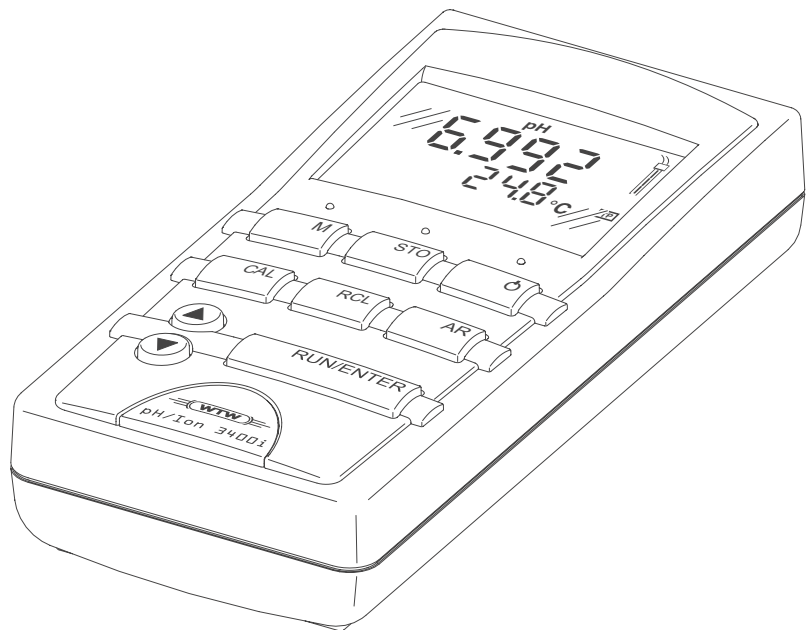


pH/ION 3400i



pH/Ion meter

**Accuracy when
going to press**

The use of advanced technology and the high quality standard of our instruments are the result of continuous development. This may result in differences between this operating manual and your instrument. Also, we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.

Warranty

We guarantee the instrument described for 3 years from the date of purchase.

The instrument warranty covers manufacturing faults that are discovered within the warranty period. The warranty does not cover components that are replaced during maintenance work, e.g. batteries.

The warranty claim extends to restoring the instrument to readiness for use but not, however, to any further claim for damages. Improper handling or unauthorized opening of the instrument invalidates any warranty claim.

To ascertain the warranty liability, return the instrument and proof of purchase together with the date of purchase freight paid or prepaid.

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Printed in Germany.

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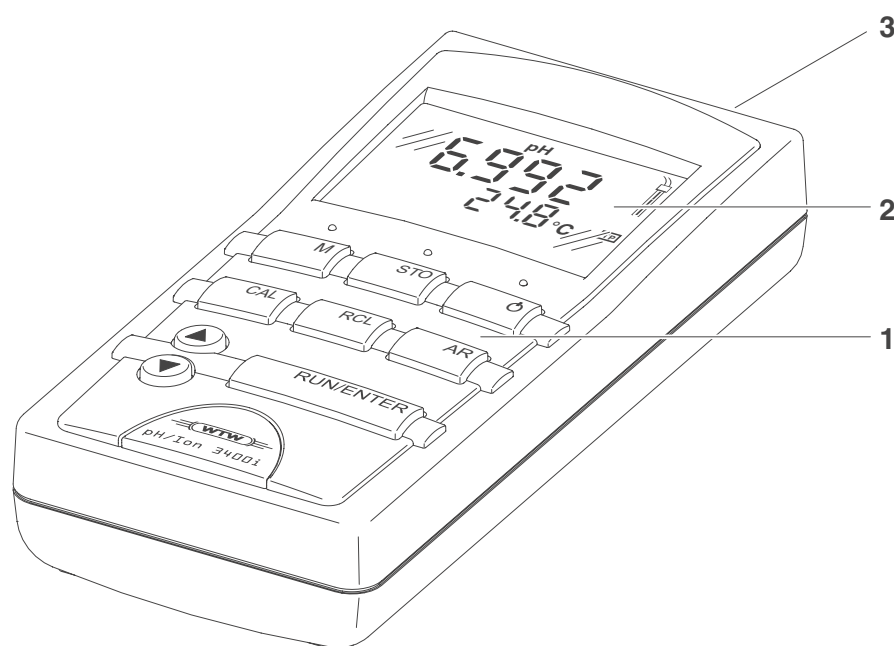
1 Overview

1.1 General features

This compact precision handheld meter enables you to carry out pH / ORP measurements and concentration measurements using ion selective electrodes rapidly and reliably.

The handheld meter provides the maximum degree of operating comfort, reliability and measuring certainty for all applications.

The proven MultiCal[®] calibration procedures and the special AutoRead function support you in your work with the handheld meter.



1	Keypad
2	Sample display
3	Jack field



Note

If you need further information or application notes, you can obtain the following material from WTW:

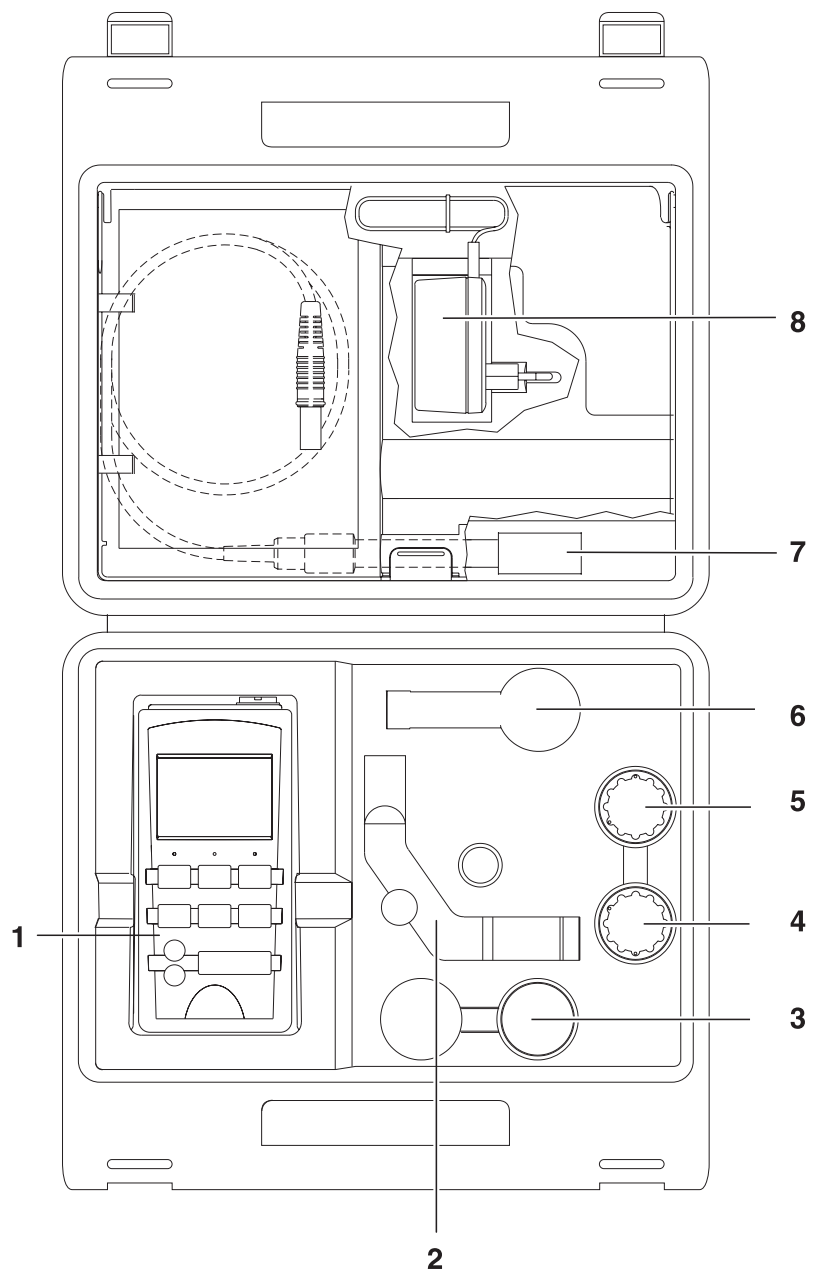
- Application reports
- Primers
- Safety datasheets.

You will find information on available literature in the WTW catalog or via the Internet.

1.2 SETs of equipment

The measuring instrument is also available as part of individual SETs of equipment.

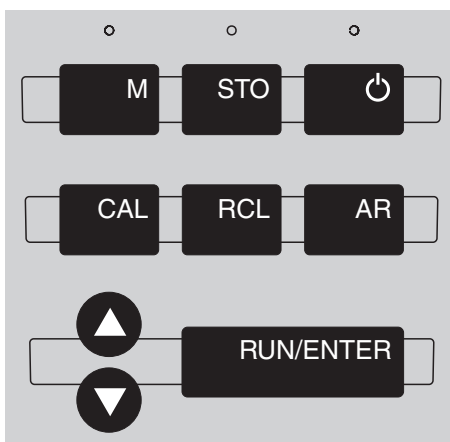
You will find additional information on this and other accessories in the WTW catalog or via the Internet.












Set (sample configuration):

1	pH/ION 3400i measuring instrument
2	Stand
3	Measuring beaker,50 ml
4	50 ml pH buffer solution, STP 4
5	50 ml pH buffer solution, STP 7
6	Storing solution for pH electrodes
7	pH combination electrode
8	Plug-in power supply (optional)

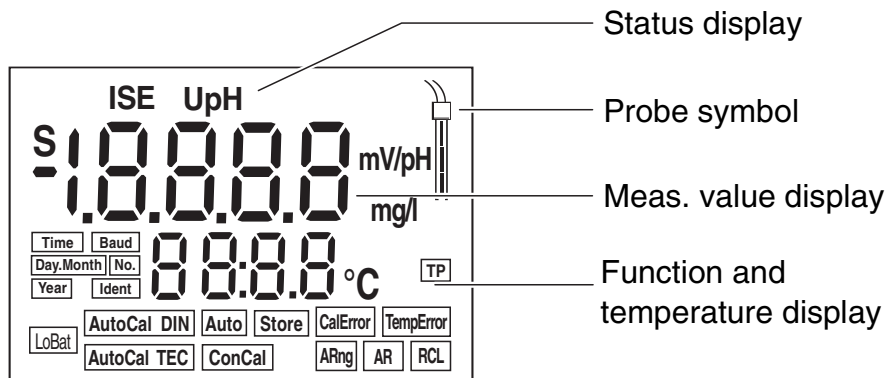
1.3 Keypad



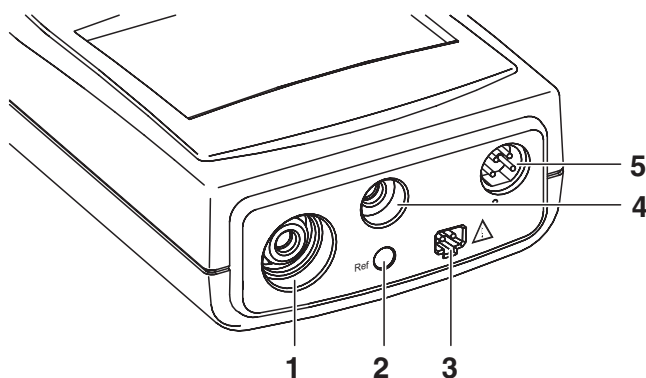
Key functions

	Select the measured variable <M> : – pH value / ORP voltage – Ion concentration
	Save a measured value <STO>
	Switch measuring instrument on/off <ON/OFF>
	Calibrate the currently set measured variable <CAL>
	Display/transmit measured values <RCL>
	Activate/deactivate the AutoRead function <AR>
	Select the measuring mode, increase values, scroll <▲ >
	Select the measuring mode, decrease values, scroll <▼ >
	Confirm entries, start AutoRead <RUN/ENTER>

1.4 Display



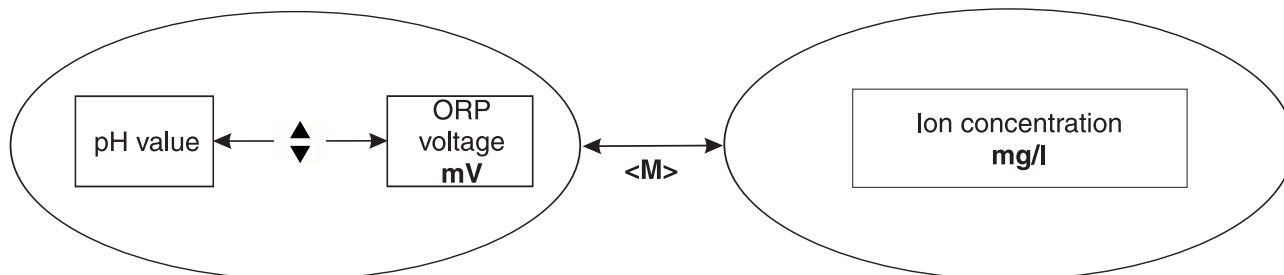
1.5 Jack field



1	pH electrode or ISE (combination) electrode
2	Reference electrode
3	Plug-in power supply (optional)
4	pH temperature sensor
5	Serial interface RS 232 / analog output (recorder)

1.6 Operating structure

The following overview diagram shows which keys you have to press to select between the different measuring modes:



2 Safety

This operating manual contains basic instructions that you must follow during the commissioning, operation and maintenance of the measuring instrument. Consequently, all responsible personnel must read this operating manual before working with the measuring system. The operating manual must always be available within the vicinity of the measuring system.

Target group

The measuring instrument was developed for work in the field and in the laboratory.

We assume that, as a result of their professional training and experience, the operators will know the necessary safety precautions to take when handling chemicals.

Safety instructions

The individual chapters of this operating manual use the following safety labels to indicate various types of danger:



Warning

indicates instructions that must be followed precisely in order to avoid the possibility of slight injuries or damage to the instrument or the environment.

Further notes



Note

indicates notes that draw your attention to special features.



Note

indicates cross-references to other documents, e.g. operating manuals.

2.1 Authorized use

The authorized use of the measuring instrument consists exclusively of the pH and ORP measurement or the measurement of the ion concentration in the field and laboratory.

The technical specifications as given in chapter 7 TECHNICAL DATA must be observed. Only the operation and running of the measuring instrument according to the instructions given in this operating manual is authorized.

Any other use is considered to be **unauthorized**.

2.2 General safety instructions

This instrument is built and inspected according to the relevant guidelines and norms for electronic measuring instruments (see chapter 7 TECHNICAL DATA).

It left the factory in a safe and secure technical condition.

Function and operating safety

The smooth functioning and operational safety of the measuring instrument can only be guaranteed if the generally applicable safety measures and the specific safety instructions in this operating manual are followed during operation.

The smooth functioning and operational safety of the measuring instrument can only be guaranteed under the environmental conditions that are specified in chapter 6 WHAT TO DO IF....

If the instrument was transported from a cold environment to a warm environment, the formation of condensate can lead to the faulty functioning of the instrument. In this event, wait until the temperature of the instrument reaches room temperature before putting the instrument back into operation.

Safe operation

If safe operation is no longer possible, the instrument must be taken out of service and secured against inadvertent operation!

Safe operation is no longer possible if the measuring instrument:

- has been damaged in transport
- has been stored under adverse conditions for a lengthy period of time
- is visibly damaged
- no longer operates as described in this manual.

If you are in any doubt, please contact the supplier of the instrument.

Obligations of the purchaser

The purchaser of the measuring instrument must ensure that the following laws and guidelines are observed when using dangerous substances:

- EEC directives for protective labor legislation
- National protective labor legislation
- Safety regulations
- Safety datasheets of the chemical manufacturers.

3 Commissioning

3.1 Scope of delivery

- 3400i handheld meter
- Plug-in power supply (optional)
- Operating manual and short operating manual
- 4 batteries, 1.5 V Mignon type AA (in the instrument)

For details of scope of delivery of SETs, see chapter 1.2 SETs OF EQUIPMENT and WTW catalog.

3.2 Initial commissioning

Perform the following activities:

- Set the date and time
- Connect the plug-in power supply (optional)

Setting the date and time

1	Press the <M> key and hold it down.
2	Press the <ON/OFF> key. The display test appears briefly on the display.
3	Press the <RUN/ENTER> key repeatedly until the date appears on the display.
4	Set the date of the current day with <▲> <▼>.
5	Confirm with <RUN/ENTER>. The date (month) flashes in the display.
6	Set the current month with <▲> <▼>.
7	Confirm with <RUN/ENTER>. The year appears on the display.
8	Set the current year with <▲> <▼>.
9	Confirm with <RUN/ENTER>. The hours flash on the display.
10	Set the current time with <▲> <▼>.
11	Confirm with <RUN/ENTER>. The minutes flash on the display.
12	Set the current time with <▲> <▼>.

- | | |
|----|---|
| 13 | Confirm with <RUN/ENTER> .
The instrument switches to a measuring mode. |
| 14 | Switch the instrument off using <ON/OFF> . |

Connecting the original plug-in power supply unit



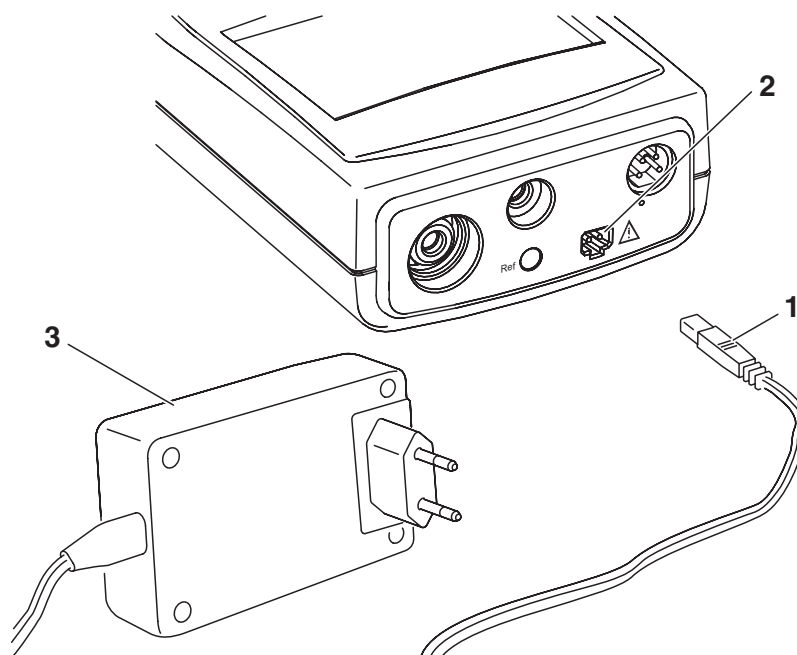
You can either operate the measuring instrument with batteries or with the plug-in power supply. The plug-in power supply supplies the measuring instrument with low voltage (12 VDC). This saves the batteries.

Warning

The line voltage at the operating site must lie within the input voltage range of the original plug-in power supply (see chapter 7 TECHNICAL DATA).

Warning

Use original plug-in power supplies only (see chapter 7 TECHNICAL DATA).



- | | |
|---|---|
| 1 | Plug the jack (1) into the socket (2) of the measuring instrument. |
| 2 | Connect the original WTW plug-in power supply (3) to an easily accessible mains socket. |

4 Operation

4.1 Switching on the measuring instrument

- 1 Press the <ON/OFF> key.
The display test appears briefly on the display.
After this, the measuring instrument automatically switches to the measuring mode.



Note

The measuring instrument has an energy saving feature to avoid unnecessary battery depletion. The energy saving feature switches the measuring instrument off if no key has been pressed for an hour.

The energy saving feature is not active

- if the power is supplied by the plug-in power supply,
- if the AutoStore function is active,
- if the communication cable and a PC with a running communication program are connected,
- if the printer cable is connected (for external printers).

4.2 pH value / ORP voltage

4.2.1 General information

Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect the pH electrode to the measuring instrument. If necessary, press the <M> key repeatedly until the status display <i>pH</i> (pH measurement) or <i>U</i> (measurement of the ORP voltage) appears.
2	Adjust the temperature of the buffer solutions or test solutions, or measure the current temperature, if you measure without a temperature sensor.
3	Calibrate or check the measuring instrument with the electrode.
4	Using <▲ > <▼>, toggle between the <i>pH</i> or <i>mV</i> measuring modes.



Note

Incorrect calibration of pH electrodes leads to incorrect measured values. Calibrate regularly before measuring.



Warning

When connecting an earthed PC/printer, measurements cannot be performed in earthed media as incorrect values would result. The RS232 interface is not galvanically isolated.

Temperature sensor

You can measure with or without a temperature sensor. If a temperature sensor is connected, it is indicated on the display by *TP*.



Note

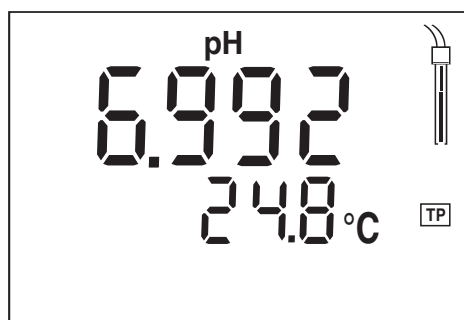
The measuring instrument automatically recognizes the type of the temperature sensor used. Therefore, you can connect temperature sensors of the NTC30 or Pt1000 type.

The temperature measurement is absolutely essential for a reproducible pH measurement. If the measurement is made without a temperature sensor, proceed as follows:

1	Measure the current temperature of the test sample using a thermometer.
2	Enter the temperature on the instrument: While pressing the <RUN/ENTER> key, enter the temperature value of the test sample with <▲ > <▼>.

4.2.2 Measuring the pH value

1	Perform the preparatory activities according to section 4.2.1.
2	Immerse the pH electrode in the test sample.
3	If required, enter the temperature of the test sample with <▲> <▼> while keeping the <RUN/ENTER> key depressed.
4	Press the <▲> <▼> keys until <i>pH</i> appears in the status display. The pH value appears on the display.



Setting the resolution

1	Press the <RUN/ENTER> key and hold it down.
2	Press the <M> key. The measured values are displayed with a high resolution, e.g. pH = 4.012.
3	Press the <RUN/ENTER> and <M> key once more. The measured values are displayed with a low resolution, e.g. pH = 4.01.

AutoRead AR (drift control)

The AutoRead function (drift control) checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of the measured values.

For identical measurement conditions, the following criteria apply:

Reproducibility	Response time
Better than 0.02	> 30 seconds

1	Call up the pH measuring mode with <M> and <▲> <▼> .
2	Activate the AutoRead function with <AR>. The current measured value is frozen (hold function).

3	Start AutoRead with <RUN/ENTER> . <i>AR</i> flashes until a stable measured value is reached. This measured value is transmitted to the interface.
4	If necessary, start the next AutoRead measurement with <RUN/ENTER> .
5	To terminate the AutoRead function: Press the <AR> key.

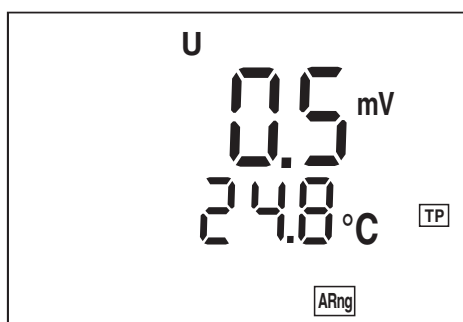
**Note**

The current AutoRead measurement can be terminated at any time (accepting the current value) by pressing **<RUN/ENTER>**.

4.2.3 Measuring the ORP voltage

In conjunction with an ORP electrode, e.g. SenTix ORP, the measuring instrument can measure the ORP voltage (mV) of a solution.

1	Perform the preparatory activities according to section 4.2.1.
2	Submerge the ORP electrode in the sample.
3	Press the <▲> <▼> keys until the U status display appears. The ORP voltage (mV) of the test sample appears on the display.
4	Wait for a stable measured value.

**Note**

ORP electrodes are not calibrated. However, you can check ORP electrodes using a test solution.

4.3 pH calibration

Why calibrate?

pH electrodes age. This changes the asymmetry (zero point) and slope of the pH electrode. As a result, an inexact measured value is displayed. Calibration determines the current values of the asymmetry and slope of the electrode and stores them in the measuring instrument. Thus, you should calibrate at regular intervals.

When to calibrate?

- After connecting another electrode
- When the sensor symbol flashes
 - (after the calibration interval has expired)
 - after a voltage interruption, e. g. after changing the batteries

You can select one of 3 calibration procedures:

AutoCal TEC

is specially matched to the WTW technical buffer solutions as a fully automatic **two-point calibration**. The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.8 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV. The calibration can be terminated after the first buffer solution. This corresponds to a **single-point calibration**. When doing so, the instrument uses the Nernst slope (-59,16 mV/pH at 25 °C) and determines the asymmetry of the electrode.

AutoCal DIN

is specially adapted to the permanently programmed buffer solutions in accordance with DIN 19266 as a fully automatic **two-point calibration**. The operating sequence of the AutoCal DIN calibration corresponds to that of the AutoCal TEC calibration. The calibration can only be terminated after the first buffer solution (**single point calibration**).

ConCal

This function is a conventional **two-point calibration** using two buffer solutions (pH 7.0 ± 0.5 and any other buffer solution) or a **single-point calibration** using any buffer solution, which is used as a high-speed method.

AutoRead

When calibrating with AutoCal TEC and AutoCal DIN, the AutoRead function is automatically activated.

The current AutoRead measurement can be terminated at any time (accepting the current value) by pressing **<RUN/ENTER>**.

Displaying the calibration data

You can view the data of the last calibration on the display. The proceeding is described on page 48.

Printing the calibration record

The calibration protocol contains the calibration data of the current calibration. You can transmit the calibration protocol to a printer via the serial interface (see page 51).



Note

You can automatically print a calibration protocol after the calibration. To do so, connect a printer to the interface according to section 4.7.2 before calibrating. After a valid calibration, the record is printed.






Sample printout:

```

CALIBRATION PROTOCOL
02.03.01      14:19
Device No.: 12345678
Calibration pH
Cal time: 01.03.01 / 15:20
Cal interval: 7d
AutoCal TEC   Tauto
Buffer 1      2.00
Buffer 2      4.01
Buffer 3      7.00 *
Buffer 4      10.00
C1           184.1 mV  25.0°C
C2            3.0 mV  25.0°C
S1           -59.4 mV/pH
ASY1         - 4 mV
Probe:       +++
    
```

Calibration evaluation

After the calibration, the measuring instrument automatically evaluates the calibration. The asymmetry and slope are evaluated separately. The worst evaluation appears on the display.

Display	Asymmetry [mV]	Slope [mV/pH]
	-15 ... +15	-60.5 ... -58
	-20 ... +20	-58 ... -57
	-25 ... +25	-61 ... -60.5 or -57 ... -56
	-30 ... +30	-62 ... -61 or -56 ... -50
Clean the electrode according to the electrode operating manual		
 Eliminate the error according to chapter 6 WHAT TO DO IF...	< -30 or > 30	... -62 or ... -50

Preparatory activities

1	Connect the pH electrode to the measuring instrument. If necessary, press the <M> key repeatedly until the status display <i>pH</i> (pH measurement) or <i>U</i> (measurement of the ORP voltage) appears.
2	Keep the buffer solutions ready.
3	Adjust the temperature of the solution and measure the current temperature if the measurement is made without the use of a temperature sensor (the <i>TP</i> display indicator is missing from the display).

4.3.1 AutoCal TEC

For this procedure, use any two WTW technical buffer solutions (pH values at 25 °C: 2.00 / 4.01 / 7.00 / 10.01).



Note

The calibration for pH 10.01 is optimized for the WTW technical buffer solution TEP 10 Trace or TPL 10 Trace. Other buffer solutions can lead to an erroneous calibration. The correct buffer solutions are given in the WTW catalog or in the Internet.



Note

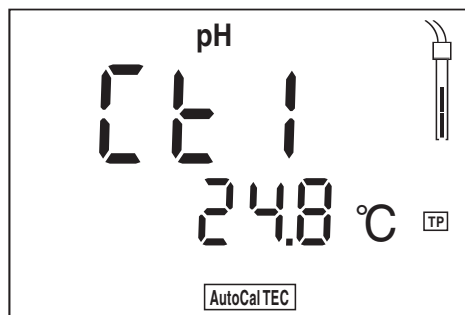
The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.8 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV.



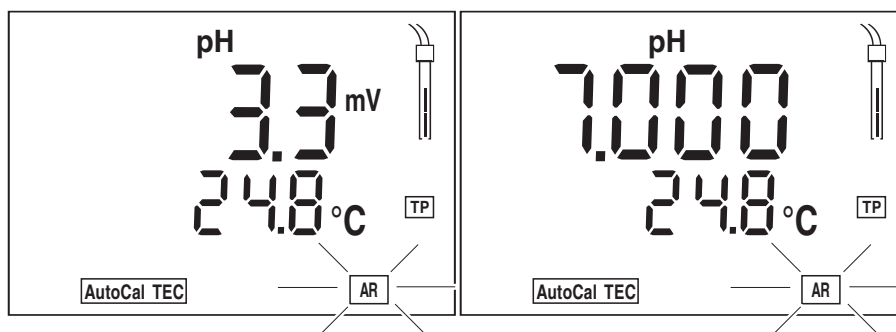
Note

Skip the steps 2 and 7 if you use a pH electrode with a temperature sensor.

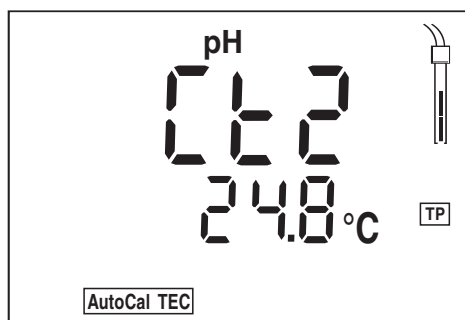
1	Press the <CAL> key repeatedly until the <i>Ct1</i> display indicator and the function display <i>AutoCal TEC</i> appears. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameters have been reset).
---	--



- 2 If required, enter the temperature of the first buffer solution with <▲> <▼> while keeping the <RUN/ENTER> key depressed.
- 3 Immerse the pH electrode in the first buffer solution.
- 4 Press the <RUN/ENTER> key.
The AR display indicator flashes.
The electrode voltage (mV) or the buffer nominal value appears on the display. Example:



- 5 When the measured value is stable, Ct2 appears.

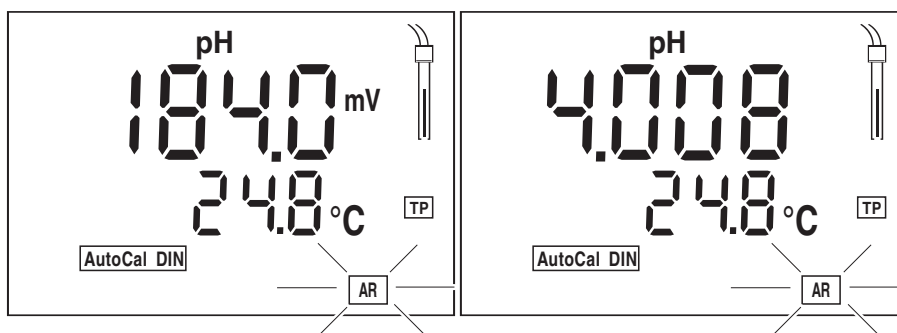


Note

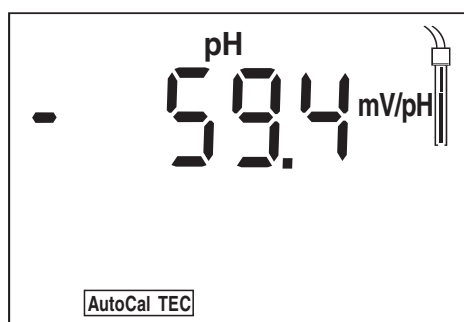
At this point, the AutoCal TEC calibration can be terminated with <M>. This corresponds to a **single-point calibration**. When doing so, the in-

strument uses the Nernst slope ($-59,16 \text{ mV/pH}$ at $25 \text{ }^\circ\text{C}$) and determines the asymmetry of the electrode.

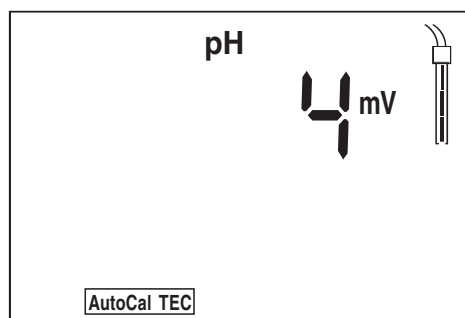
- | | |
|---|---|
| 6 | Thoroughly rinse the electrode with deionized water. |
| 7 | If required, enter the temperature of the second buffer solution with $\langle \blacktriangle \rangle$ $\langle \blacktriangledown \rangle$ while keeping the $\langle \text{RUN/ENTER} \rangle$ key depressed. |
| 8 | Immerse the pH electrode in the second buffer solution. |
| 9 | Press the $\langle \text{RUN/ENTER} \rangle$ key.
The <i>AR</i> display indicator flashes.
The electrode voltage (mV) or the buffer nominal value appears on the display. Example: |



- | | |
|----|---|
| 10 | When the measured value is stable, <i>AR</i> disappears. The value of the slope (mV/pH) appears on the display. The probe symbol shows the evaluation of the current calibration. |
|----|---|



- | | |
|----|---|
| 11 | Press the $\langle \text{RUN/ENTER} \rangle$ key. The value of the asymmetry (mV) appears on the display. |
|----|---|



12 | Switch to the measuring mode with <M>.

4.3.2 AutoCal DIN

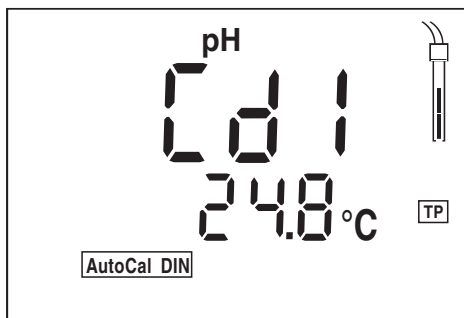
For this procedure, use two different standard buffer solutions according to DIN 19266 (type A, C, D or F with pH values at 25 °C of: 1.679 / 4.006 / 6.865 / 9.180).



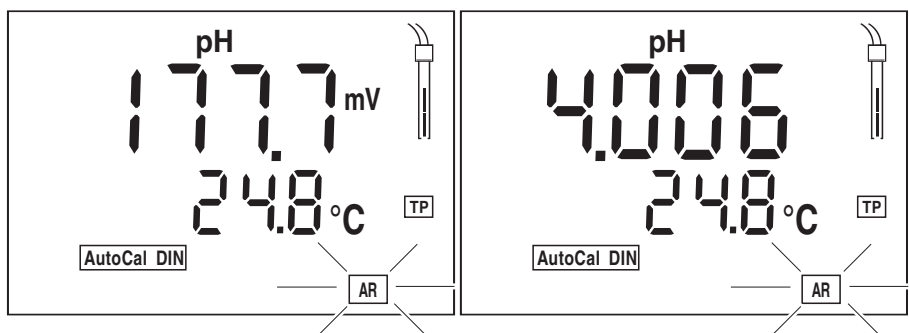
Note

Skip the steps 2 and 7 if you use a pH electrode with a temperature sensor.

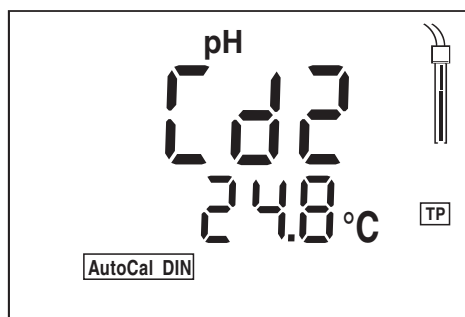
- 1 Press the **<CAL>** key repeatedly until the display *Cd1* and the function display *AutoCal DIN* appear. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameter has been reset).



- 2 If required, enter the temperature of the first buffer solution with **<▲>** **<▼>** while keeping the **<RUN/ENTER>** key depressed.
- 3 Immerse the pH electrode in the first buffer solution.
- 4 Press the **<RUN/ENTER>** key. The *AR* display indicator flashes. The electrode voltage (mV) or the buffer nominal value appears on the display. Example:



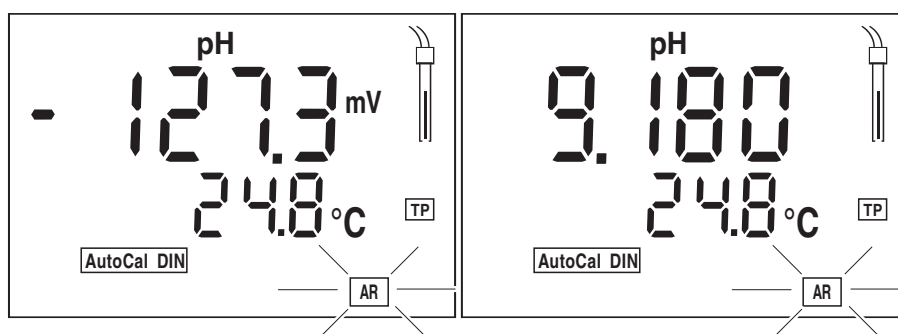
- 5 When the measured value is stable, *Cd2* appears.



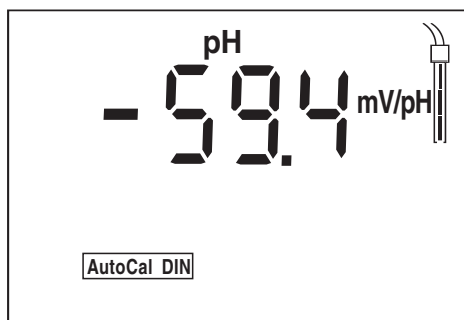
Note

At this point, the AutoCal DIN calibration can be terminated with **<M>**. This corresponds to a **single-point calibration**. When doing so, the instrument uses the Nernst slope (-59,16 mV/pH at 25 °C) and determines the asymmetry of the electrode.

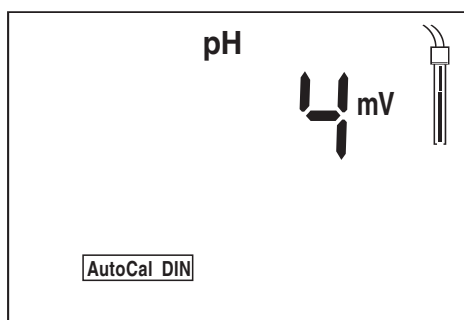
- 6 Thoroughly rinse the electrode with deionized water.
- 7 If required, enter the temperature of the second buffer solution with **<▲>** **<▼>** while keeping the **<RUN/ENTER>** key depressed.
- 8 Immerse the pH electrode in the second buffer solution.
- 9 Press the **<RUN/ENTER>** key.
The *AR* display indicator flashes.
The electrode voltage (mV) or the buffer nominal value appears on the display. Example:



- 10 When the measured value is stable, *AR* disappears. The value of the slope (mV/pH) appears on the display. The probe symbol shows the evaluation of the current calibration.



- 11 Press the **<RUN/ENTER>** key. The value of the asymmetry (mV) appears on the display.



- 12 Switch to the measuring mode with **<M>**.

4.3.3 ConCal

Two-point calibration

For this procedure, use two buffer solutions:

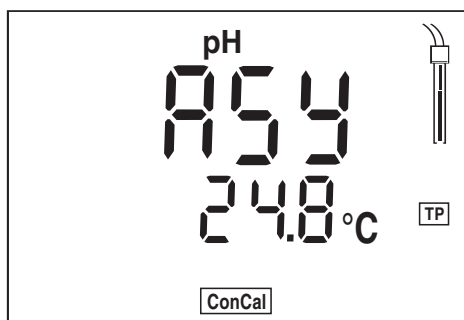
- pH 7.0 ± 0.5
- any other buffer solution



Note

Skip the steps 2 and 8 if you use a pH electrode with a temperature sensor.

- | | |
|---|--|
| 1 | Press the <CAL> key repeatedly until the ASY display and the ConCal function display appears. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameter has been reset). |
|---|--|

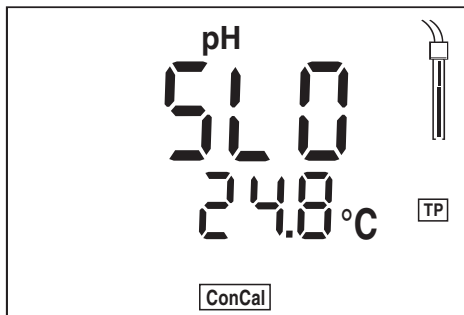


- | | |
|---|---|
| 2 | If required, enter the temperature of the first buffer solution with <▲> <▼> while keeping the <RUN/ENTER> key depressed. |
| 3 | Immerse the pH electrode in the first buffer solution (pH 7.0 ± 0.5 in two-point calibration). |
| 4 | Press the <RUN/ENTER> key.
The measured pH value appears on the display. |
| 5 | Set the measured value to the nominal pH value of the buffer solution (at the current temperature) with <▲> <▼>. |
| 6 | When the measured value is stable, press the <RUN/ENTER> key. The value of the asymmetry appears. |
| 7 | Press the <RUN/ENTER> key. SLO appears. |

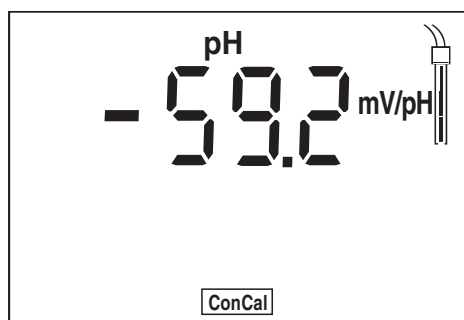


Note

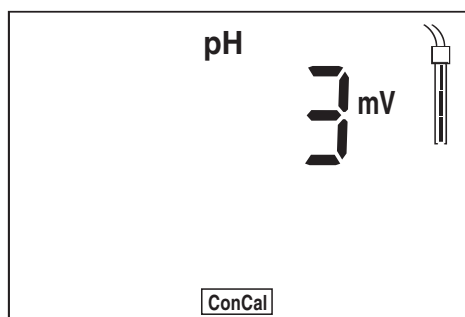
At this point, the ConCal calibration can be broken off with <M>. This corresponds to a **single-point calibration**. When doing so, the instrument uses the Nernst slope (-59,16 mV/pH at 25 °C) and the fixed asymmetry of the electrode.



8	Thoroughly rinse the electrode with deionized water.
9	If required, enter the temperature of the second buffer solution with <▲> <▼> while keeping the <RUN/ENTER> key depressed.
10	Immerse the pH electrode in the second buffer solution.
11	Press the <RUN/ENTER> key.
12	Set the measured value to the nominal pH value of the buffer solution (at the current temperature) with <▲> <▼>.
13	When the measured value is stable, press the <RUN/ENTER> key. The value of the slope (mV/pH) appears on the display. The probe symbol shows the evaluation of the current calibration.



14	Press the <RUN/ENTER> key. The value of the asymmetry (mV) appears on the display.
----	--



- 15 | Switch to the measuring mode with <M>.

4.4 Ion concentration

4.4.1 General information

Preparatory activities

Perform the following preparatory activities when you want to measure the concentration using an ion selective electrode:

1	Connect the ion selective electrode and the reference electrode to the measuring instrument.
2	If necessary, connect a temperature sensor (sockets 2 and 4, see section 1.5 JACK FIELD on page 9).
3	If necessary, press the <M> key repeatedly until the status display <i>ISE</i> appears.
4	Adjust the temperature of the solutions and measure the current temperature if the measurement is made without temperature sensor.



Note

Incorrect calibration of ion selective electrodes leads to incorrect measured values. Calibrate regularly before measuring.



Warning

When connecting an earthed PC/printer, measurements cannot be performed in earthed media as incorrect values would result. The RS232 interface is not galvanically isolated.

Temperature sensor

You can measure with or without a temperature sensor. If a temperature sensor is connected, it is indicated on the display by *TP*.



Note

The measuring instrument automatically recognizes the type of the temperature sensor used. Therefore, you can connect temperature sensors of the NTC30 or Pt1000 type.

The temperature measurement is absolutely essential for a reproducible ISE measurement. If the measurement is made without a temperature sensor, proceed as follows:

1	Measure the current temperature using a thermometer.
2	Bring the test sample and calibration standards to the same temperature (± 2 °C).



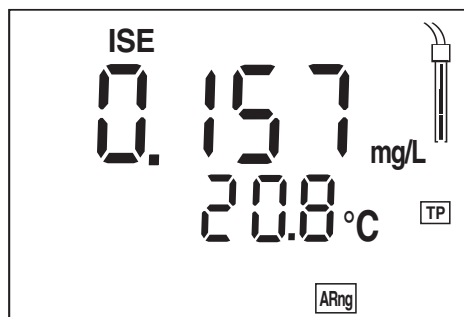
Note

For ISE measurements and ISE calibration, it is not possible to enter temperature values manually.

4.4.2 Measuring the ion concentration

To perform ion concentration measurements, proceed as follows:

1	Perform the preparatory activities according to section 4.4.1.
2	Immerse the ISE electrode and, if necessary, the temperature sensor in the test sample.



AutoRead AR (Drift control)

The AutoRead function (drift control) checks the stability of the measurement signal. The stability has a considerable effect on the reproducibility of the measured value.

For identical measurement conditions, the following criteria apply:

Reproducibility	Response time
better ± 0.05 mV	> 30 seconds

1	Activate the AutoRead function with <AR> . The current measured value is frozen (hold function).
2	Start AutoRead with <RUN/ENTER> . <i>AR</i> flashes until a stable measured value is reached. This measured value is transmitted to the interface.
3	If necessary, start the next AutoRead measurement with <RUN/ENTER> .
4	To terminate the AutoRead function: Press the <AR> key.

**Note**

The current AutoRead measurement can be terminated at any time (accepting the current value) by pressing **<RUN/ENTER>**.

4.4.3 Calibration for ion selective measurements**Why calibrate?**

Ion sensitive electrodes age and are temperature dependent. This changes the slope. As a result, an inexact measured value is displayed. Calibration determines the current value of the slope of the electrode and stores it in the measuring instrument.

Thus, you should calibrate before each measurement (if possible), and at regular intervals.

**Note**

For calibration, use tempered standard solutions with a temperature that differs by maximum ± 2 °C from the temperature of the test sample.

When to calibrate?

- Before each ISE measurement if possible
- After connecting another ion selective electrode or reference electrode
- When the sensor symbol flashes after a voltage interruption, e.g. battery change

ConCal

This is the conventional two-point or three-point calibration procedure that uses 2 or 3 freely selectable standard solutions. The concentration expected for the measurement determines the concentration of the calibration standards.

AutoRead

The calibration procedure automatically activates the AutoRead function. To accept the current measured value without waiting for the AutoRead function to finish, just press **<RUN/ENTER>**.

TP display

If you use a temperature sensor, a flashing *TP* display indicates that the difference in temperature of the standard solutions is too high (more than 2 °C).

Displaying the calibration data

You can view the data of the last calibration on the display. The proceeding is described on page 48.

Printing the calibration protocol

The calibration protocol contains the calibration data of the current calibration. You can transmit the calibration protocol to a printer via the serial interface (see page 51).



Note

You can automatically print a calibration protocol after the calibration. To do so, connect a printer to the interface according to section 4.7.2 before calibrating. After a valid calibration, the record is printed.

Sample printout:

```

CALIBRATION PROTOCOL
 02.03.99 / 16:20
Device No.: 1234
CALIBRATION ISE
Cal time: 01.03.99 / 15:10
Std 1  10,00 mg/l
Std 2  20,00 mg/l
Std 3  50,00 mg/l
C1      0,5 mV  25.0°C
C2      8,4 mV  24.9°C
C3     21,2 mV  25.0°C
S1     26.4 mV
S2     32,1 mV
Probe:   +++
    
```

Calibration evaluation

After the calibration, the measuring instrument evaluates the calibration. The slope (in mV) is evaluated. The probe symbol shows the calibration evaluation.

Display	Slope [mV]
	50.0 ... 70.0 25.0 ... 35.0
E3	Eliminate the error according to chapter 6 WHAT OT DO IF...

Preparatory activities

Perform the following preparatory activities:

1	Connect the ion selective electrode and the reference electrode to the measuring instrument.
2	Connect a temperature sensor (sockets 2 and 4, see section 1.5 JACK FIELD on page 9).
3	If necessary, press the <M> key repeatedly until the status display <i>ISE</i> appears.
4	Keep tempered standard solutions ready.

**Note**

For calibration, use tempered standard solutions with a temperature that differs by maximum ± 2 °C from the temperature of the test sample.

Standard solutions

Use two or three different standard solutions from the following selection. In the three-point calibration, the standards must be selected in either ascending or descending order.

Parameter	Values [mg/l]
Std 1	0.01 / 0.02 / 0.05 / 0.1 / 0.2 / 0.5 / 1 / 2 / 5 / 10 / 20 / 50 / 100 / 200 / 500 / 1000
Std 2	If Std 2 > Std 1, Std 3 must be > Std 2
Std 3	If Std 2 < Std 1, Std 3 must be < Std 2

With a two-point calibration, the calculated slope is used for the entire measuring range of the electrode. With a three-point calibration, the entire measuring range is divided into measuring range I and II. Different calibration values apply for the two measuring ranges. The measured value of standard solution 2 separates the two measuring ranges from each other.

**Note**

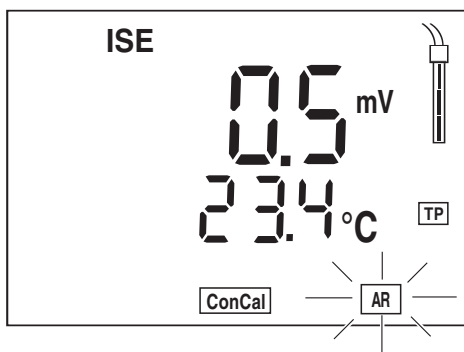
Among other things, the measuring accuracy depends on the selected standards solutions. Therefore, the standard solutions selected should cover the expected value range of the following concentration measurement.

Two-point calibration

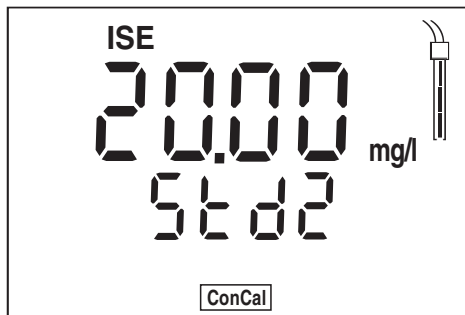
- 1 Press the **<CAL>** key. The previously set up concentration of the first standard solution and *ConCal* appear on the display.



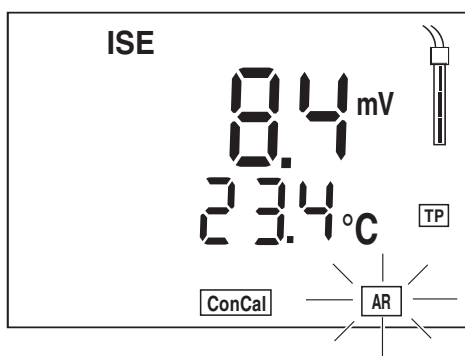
- 2 Enter the current concentration of the first standard solution with **<▲>** **<▼>**.
- 3 Immerse the ISE electrode and, if necessary, the temperature sensor in the first standard solution.
- 4 Press the **<RUN/ENTER>** key. The electrode voltage appears on the display, the *AR* display indicator flashes.



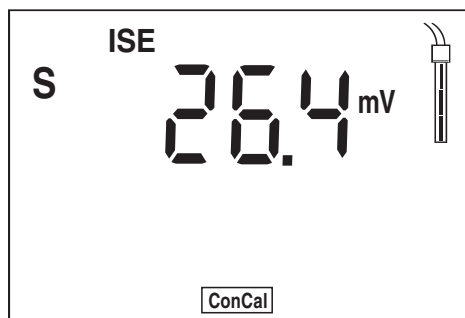
- 5 As soon as a stable value is achieved, *AR* stops flashing. The previously set up concentration of the second standard solution appears on the display.



- | | |
|---|--|
| 6 | Enter the current concentration of the second standard solution with <▲> <▼>. |
| 7 | Thoroughly rinse the ion selective electrode and, if necessary, the temperature sensor with deionized water. |
| 8 | Immerse the ion selective electrode and, if necessary, the temperature sensor in the second standard solution. |
| 9 | Press the <RUN/ENTER> key.
The electrode voltage appears on the display, the AR display indicator flashes. |



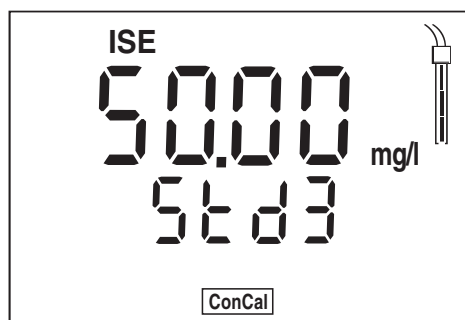
- | | |
|----|---|
| 10 | As soon as a stable value is reached, the AR display indicator stops flashing. The slope (mV) of the electrode after the two-point calibration appears on the display.
The probe symbol shows the evaluation of the two-point calibration for the measuring range I. |
|----|---|



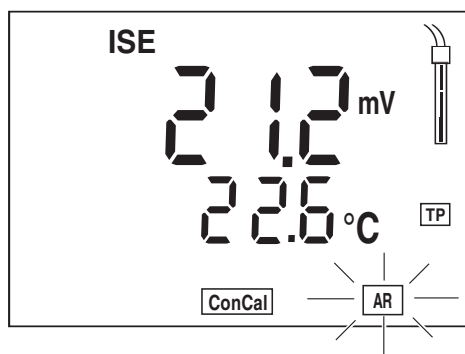
- 11 To return to the measuring mode: Press the **<M>** key or go on to the three-point calibration by pressing the **<RUN/ENTER>** key.

Three-point calibration

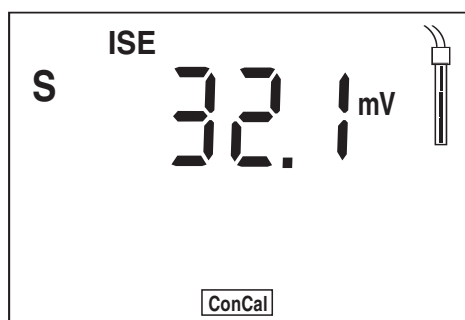
- 12 The previously set up concentration of the third standard solution appears on the display.



- 13 Enter the current concentration of the third standard solution with **<▲>** **<▼>**.
- 14 Thoroughly rinse the ion selective electrode and, if necessary, the temperature sensor with deionized water.
- 15 Immerse the ion selective electrode and, if necessary, the temperature sensor in the third standard solution.
- 16 Press the **<RUN/ENTER>** key.
The electrode voltage appears on the display, the *AR* display indicator flashes.



- 17 | As soon as a stable value is reached, the *AR* display indicator stops flashing. The slope (mV) of the electrode for the measuring range II is displayed. The probe symbol shows the evaluation of the three-point calibration for the measuring range II.



- 18 | To return to the measuring mode: Press the <M> key.

**Note**

You can prematurely terminate the three-point calibration by pressing <M>. The values of the two-point calibration will then remain stored.

4.5 Calibration interval (Int 3)

The flashing probe symbol reminds you to calibrate regularly (pH/ORP). When the fixed calibration interval (Int 3) has expired, the probe symbol flashes. It is still possible to measure. The calibration interval is set to 7 days in the factory.



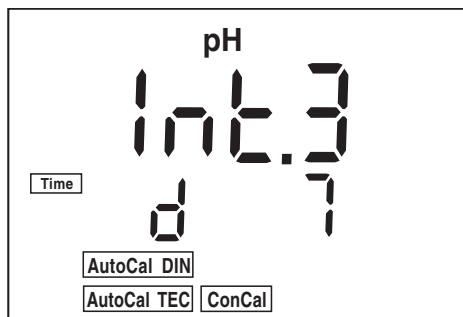
Note

To ensure the high measuring accuracy of the measuring system, calibrate after the calibration interval has expired.

Setting the calibration interval

You can change the interval set in the factory (1 ... 999 days):

1	Switch off the measuring instrument.
2	Press the <M> key and hold it down.
3	Press the <ON/OFF> key. The display test appears briefly on the display. After this, the measuring instrument automatically switches over to configuration.
4	Press the <RUN/ENTER> key repeatedly until <i>Int 3</i> appears. Example:



5	Set the required interval (in days) until the next calibration with <▲> <▼>.
6	Confirm with <RUN/ENTER>.
7	Switch to the measuring mode with <M>.

4.6 Saving

The measuring instrument has an internal data memory. It can store up to 500 data records.

A complete data record consists of:

- Number of the storage location
- Date/time
- Measured value
- Temperature
- Temperature measuring procedure
- ID number

You can transmit measured values (data records) to the data storage in two ways:

- Save manually
- Switch on AutoStore (Int 1), (see page 44).



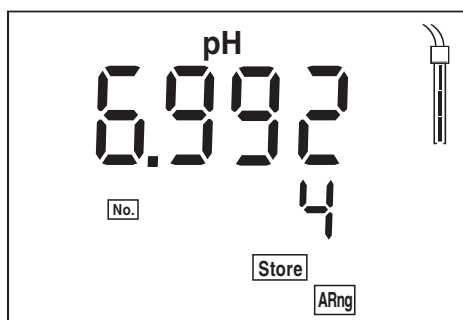
Note

If you connect a recorder (analog output), the output on the digital interface is switched off.

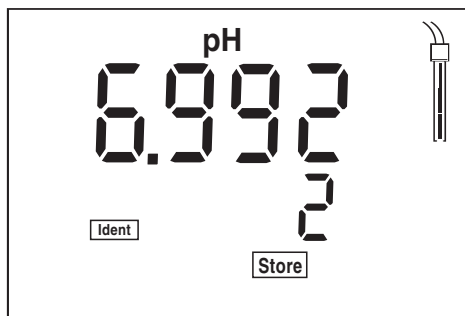
4.6.1 Saving manually

You can transmit a measured value to the data storage as follows:

- 1 Press the **<STO>** key.
The current number (location number *No.*) of the next free storage location appears under the current measured value on the display.



- 2 Confirm with **<RUN/ENTER>**.
The display switches to entering the ID number.



3	Using <▲> <▼>, set the required ID number (1 ... 999).
4	Confirm with <RUN/ENTER>. The measured values are stored. The instrument changes to the measuring mode.

Message **StoFull**

This message appears when all of the 500 storage locations are occupied.

You have the following options:

Saving the current measured value. The oldest measured value (storage location 1) will be overwritten by this	Press <RUN/ENTER>
Returning to the measuring mode without saving	press any key
Outputting the data storage	see section 4.6.3
Clearing the memory	see section 4.6.4

4.6.2 Switching on AutoStore (Int 1)

The save interval (Int 1) determines the chronological interval between automatic save processes. After the fixed interval has expired, the current data record is transmitted to the internal storage and to the interface.

Setting the save interval

The default setting for the save interval (Int 1) is OFF.

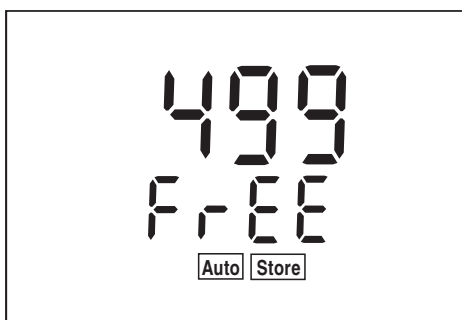
By this, the *AutoStore* function is switched off.

To switch the function on, set an interval (5 s, 10 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min):

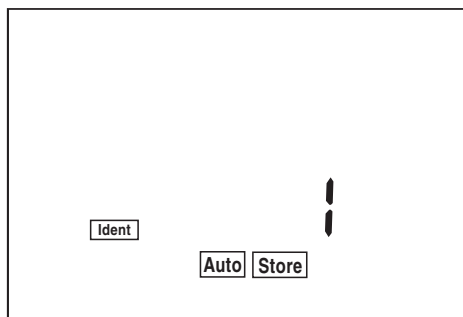
- 1 Press the **<RUN/ENTER>** key and hold it down.
- 2 Press the **<STO>** key. *Int 1* appears on the display.



- 3 Set the required interval between the saving procedures with **<▲>** **<▼>** (Selection: 5 s, 10 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min).
- 4 Confirm with **<RUN/ENTER>**.
The number of free memory locations appears on the display.



- 5 Confirm with **<RUN/ENTER>**.
The prompt for the ID number appears on the display.



6	Set the required ID number with <▲> <▼>.
7	Confirm with <RUN/ENTER>. The measuring instrument switches to the last active measuring mode and starts the measuring and saving procedure. AutoStore flashes on the display.

As soon as all of the 500 storage locations are occupied, AutoStore is terminated (Int 1 = OFF). If there are not enough storage locations available for your measurements:

- Output and backup the data storage (see page 46) and
- Clear the memory (see page 52).



Note

The AutoStore function is interrupted if you start other functions, e.g. output the data storage. After the function is finished, the AutoStore function is continued. By this, however, temporal gaps in the recording of the measured values will occur.

Switching off AutoStore

Switch AutoStore off by:

- setting the save interval (Int 1) to OFF, or
- switching the measuring instrument off and then on again.

4.6.3 Outputting the data storage

You can output the contents of the data storage:

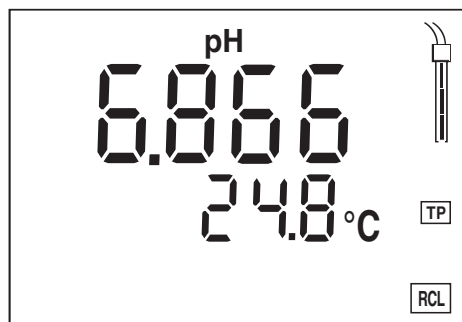
- Stored data on the display
- Calibration data on the display
- Stored data on the serial interface
- Calibration protocol to the interface

Outputting stored data on the display

- 1 Press the **<RCL>** key repeatedly until *StO dISP* appears on the display.



- 2 Press the **<RUN/ENTER>** key.
A measured value appears on the display.
The storage location of the data record is displayed for approx. 2 s, then the respective temperature appears.



You can perform the following activities:

Display further data of the data record (ID number, date, time, storage location)	Press <RUN/ENTER>
Advance one data record (storage location)	Press <▲>
Go back one data record (storage location)	Press <▼>

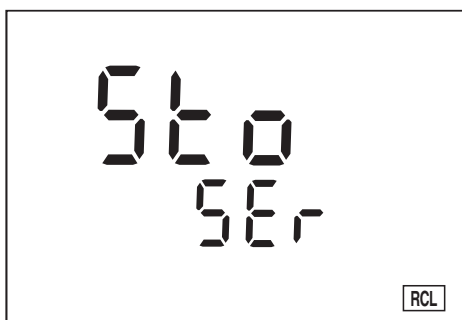
**Note**

If you want to search for a certain element of the data record (e.g. date), proceed as follows:

- | | |
|---|--|
| 1 | Using <RUN/ENTER>, select the element (e.g. date). |
| 2 | Press <▲> or <▼> repeatedly until the required element appears on the display.
After approx. 2 s the temperature of the displayed measured value appears. |

Outputting stored data to the interface

- | | |
|---|---|
| 1 | Press the <RCL> key repeatedly until <i>Sto SEr</i> appears on the display. |
|---|---|



- | | |
|---|--|
| 2 | Press the <RUN/ENTER> key.
The complete contents of the storage are transmitted to the interface. During the data transmission the instrument increments the storage numbers. After the data transmission, the instrument automatically switches to the last active measurement mode. |
|---|--|

**Note**

You can cancel the transmission with <M> or <RUN/ENTER>.

The transmitted data contains the entire contents of the storage in incrementing order of the location numbers.

Sample printout:

```

No.    1:
 09.03.99      17:10
pH 10.013      25 °C
Tman          AR
Ident : 1

No.    2:
 09.03.99      17:11
pH 10.104      24.7 °C
Tauto          AR
Ident : 1

No.    3:
 09.03.99      17:12
 305.2 mV
Tauto
Ident : 13
...

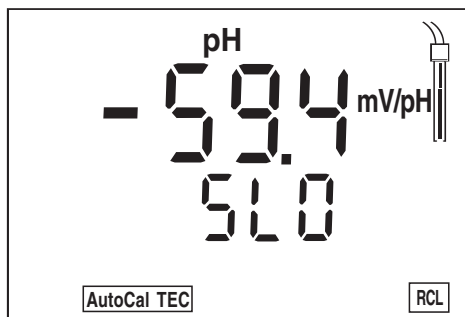
```

Outputting the calibration data on the display

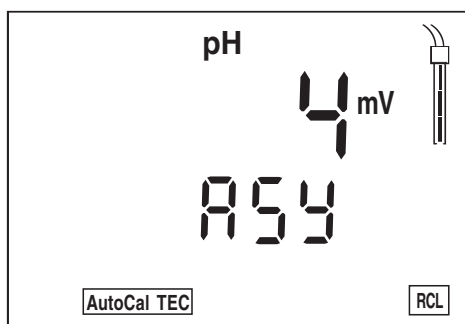
- 1 Press the **<RCL>** key repeatedly until *CAL disp* appears on the display.



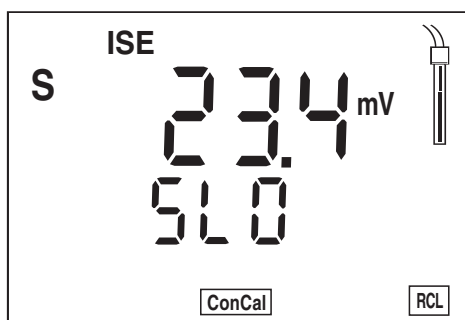
- 2 Press the **<RUN/ENTER>** key.
The data of the last calibration of all measured variables appears in the following sequence:
 - pH: Slope *SLO* and asymmetry *ASY*
 - ISE: Slope of the electrode for calibration range I (*SLO1*) and calibration range II (*SLO2*)
 Information concerning the calibration procedure is output as well.



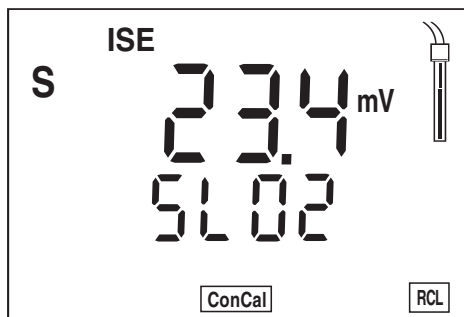
- 3 Press <RUN/ENTER> to display the value of the asymmetry (mV).



- 4 Press <RUN/ENTER> to display the slope of the ion selective electrode in the calibration range I.



- 5 Press <RUN/ENTER> to display the slope of the ion selective electrode in the calibration range II.



- 6 With **<M>** you can switch back to the last active measuring mode.

Outputting the calibration protocol on the interface

- 1 Press the **<RCL>** key repeatedly until *CAL SEr* appears on the display.



- 2 Press the **<RUN/ENTER>** key.
The calibration protocol for all measured variables is transmitted to the interface. After the data transmission, the instrument automatically switches to the last active measurement mode.

Sample printout:

```

CALIBRATION PROTOCOL
02.03.01      14:19
Device No.: 12345678

Calibration pH
Cal time: 01.10.01 / 15:20
Cal interval: 7d
AutoCal TEC   Tauto
Buffer 1      2.00
Buffer 2      4.01
Buffer 3      7.00 *
Buffer 4      10.00
C1            174.1 mV  25.0°C
C2            -133.3 mV 25.0°C
S1            -59.4 mV/pH
ASY1         -   4 mV
Probe:       +++

CALIBRATION ISE
Cal time: 01.10.01 / 15:30
Std 1        10,00 mg/l
Std 2        20,00 mg/l
Std 3        50,00 mg/l
C1           0,5 mV  25.0°C
C2           8,4 mV  24.9°C
C3          21,2 mV  25.0°C
S1           26.4 mV
S2          32,1 mV
Probe:       +++

```

4.6.4 Clearing the memory

With this function, you can delete stored data records. 500 storage locations will then be available again.

**Note**

The *Clear memory* function only appears when there are data records stored in the memory. Otherwise, the measuring instrument automatically switches to the last active measuring mode.

Proceed as follows to clear all data records:

1	Switch off the measuring instrument.
2	Press the <STO> key and hold it down.
3	Press the <ON/OFF> key. The display test appears briefly on the display.



4	Confirm the clearing process with <RUN/ENTER>. Pressing any other key prevents the clearing, the data records will remain stored.
---	---

**Note**

The calibration data remain stored and can be called up.

4.7 Transmitting data

You have the following possibilities of transmitting data:

- One of the following options:
 - With the *AutoStore* function (page 44), measured values are periodically saved internally (save interval Int 1) and output on the interface.
 - With the *Data transmission interval* function (Int 2), measured values are periodically output on the interface (see below).
- With the *Output data storage* function (page 46), calibration data or saved measured values are output on the interface.

4.7.1 Data transmission interval (Int 2)

The interval to the data transmission (Int 2) determines the chronological interval between automatic data transmissions. After the selected interval expires, the current data record is transmitted to the interface.



Setting the Data transmission interval

Note

The setting of the interval (Int 2) is only effective if the save interval (*AutoStore* function) is switched off!

The default setting for the interval is OFF.

To start the data transmission, set an interval (5 s, 10 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min):

1	Press the <RUN/ENTER> key and hold it down.
2	Press the <RCL> key. <i>Int 2</i> appears on the display.



3	Set the required interval between the saving procedures with <▲> <▼>.
4	Confirm with <RUN/ENTER>. The measuring instrument switches to the last active measuring mode.



Note

When the *AutoStore* function is active at the same time, the data transmission is performed according to the setting of the save interval (Int 1). Set the save interval (Int 1) to OFF to activate the Data transmission *interval* (Int 2).

4.7.2 PC/external printer (RS232 interface)

Via the RS 232 interface, you can transmit the data to a PC or an external printer. Use the AK340/B (PC) or AK325/S (ext. printer) cable to connect the interface to the instruments. The data output automatically switches to the RS232 interface.



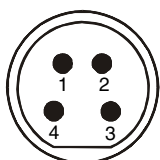
Warning

The RS232 interface is not galvanically isolated. When connecting an earthed PC/printer, measurements cannot be performed in earthed media as incorrect values would result.

Set up the following transmission data on the PC/printer:

Baud rate	selectable between: 1200, 2400, 4800 , 9600
Handshake	RTS/CTS + Xon/Xoff
Parity	none
Data bits	8
Stop bits	2
Cable length	Max. 15 m

Socket assignment



RS 232
REC

- 1 CTS
- 2 RxD
- 3 Ground
- 4 TxD

4.7.3 Remote control

The measuring instrument can be remotely controlled from a PC. This requires the KOM pilot communication kit. It is available as an accessory. The instrument is then controlled via commands that simulate keystrokes and request the current display contents.

**Note**

A more detailed description is provided within the scope of delivery of the communication kit.

4.8 Configuration

You can adapt the measuring instrument to your individual requirements. To do this, the following parameters can be changed (the status on delivery is marked in bold):

Baud rate	1200, 2400, 4800 , 9600
Display during the pH calibration	Buffer nominal value , or current electrode voltage
Intervals Calibration (Int 3) in days (d)	– pH: 1 ... 7 ... 999 d <i>Int 3</i> – ISE: no interval
Date/time	Any



Note

You can leave the configuration menu at any time with <M>. The parameters that have already been changed are stored.

- 1 | Switch off the measuring instrument.
- 2 | Press the <M> key and hold it down.
- 3 | Press the <ON/OFF> key.
The display test appears briefly on the display. The measuring instrument then switches automatically to the setting of the baud rate.

Baudrate

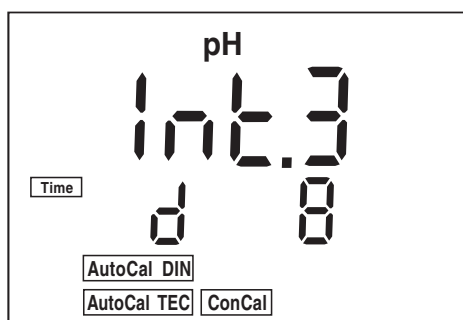


- 4 | Select the required Baud rate with <▲> <▼>.
- 5 | Confirm with <RUN/ENTER>. *CAL dISP* appears on the display.



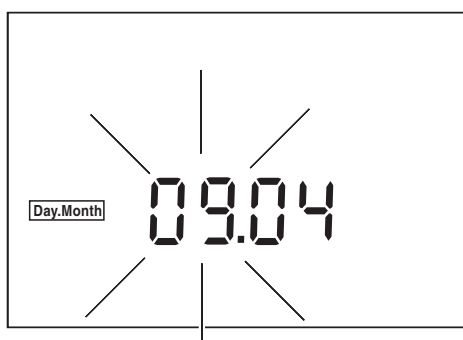
- | | |
|---|---|
| 6 | Select the required display during the pH calibration with <▲> <▼> .
<i>mV</i> : Display of the current electrode voltage
<i>/pH</i> : Display of the buffer nominal value. |
| 7 | Confirm with <RUN/ENTER> . On the display, <i>Int 3</i> appears. |

Calibration intervals



- | | |
|---|--|
| 8 | Set the required interval (in days) with <▲> <▼> . |
| 9 | Confirm with <RUN/ENTER> . The date flashes on the display. |

Date and time



- | | |
|----|---|
| 10 | Set the date of the current day with <▲> <▼> . |
| 11 | Confirm with <RUN/ENTER> .
The date (month) flashes on the display. |
| 12 | Set the current month with <▲> <▼> . |

13	Confirm with <RUN/ENTER> . The year appears on the display.
14	Set the current year with <▲> <▼> .
15	Confirm with <RUN/ENTER> . The hours flash on the display.
16	Set the current time with <▲> <▼> .
17	Confirm with <RUN/ENTER> . The minutes flash on the display.
18	Set the current time with <▲> <▼> .
19	Confirm with <RUN/ENTER> . The measuring instrument switches to the last active measuring mode.

4.9 Reset

You can reset (initialize) the measurement parameters and the configuration parameters separately from one another.

Measurement parameters

The following measuring parameters are reset to the delivery status:

pH	Measuring mode	pH
	Slope	-59.16 mV/pH
	Asymmetry	0 mV
	Manual temperature input	25 °C
	Resolution of pH display	0.001 (high resolution)



Note

The calibration data gets lost when the measuring parameters are reset. Recalibrate after performing a reset.

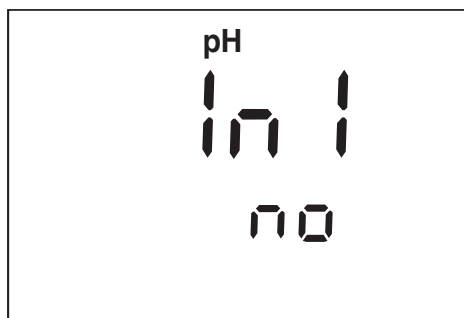
Configuration parameters

The following configuration parameters (InI) are reset to the delivery status:

Baud rate	4800
Display during the pH calibration	Buffer nominal value
Interval 1 (automatic save)	OFF
Interval 2 (for data transmission)	OFF

**Resetting the
measuring parameters**

- 1 Press the **<RUN/ENTER>** key and hold it down.
- 2 Press the **<CAL>** key. The setting to reset the pH measuring parameters appears on the display.



- 3 Using **<▲>** **<▼>**, toggle between *no* and *YES*.
YES: Resetting the pH measuring parameters
no: Retaining settings.
- 4 Confirm with **<RUN/ENTER>**.
The measuring instrument switches to the configuration parameters.

Resetting the configuration parameters



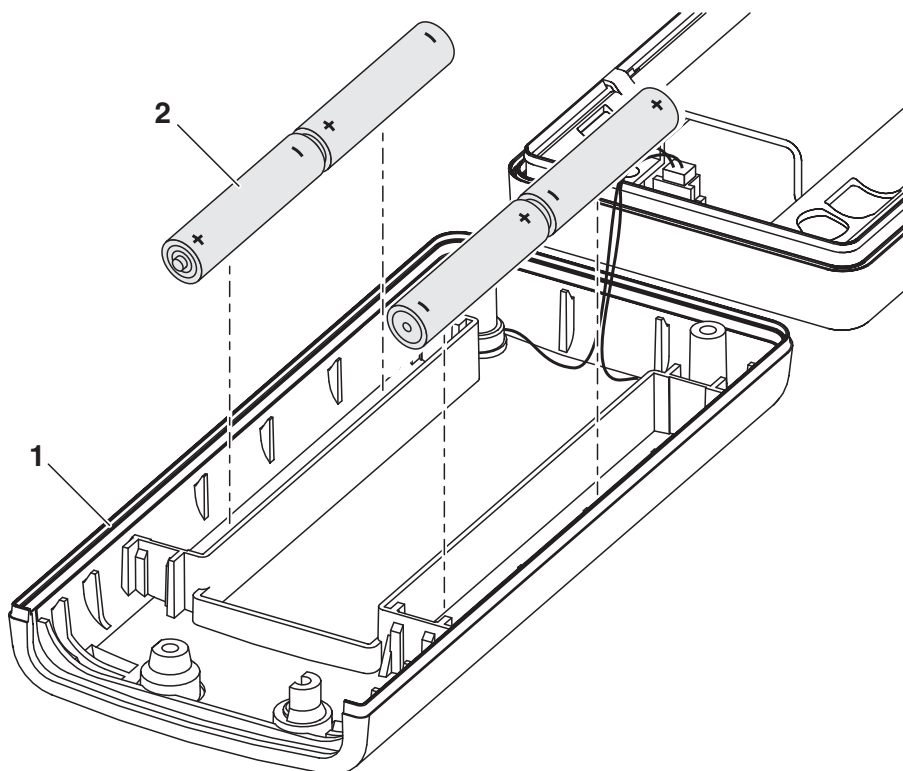
- | | |
|---|--|
| 5 | Using <▲> <▼>, toggle between <i>no</i> and <i>YES</i> .
<i>YES</i> : Resetting the configuration parameters
<i>no</i> : Retaining settings. |
| 6 | Confirm with <RUN/ENTER>.
The measuring instrument automatically switches to the last active measuring mode. |

5 Maintenance, cleaning, disposal

5.1 Maintenance

The measuring instrument is almost maintenance-free. The only maintenance task is replacing the batteries. *LoBat* on the display indicates that the batteries should be changed. The batteries are then largely depleted.

Replacing the batteries



1	Open the housing after the instrument has been switched off: – Undo the four screws on the underside of the instrument – Pull down the lower cover (1).
2	If necessary, take the four depleted batteries (2) out of the battery compartment.
3	Place four new batteries (type Mignon AA) in the battery compartment.
4	Close the lower cover (1).



Warning

Make sure that the poles of the batteries are the right way round. The \pm signs on the batteries must correspond to the \pm signs in the battery compartment. Only use leakproof alkaline manganese batteries.

**Note**

For maintenance of electrodes and ion-selective electrodes, follow the corresponding operating manual.

5.2 Cleaning

Occasionally wipe the outside of the measuring instrument with a damp, lint-free cloth. Disinfect the housing with isopropanol as required.

**Warning**

The housing is made of a synthetic material (ABS). Thus, avoid contact with acetone and similar detergents that contain solvents. Remove any splashes immediately.

5.3 Disposal**Packing**

This measuring instrument is sent out in a protective transport packing. We recommend: Keep the packing material. The original packing protects the instrument against damage during transport.

Batteries

This note refers to the battery regulation that applies in the Federal Republic of Germany. We would ask end-consumers in other countries to follow their local statutory provisions.

**Note**

This instrument contains batteries. Batteries that have been removed must only be disposed of at the recycling facility set up for this purpose or via the retail outlet.

It is illegal to dispose of them in household refuse.

Measuring instrument

Dispose of the measuring instrument as electronic waste at an appropriate collection point. It is illegal to dispose of the instrument in household refuse.

6 What to do if...

6.1 pH system messages

Error message **0FL**

Cause	Remedy
pH electrode:	
– Not connected	– Connect electrode
– Air bubble in front of the diaphragm	– Remove air bubble
– Air in the diaphragm	– Extract air or moisten diaphragm
– Cable broken	– Replace electrode
– Gel electrolyte dried out	– Replace electrode

Error message **E3**

Cause	Remedy
Electrode	
– Diaphragm contaminated	– Clean diaphragm
– Membrane contaminated	– Clean membrane
– Moisture in the plug	– Dry plug
– Electrolyte out of date	– Replenish electrolyte or replace electrode
– Electrode worn out	– Replace electrode
– Electrode broken	– Replace electrode
Measuring instrument:	
– Incorrect calibration procedure	– Select correct procedure
– Incorrect solution temperature (without temperature sensor)	– Set up correct temperature
– Socket damp	– Dry socket

	Buffer solutions	
	– Incorrect buffer solutions	– Change calibration procedure
	– Buffer solutions too old	– Use only once. Note the shelf life
	– Buffer solutions depleted	– Change solutions
No stable measured value	Cause	Remedy
	pH electrode:	
	– Diaphragm contaminated	– Clean diaphragm
	– Membrane contaminated	– Clean membrane
	Test sample:	
	– pH value not stable	– Measure with air excluded if necessary
	– Temperature not stable	– Adjust temperature if necessary
	Electrode + test sample:	
	– Conductivity too low	– Use suitable electrode
	– Temperature too high	– Use suitable electrode
	– Organic liquids	– Use suitable electrode
	Obviously incorrect measured values	Cause
pH electrode:		
– pH electrode unsuitable		– Use suitable electrode
– Temperature difference between buffer and test sample too high		– Adjust temperature of buffers or test samples
– Measurement procedure not suitable		– Follow special procedure

6.2 ISE system messages

Error message **0FL**

Cause	Remedy
Ion-selective electrode:	
– Not connected	– Connect the electrode
– Cable broken	– Replace the electrode

Error message **E3**

Cause	Remedy
Ion-selective electrode:	
– Slope not in the range 50 ... 70 mV or 23 ... 35 mV	– Replace the electrode – recalibrate
– Moisture in the plug	– Dry plug
– Electrode obsolete	– Replace the electrode
– Electrode broken	– Replace the electrode
Measuring instrument:	
– Calibration procedures: Incorrect order of the standards with 3-point calibration	– Select the correct order
– Socket damp	– Dry socket

Concentration display flashes

Cause	Remedy
In measurement:	
– The measured value is outside the range determined through calibration	– Select the calibration standards so that the measured value is in between them
In calibration:	
$ U_2 - U_1 \leq 5\text{ mV}$ $ U_3 - U_2 \leq 5\text{ mV}$	– Calibration standards lie too closely together. Select other calibration standards

TP and Temp Error flash	Cause	Remedy
	In calibration:	
	<ul style="list-style-type: none"> – Calibration standards do not have the correct temperature (max. temperature difference ± 2 °C) 	<ul style="list-style-type: none"> – Temper the calibration standards
	In measurement:	
	<ul style="list-style-type: none"> – Test sample does not have the correct temperature (max. temperature difference ± 2 °C) 	<ul style="list-style-type: none"> – Temper the test sample

Calibration Std 2 flashes	Cause	Remedy
	<ul style="list-style-type: none"> – Standard 2 = Standard 1 	<ul style="list-style-type: none"> – Use different calibration standards

Calibration Std 3 flashes	Cause	Remedy
	Requirement not met:	
<ul style="list-style-type: none"> – Standard 3 > Standard 2, if Std 2 > Std 1 or – Standard 3 < Standard 2, if Std 2 < Std 1 		

6.3 General errors

Display LoBat	Cause	Remedy
	<ul style="list-style-type: none"> – Batteries almost empty 	<ul style="list-style-type: none"> – Exchange the batteries (see section 5.1 MAINTENANCE)

Instrument does not react to keystroke	Cause	Remedy
	<ul style="list-style-type: none"> – Operating condition undefined or EMC load unallowed 	<ul style="list-style-type: none"> – Processor reset: Switch the instrument on while pressing the <CAL> key

Display to	Cause – Time-out of the interface	Remedy – Check the instrument that is connected
Probe symbol flashes	Cause – Calibration interval expired	Remedy – Recalibrate the measuring system
Message StoFull	Cause – All memory locations are full	Remedy – Output data storage and clear data storage

7 Technical data

Dimensions and weight	Length [mm]	172	
	Width [mm]	80	
	Height [mm]	37	
	Weight [kg]	Approx. 0.3	
Mechanical structure	Type of protection	IP 66	
Electrical safety	Protective class	III	
Ambient conditions	Storage	- 25 °C ... + 65 °C	
	Operation	-10 °C ... + 55 °C	
	Climatic class	2	
pH/ORP measuring ranges		Measuring range	Resolution
	pH	- 2.000 ... + 19.999	0.001
		- 2.00 ... + 19.99	0.01
	U [mV]	- 999.9 ... + 999.9	0.1
- 1999 ... + 1999		1	
T [°C]	- 5.0 ... + 105.0	0.1	
Precision of pH/ORP (± 1 digit)	pH (± 2 pH units from the calibration point)	± 0.003 at + 15 °C ... + 35 °C	
	U [mV]	± 0.2 at + 15 °C ... + 35 °C ± 0.1	
	T [°C]	NTC 30: ± 0.1 PT 1000: ± 0.5 at 0 °C ... 15 °C ± 0.1 at 15 °C ... 35 °C ± 1 at 35 °C ... 55 °C	

pH temperature input: - 20 °C ... + 130 °C

ISE measuring ranges	Measuring range 1 Resolution	0.000 ... 9.999 mg/l 0.001 mg/l
	Measuring range 2 Resolution	0.00 ... 99.9 mg/l 0.01 mg/l
	Measuring range 3 Resolution	0.0 ... 999.9 mg/l 0.1 mg/l
	Measuring range 4 Resolution	0 ... 1999 mg/l 1 mg/l

Usable ISE electrodes Combination and double electrodes with connector according to DIN 19262

ISE calibration procedure Two point calibration or three point calibration with standards suiting the sample

ISE slope ranges ± 25 to 35 mV and ±50 to 70 mV

Analog output Automatic switchover when the recorder is connected by the cable, AK 323.

Output signals	Corresponds to the electrode voltage, i.e. 50-62 mV/pH unit
Accuracy	± 0.1 % of the measured value ± 4 mV
Internal resistance	< 5 Ohm (current limited to max. 0.2 mA output current)

Serial interface Automatic switchover when a PC or a printer is connected via the cable, AK 340/B or AK 325/S.

Type	RS232, data output
Baud rate	Selectable 1200, 2400, 4800, 9600 baud
Data bits	8
Stop bit	2
Parity	None
Handshake	RTS/CTS + Xon/Xoff
Cable length	Max. 15m

Power supply	Batteries	4 x 1.5 V alkali-manganese batteries, type AA
	Operational life	Approx. 3000 operating hours
	Mains (optional)	<p>The following specifications apply to all plug-in power supplies: Max. overvoltage connection category II</p> <p>Plug-in power supply unit (Euro, US , UK, Australian plug) FRIWO FW7555M/09, 15.1432 Friwo Part. No. 1822089 Input: 100 ... 240 V ~ / 50 ... 60 Hz / 400 mA Output: 9 V = / 1,5 A</p> <p>Plug-in power supply with Euro plug: FRIWO FW1199, 11.7864 Friwo Part. No. 1762613 Input: 230 V ~ / 50 Hz / 5.6 VA Output: 12 V = / 130 mA / 1.56 VA</p> <p>Plug-in power supply with US plug: FRIWO FW1199, 11.7880 Friwo Part. No. 1794043 Input: 120 V ~ / 60 Hz / 6 VA Output: 12 V = / 150 mA</p> <p>Plug-in power supply with UK plug: FRIWO FW1199, 11.7872 Friwo Part No. 1816491 Input: 230V ~ / 50 Hz / 5.6 VA Output: 12 V = / 130 mA / 1.56 VA</p>

Guidelines and norms used	EMC	E.C. guideline 89/336/EEC EN 61326-1:1997 EN 61000-3-2 A14:2000 EN 61000-3-3:1995 FCC Class A
	Instrument safety	E.C. guideline 73/23/EEC EN 61010-1 A2:1995
	Climatic class	VDI/VDE 3540
	Type of protection	EN 60529:1991

FCC Class A Equipment Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Test certificates cETLus, CE

8 Lists

This chapter provides additional information and orientation aids.

Abbreviations

The list of abbreviations explains the indicators and the abbreviations that appear on the display and in the manual.

Specialist terms

The glossary briefly explains the meaning of the specialist terms. However, terms that should already be familiar to the target group are not described here.

Index

The index will help you to find the topics that you are looking for.

Abbreviations

AR	AutoRead (drift control)
ARng	Automatic range switching Measuring instrument measures with highest resolution
ASY	Asymmetry
AutoCal DIN	Automatic pH calibration with buffer solutions prepared according to DIN 19 266
AutoCal TEC	Automatic pH calibration with WTW technical buffer solutions according to DIN 19267
°C	Temperature unit, degrees Celsius
Cal	Calibration
Cd...	Display indicator during calibration for pH measurements. Indicates the selection of the buffer data record for buffer solutions prepared according to DIN 19 266
Cm...	Display indicator during calibration for pH measurements. Indicates the selection of buffer data records for buffer solutions of the Merck company
ConCal	Conventional single-point or two-point calibration for pH measurements
Ct...	Display indicator during calibration for pH measurements. Indicates the selection of the buffer data records for WTW technical buffer solutions
E3	Error message see chapter 6 WHAT TO DO IF...
InI	Initialization Resets individual basic functions to the status they had on delivery
ISE	Ion sensitive electrode
LoBat	Batteries almost empty(Low Battery)
mV	Voltage unit
mV/pH	Unit of the electrode slope (internat. mV)
OFL	Display range exceeded (Overflow)
pH	pH value

S	Slope (internat. k)
SELV	Safety Extra Low Voltage
SLO	Slope setting on calibration
TP	Temperature measurement active (Temperature Probe)
U _{ASY}	Asymmetry

Glossary

Adjusting	To manipulate a measuring system so that the relevant value (e. g. the displayed value) differs as little as possible from the correct value or a value that is regarded as correct, or that the difference remains within the tolerance.
Asymmetry	Designation for the offset potential of a pH electrode. It is the measurable potential of a symmetrical electrode, the membrane of which is immersed in a solution with the pH of the nominal electrode zero point (WTW electrodes: pH = 7).
AutoRange	Name of the automatic selection of the measuring range.
AutoRead	WTW name for a function to check the stability of the measured value.
Calibration	Comparing the value from a measuring system (e. g. the displayed value) to the correct value or a value that is regarded as correct. Often, this expression is also used when the measuring system is adjusted at the same time (see adjusting).
Diaphragm	The junction is a porous body in the housing wall of reference electrodes or electrolyte bridges. It forms the electrical contact between two solutions and makes electrolyte exchange more difficult. The expression, junction, is also used for ground or junction-less transitions.
Electrode zero point	The zero point of a pH electrode is the pH value at which the electromotive force of the pH electrode at a specified temperature is zero. Normally, this is at 25 °C.
Electromotive force of an electrode	The electromotive force U of the electrode is the measurable electromotive force of an electrode in a solution. It equals the sum of all the galvanic voltages of the electrode. Its dependency on the pH results in the electrode function which is characterized by the parameters, slope and zero point.
Measured parameter	The measured parameter is the physical dimension determined by measuring, e. g. pH, conductivity or D. O. concentration.
Measured value	The measured value is the special value of a measured parameter to be determined. It is given as a combination of the numerical value and unit (e. g. 3 m; 0.5 s; 5.2 A; 373.15 K).
Measuring system	The measuring system comprises all the devices used for measuring, e. g. measuring instrument and probe. In addition, there is the cable and possibly an amplifier, terminal strip and armature.
Molality	Molality is the quantity (in Mol) of a dissolved substance in 1000 g solvent.
MultiCal®	WTW name stating that a measuring instrument provides several calibration procedures.

Offset potential	The measurable potential of a symmetrical electrode, the membrane of which is immersed in a solution with the pH of the nominal electrode zero point. The asymmetry is part of the offset potential.
ORP voltage	The ORP is caused by oxidizing or reducing substances dissolved in water if these substances become effective on an electrode surface (e. g. a gold or platinum surface).
pH value	The pH is a measure of the acidic or basic effect of an aqueous solution. It corresponds to the negative decadic logarithm of the molal hydrogen ions activity divided by the unit of the molality. The practical pH value is the value of a pH measurement.
Potentiometry	Name of a measuring technique. The signal (depending on the measured parameter) of the electrode is the electrical potential. The electrical current remains constant.
Reference temperature	Fixed temperature value to compare temperature-dependent measured values. For conductivity measurements, the measured value is converted to a conductivity value at a reference temperature of 20 °C or 25 °C.
Reset	Restoring the original condition of all settings of a measuring system.
Resolution	Smallest difference between two measured values that can be displayed by a measuring instrument.
Slope	The slope of a linear calibration function.
Standard solution	The standard solution is a solution where the measured value is known by definition. It is used to calibrate a measuring system.
Temperature coefficient	Value of the slope of a linear temperature function.
Temperature function	Name of a mathematical function expressing the temperature behavior of a test sample, a probe or part of a probe.
Test sample	Designation of the sample ready to be measured. Normally, a test sample is made by processing the original sample. The test sample and original sample are identical if the test sample was not processed.

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