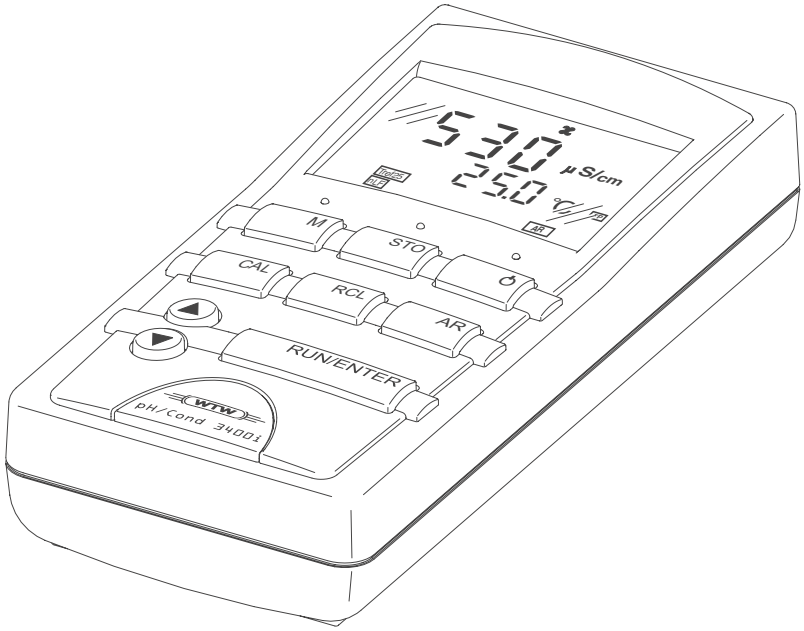
Operating manual

pH/Cond 3400i



pH/Conductivity measuring instrument

ba75687e01 01/2007

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.

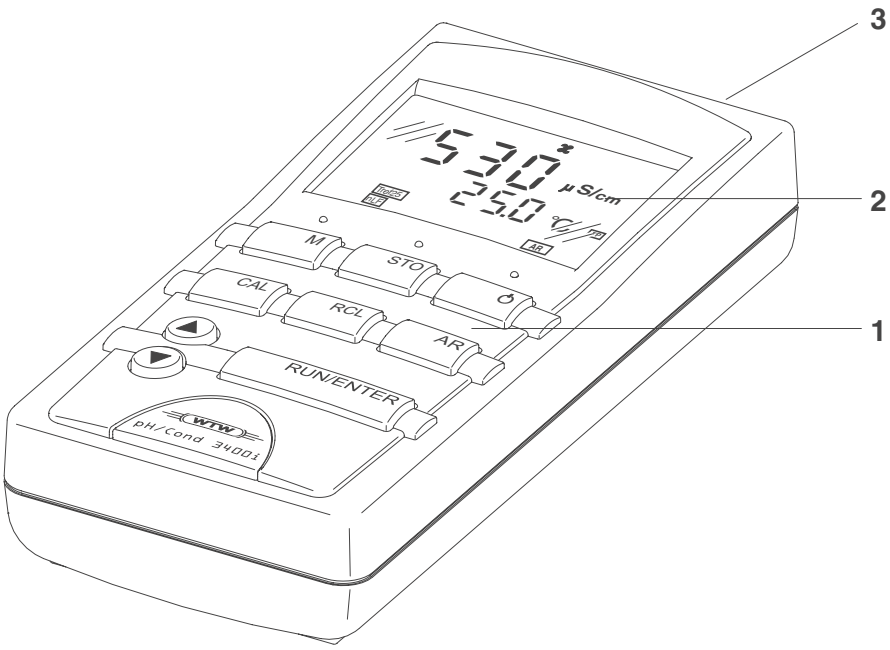
Copyright

1 Overview

1.1 General features

This compact precision handheld meter enables you to carry out pH / ORP measurements and conductivity measurements 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 or the proven procedure for adjusting or setting the cell constant and the special AutoRead function support you in your work with the handheld meter.



1	Keypad
2	Sample display
3	Jack field

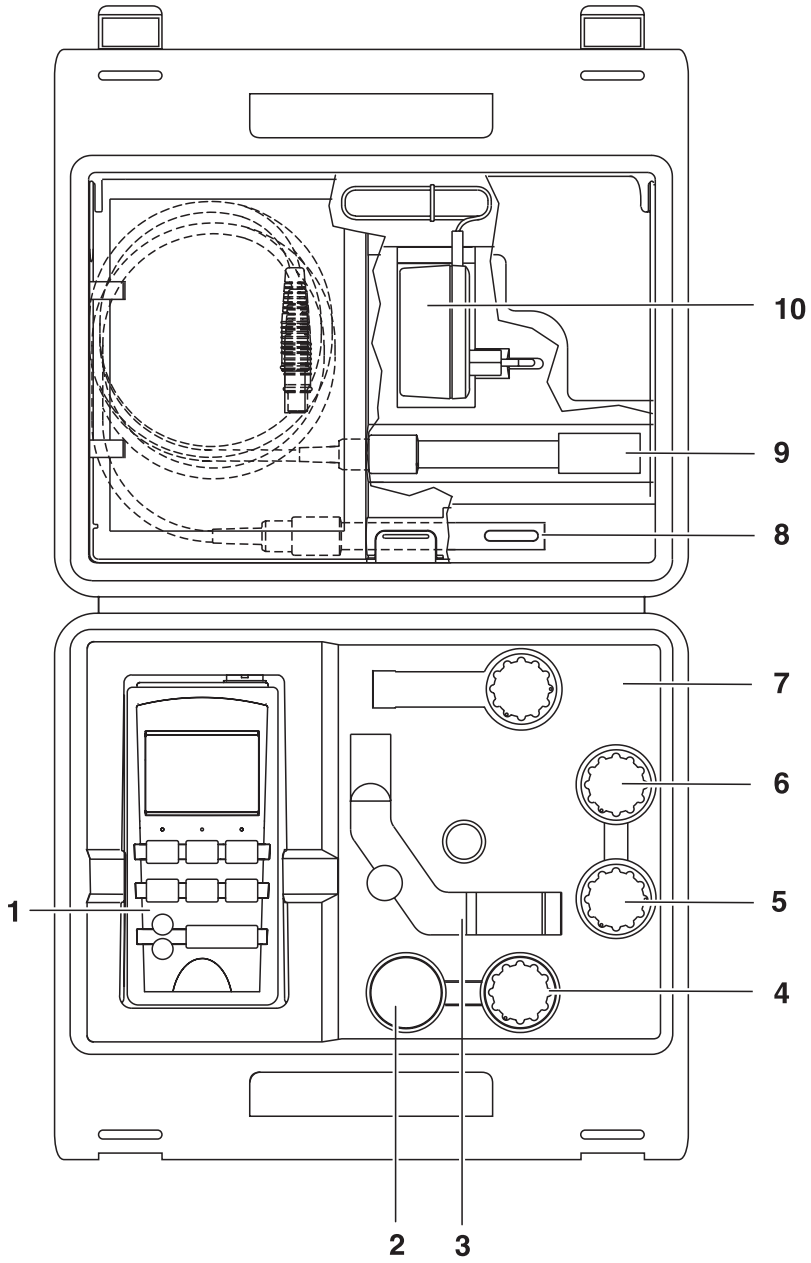
Note
If you need further information or application notes, you can obtain the following material from WTW:

- 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

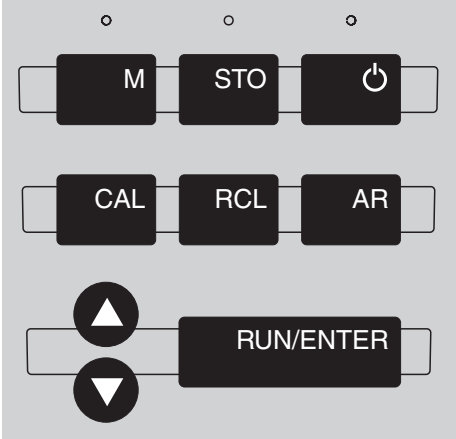
The measuring instrument is also available as part of individual SETs of equipment.
You will find additional information on this and other accessories in the WTW catalog or via the Internet.



Set (sample configuration):

1	pH/Cond 3400i measuring instrument
2	Beaker, 50 ml
3	Stand
4	Calibration and control standard for conductivity measuring cells, 50 ml
5	50 ml pH buffer solution, STP 4
6	50 ml pH buffer solution, STP 7
7	Storing solution for pH electrodes
8	Conductivity measuring cell
9	pH combination electrode
10	Plug-in power supply (optional)

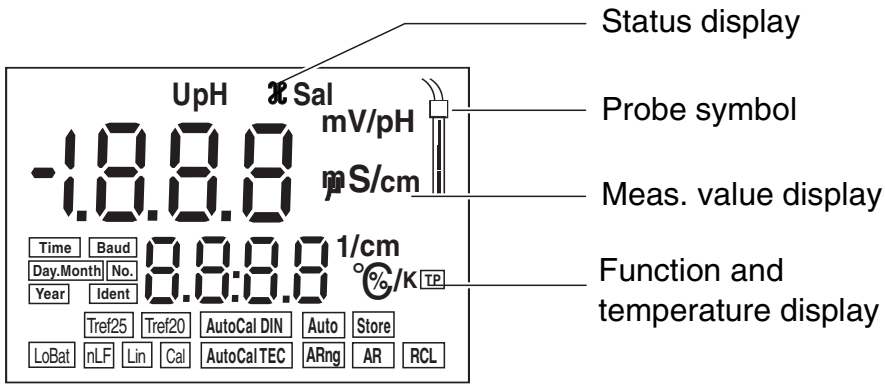
1.3 Keypad



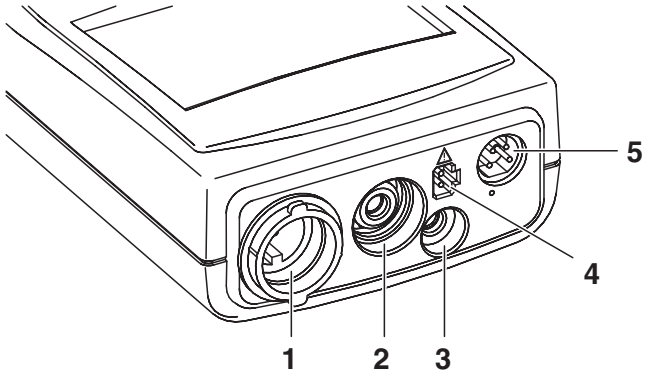
Key functions

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

1.4 Display



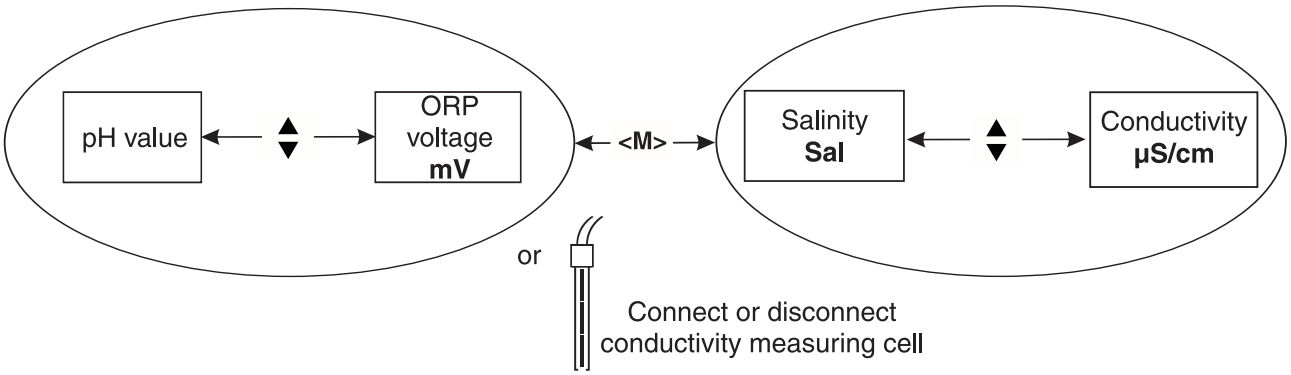
1.5 Jack field



1	TetraCon 325 conductivity measuring cell
2	pH electrode
3	pH temperature sensor
4	Plug-in power supply (optional)
5	Serial interface RS 232

1.6 Operating structure

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



Note
When connecting a conductivity measuring cell with temperature sensor, the measuring instrument recognizes the probe and automatically switches to the last selected conductivity measuring mode. As soon as the probe is disconnected, the instrument switches to the pH or ORP measuring mode.

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.

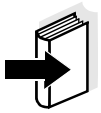
Safety instructions

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 conductivity and salinity 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 **<▲> <▼>**.

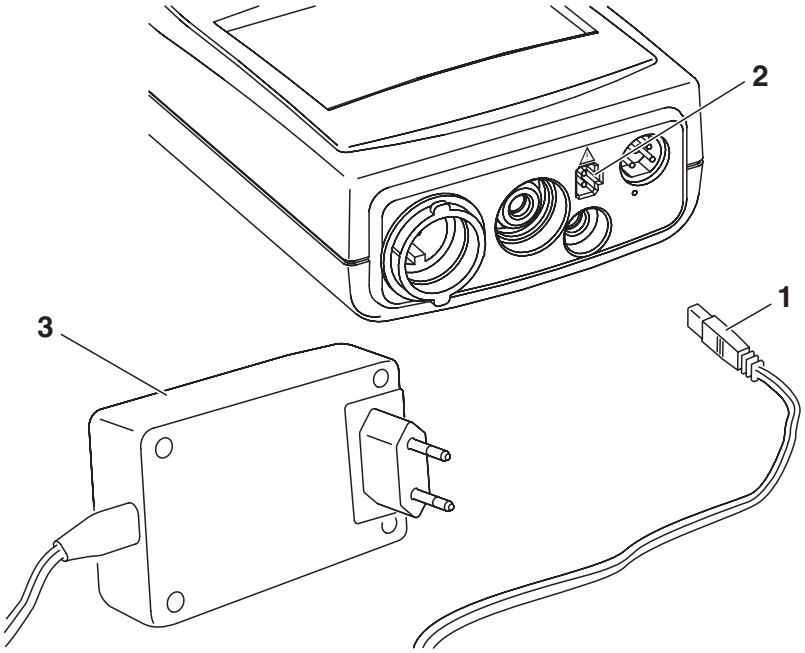
13	Confirm with **<RUN/ENTER>**. The instrument switches to a measuring mode.
14	Switch the instrument off using **<ON/OFF>**.

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.

Measuring mode when switching on

Connected sensor	Measuring mode
No sensor or pH/ORP electrode	pH or ORP measurement (depending on the last setting)
Conductivity measuring cell	Last selected measuring mode
2 sensors	Last selected 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 *pH* (pH measurement) or *U* (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 *pH* or *mV* measuring modes.

Note
Incorrect calibration of pH electrodes leads to incorrect measured values. Calibrate regularly before measuring. You can only connect electrodes of the NTC30 type or without temperature sensor.

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 measurement in pH measurements

You can perform pH measurements with or without a temperature sensor as well as with the temperature sensor of a conductivity measuring cell. The measuring instrument recognizes which sensors are connected and automatically switches to the correct mode for the temperature measurement.

The following cases are distinguishable.

Temperature sensor		Display	Mode
pH	***Cond***		
yes	-	*TP*	Automatic with pH temperature sensor
yes	yes	*TP*	
-	-		Manual
-	yes	*TP* flashes	The temperature value of the 2nd sensor (Cond) in the same test sample is used for the pH measurement*

* If you do not wish that, you can:

– either disconnect the 2nd sensor and use the manual temperature input or

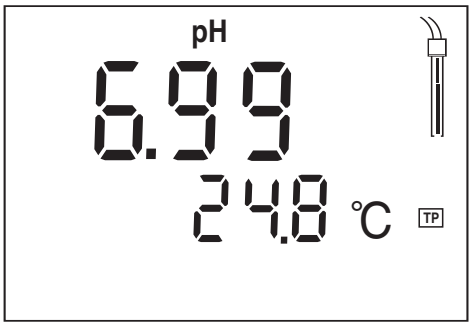
– use an electrode with a temperature sensor.

If a temperature sensor is connected, it is indicated on the display by *TP*.

Note
When calibrating without a temperature sensor (no *TP* display indicator displayed), enter the current temperature of the respective buffer solution manually using the **<▲> <▼>** keys while keeping the **<RUN/ENTER>** key depressed.

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	Press the **<▲> <▼>** keys until *pH* appears in the status display. The pH value appears on the display.



4	When measuring without a connected temperature sensor: Options: ● Determine the current temperature using a thermometer and, while keeping the **<RUN/ENTER>** key depressed, enter this temperature value with **<▲> <▼>**. ● *TP* display indicator not displayed, socket for the second probe is free: Connect the second probe (Cond) and immerse it in the same test sample. *TP* flashes, the temperature is automatically measured using the second probe.

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).

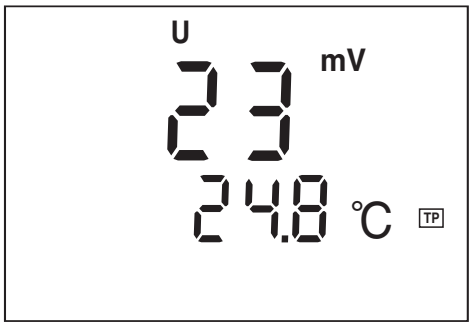
3	Start AutoRead with **<RUN/ENTER>**. *AR* flashes until a stable measured value is reached. This measured value is transmitted to the interface.
4	If necessary, start the next AutoRead measurement with **<RUN/ENTER>**.
5	To terminate the AutoRead function: Press the **<AR>** key.

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	Submerse 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 (-59,2 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 51.

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 53).

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
 Clean the electrode according to the electrode operating manual	-30 ... +30	-62 ... -61 or -56 ... -50
E3 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 *pH* (pH measurement) or *U* (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 *TP* display indicator is missing from the display).

4.3.1 AutoCal TEC

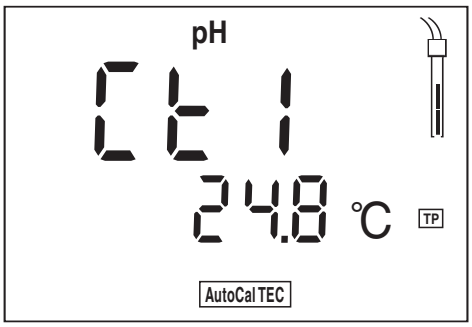
For this procedure, use any two WTW technical buffer solutions (pH values at 25 °C: 2.00 / 4.01 / 7.00 / 10.01).

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.

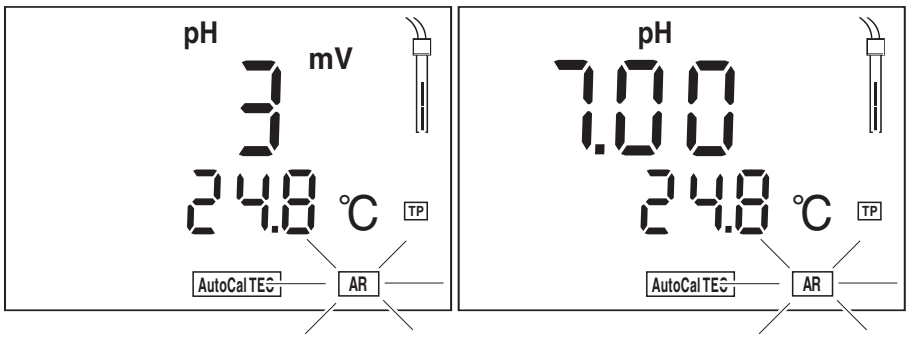
Note
The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.8 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV.

Note
Skip the steps 2 and 7 if you use a pH electrode with a temperature sensor or the temperature sensor of a conductivity measuring cell.

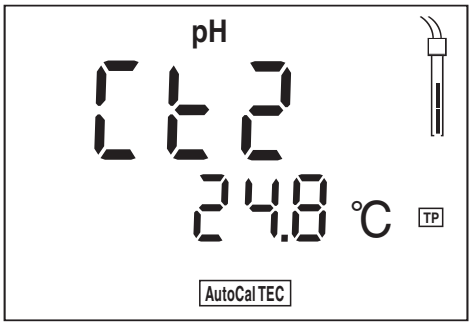
1	Press the **<CAL>** key repeatedly until the *Ct1* display indicator and the function display *AutoCal TEC* appears. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameters have been reset).



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:



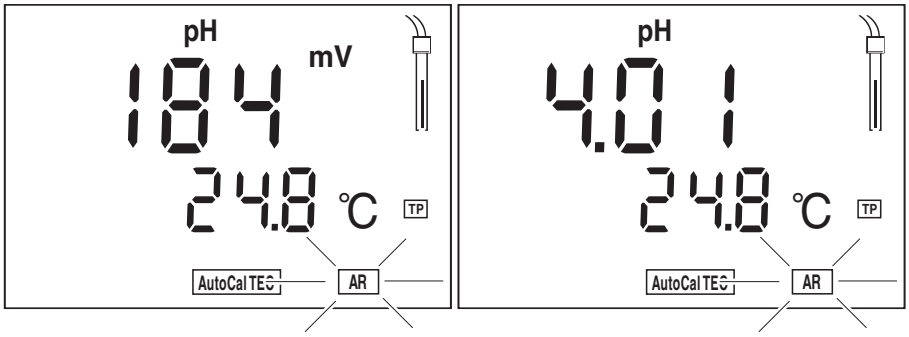
5	When the measured value is stable, *Ct2* appears.



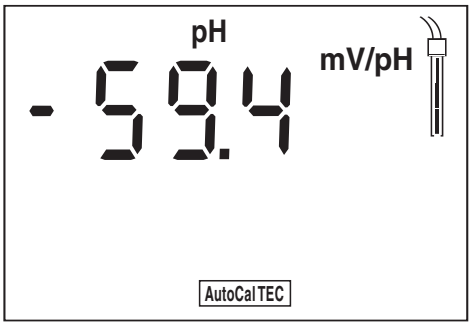
Note
At this point, the AutoCal TEC calibration can be terminated with **<M>**. This corresponds to a **single-point calibration**. When doing so, the in-

strument uses the Nernst slope (-59,2 mV/pH at 25 °C) and determines the asymmetry of the electrode.

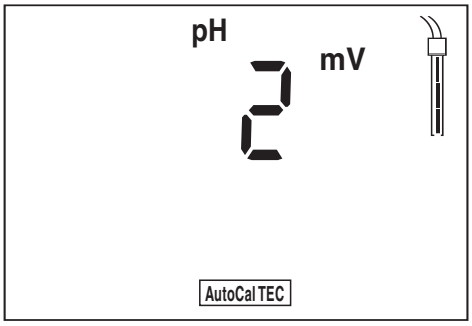
6	Thoroughly rinse the electrode with deionized water.
7	If required, enter the temperature of the second buffer solution with **<▲> <▼>** while keeping the **<RUN/ENTER>** key depressed.
8	Immerse the pH electrode in the second buffer solution.
9	Press the **<RUN/ENTER>** key. The *AR* display indicator 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.



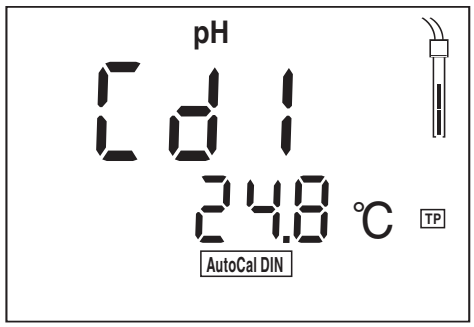
12	Switch to the measuring mode with **<M>**.

4.3.2 AutoCal DIN

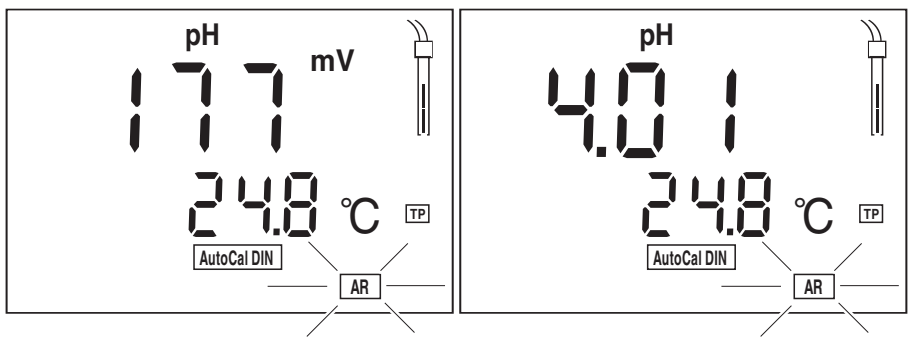
For this procedure, use two different standard buffer solutions according to DIN 19266 (type A, C, D or F with pH values at 25 °C of: 1.679 / 4.006 / 6.865 / 9.180).

Note
Skip the steps 2 and 7 if you use a pH electrode with a temperature sensor or the temperature sensor of a conductivity measuring cell.

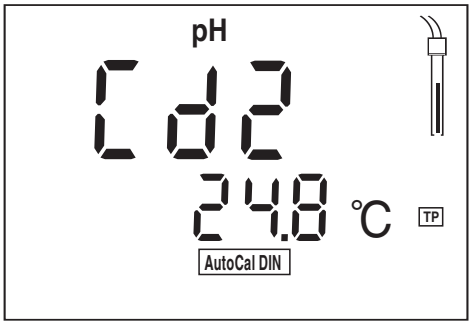
1	Press the **<CAL>** key repeatedly until the display *Cd1* and the function display *AutoCal DIN* appear. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameter has been reset).



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:

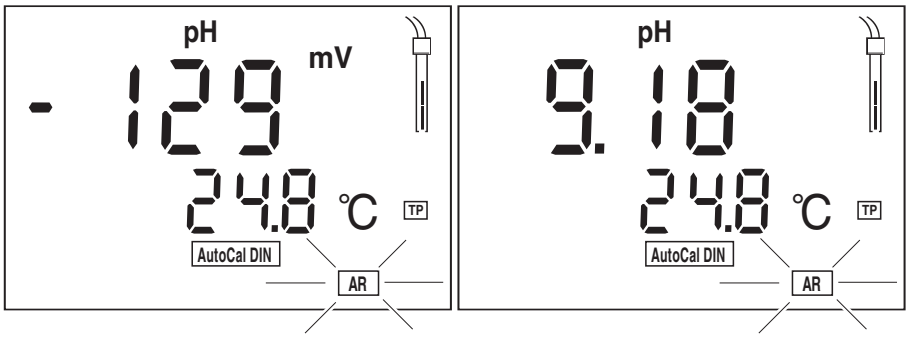


5	When the measured value is stable, *Cd2* appears.

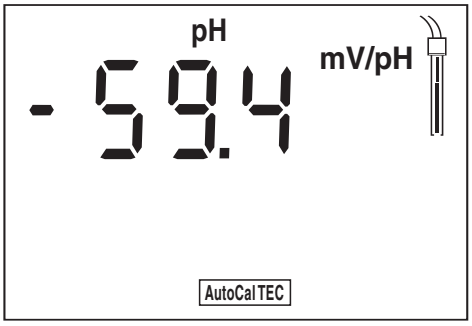


Note
At this point, the AutoCal DIN calibration can be terminated with **<M>**. This corresponds to a **single-point calibration**. When doing so, the instrument uses the Nernst slope (-59,2 mV/pH at 25 °C) and determines the asymmetry of the electrode.

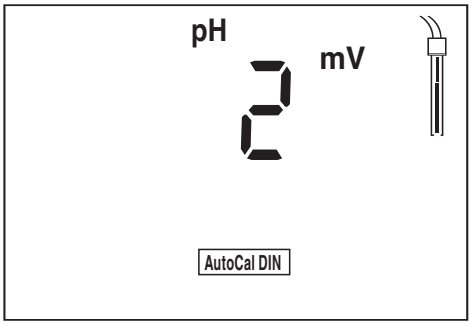
6	Thoroughly rinse the electrode with deionized water.
7	If required, enter the temperature of the second buffer solution with **<▲> <▼>** while keeping the **<RUN/ENTER>** key depressed.
8	Immerse the pH electrode in the second buffer solution.
9	Press the **<RUN/ENTER>** key. The *AR* display indicator 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

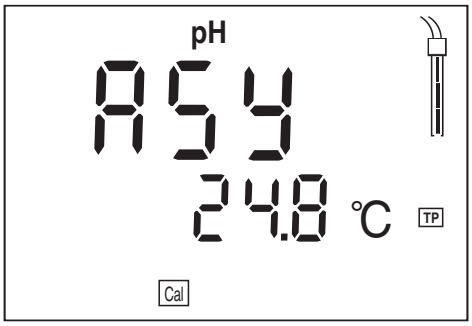
Two-point calibration

For this procedure, use two buffer solutions:

- pH 7.0 ± 0.5
- any other buffer solution

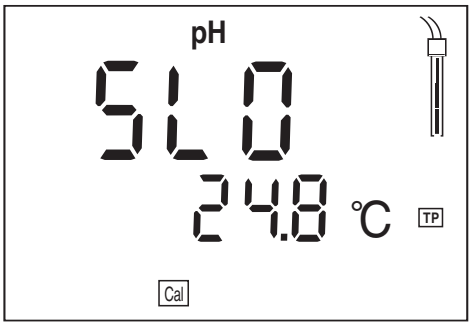
Note
Skip the steps 2 and 8 if you use a pH electrode with a temperature sensor or the temperature sensor of a conductivity measuring cell.

1	Press the **<CAL>** key repeatedly until the *ASY* display and the *Cal* 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).

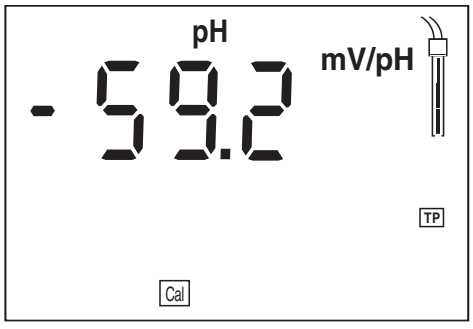


2	If required, enter the temperature of the first buffer solution with **<▲> <▼>** while keeping the **<RUN/ENTER>** key depressed.
3	Immerse the pH electrode in the first buffer solution (pH 7.0 ± 0.5 in two-point calibration).
4	Press the **<RUN/ENTER>** key. The measured pH value appears on the display.
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.

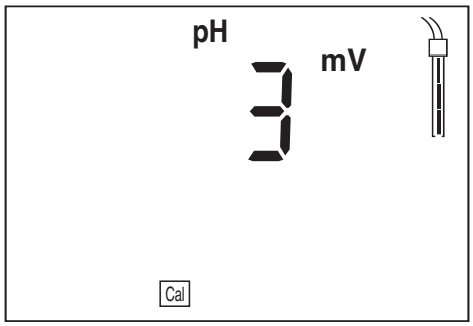
Note
At this point, the ConCal calibration can be broken off with **<M>**. This corresponds to a **single-point calibration**. When doing so, the instrument uses the Nernst slope (-59,2 mV/pH at 25 °C) and the fixed asymmetry of the electrode.



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 Conductivity/Salinity

4.4.1 General information

Note
Conductivity measurements with the pH/Cond 340 can only be carried out using the TetraCon 325 measuring cell.

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.

Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect a conductivity measuring cell to the measuring instrument. The instrument automatically switches over to conductivity measurement (status display $\mathcal{X}$ or *SAL*). If the conductivity measuring cell is already connected, press the **<M>** key repeatedly until the status display $\mathcal{X}$ or *SAL* appears.
2	Check the selected cell constant (see below) or calibrate the measuring instrument with the measuring cell (see section 4.4.5).
3	Using **<▲ > <▼>**, toggle between the measuring modes, conductivity ($\mathcal{X}$ in µ*S/cm*) or salinity (*SAL*).

Temperature sensor

The TetraCon 325 conductivity measuring cell has a temperature sensor integrated in it. The temperature sensor is shown on the display by *TP*.

Temperature compensation

Selectable linear or nonlinear temperature compensation, can be switched off (see section 4.8 CONFIGURATION).

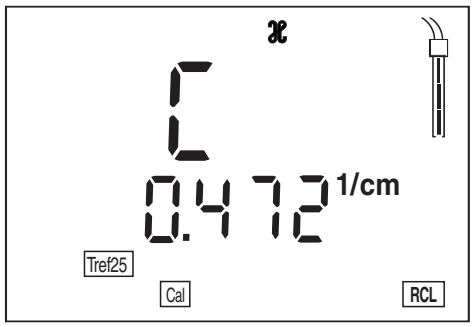
Reference temperature, Tref

The reference temperature (Tref) can be switched between 20 °C and 25 °C. It appears on the display as *Tref20* or *Tref25*. To switch over the reference temperature, see SWITCHING OVER THE REFERENCE TEMPERATURE, page 60.

Checking the cell constant

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

2	Press the **<RUN/ENTER>** repeatedly until the last calibrated cell constant is displayed, e. g. 0.472 cm^{-1}.

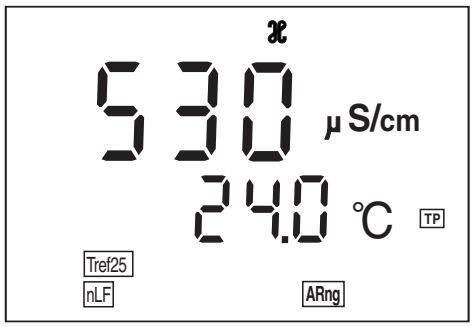


3	To return to the measuring mode: Press the **<M>** key when the correct cell constant is displayed.
4	If you want to recalibrate the cell constant, proceed according to section 4.4.5 DETERMINING THE CELL CONSTANT (CALIBRATION IN THE CONTROL STANDARD).

4.4.2 Measuring the conductivity

You can meaure the conductivity as follows:

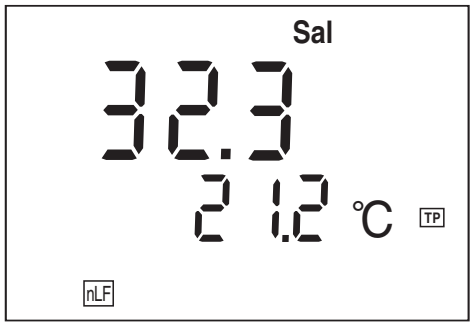
1	Perform the preparatory activities according to section 4.4.1.
2	Immerse the conductivity measuring cell in the test sample.
3	Press the <▲> <▼> keys until $\mathcal{X}$ and the unit µ*S/cm* appears in the status display. The conductivity value appears on the display.



4.4.3 Measuring the salinity

You can measure the salinity as follows:

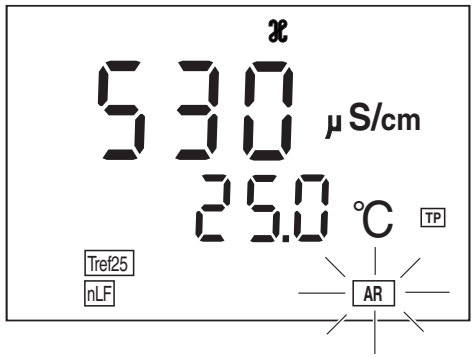
1	Perform the preparatory activities according to section 4.4.1.
2	Immerse the conductivity measuring cell in the test sample.
3	Press the <▲> <▼> keys until the *Sal* status display appears. The salinity value appears on the display.



4.4.4 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.

1	Select the $\mathcal{X}$ or *SAL* measuring mode with **<M>** and/or **<▲ > <▼>**.
2	Immerse the conductivity measuring cell in the test sample.
3	Activate the AutoRead function with **<AR>**. The current measured value is frozen (hold function).
4	Start AutoRead with **<RUN/ENTER>**. *AR* flashes until a stable measured value is reached. This measured value is transmitted to the interface.



5	If necessary, start the next AutoRead measurement with **<RUN/ENTER>**.
6	To terminate AutoRead: Press the **<AR>** key.

Note
The current AutoRead measurement can be terminated at any time (accepting the current value) by pressing **<RUN/ENTER>**. You can only change to another measuring mode after completion of AutoRead.

4.4.5 Determining the cell constant (Calibration in the control standard)

Why determine the cell constant?

Aging slightly changes the cell constant, e. g. by coatings. As a result, an inexact measured value is displayed. The original characteristics of the cell can often be restored by cleaning the cell. Calibration determines the current value of the cell constant and stores this value in the instrument.
Thus, you should calibrate at regular intervals.

In the delivery condition, the cell constant of the measuring instruments is set to 0.475 cm^{-1} (TetraCon 325 conductivity measuring cell).

AutoRead

The calibration procedure automatically activates the *AutoRead* function. The *AR* display indicator flashes. The calibration process is finished when *AR* stops flashing.

Displaying calibration data

You can view the data of the last calibration on the display. The proceeding is described on page 51.

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 53).

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
 14.04.01      11:37
Device No.: 99990000
Calibration Conductivity
Cal time: 14.04.01 / 11:37
Cal interval:  180d
Cal Std.:   0.01 mol/l KCL
            40.0 °C
Conduct./Tref25: 1413µS/cm
Cell Const :  0.478   1/cm
Probe :     +++
```

Calibration evaluation

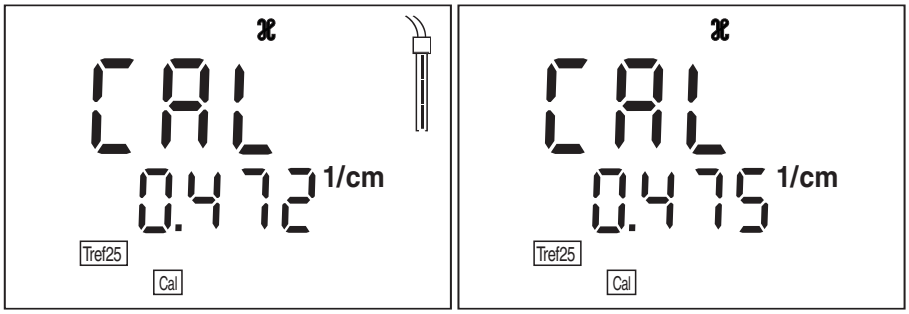
After the calibration, the measuring instrument automatically evaluates the current status of the calibration. The evaluation appears on the display.

Display	Cell constant [cm^{-1}]
	0.450 ... 0.500 cm^{-1}
E3 Eliminate the error according to chapter 6 WHAT TO DO IF...	Outside the range 0.450 ... 0.500 cm^{-1}

Determining the cell constant

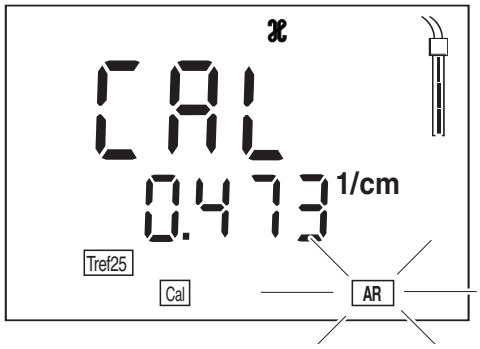
You can determine the cell constant (conductivity measuring cell TetraCon 325) as follows:

1	Press the **<CAL>** key repeatedly until the $\mathcal{X}$ and *CELL* status displays appear.
2	Press the **<RUN/ENTER>** key. The *CAL* display appears, as well as – the current, calibrated cell constant (**with** sensor symbol on the display) or – the fixed cell constant *0.475 1/cm* (**without** sensor symbol on the display). In this case, the measurement parameters are initialized. See “Reset” on page 62.



3	Immerse the conductivity measuring cell in the control standard solution, 0.01 mol/l KCl.

4 Press the **<RUN/ENTER>** key.
The AutoRead measurement to determine the cell constant starts. The *AR* display indicator flashes until a stable signal is reached. The cell constant determined is displayed. The measuring instrument automatically stores the cell constant.



5 To return to the measuring mode: Press the **<M>** key. The determined cell constant is taken over for the measurement.

Note
If the error message E3 appears, refer to chapter 6 WHAT TO DO IF...

4.4.6 Setting the temperature compensation

The calculation of the temperature compensation is based on the preset reference temperature, *Tref 20* or *Tref 25* (see section 4.8 CONFIGURATION).

You can select one of the following temperature compensations:

- **Nonlinear temperature compensation (*nLF*)** according to EN 27 888
- **Linear temperature compensation (*Lin*)** with adjustable coefficient in the range 0.001 ... 3.000 %/K
- **No temperature compensation (----)**

Note
Select the following temperature compensations given in the table according to the respective test sample:

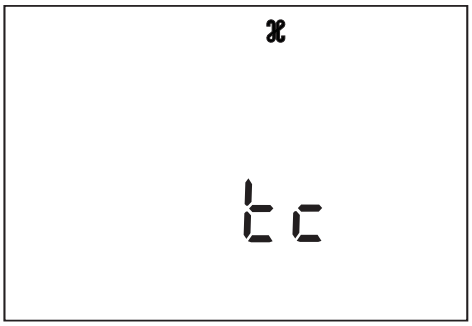
Application tips

Test sample	Temperature compensation	Display indicator
Natural water (ground water, surface water and drinking water)	nLF according to DIN 38404 EN 27 888	nLF
Ultrapure water	nLF according to DIN 38404 EN 27 888	nLF
Other aqueous solutions	Set linear temperature coefficient 0.001 ... 3.000 %/K	Lin
Salinity (seawater)	Automatically nLF according to IOT	Sal, nLF

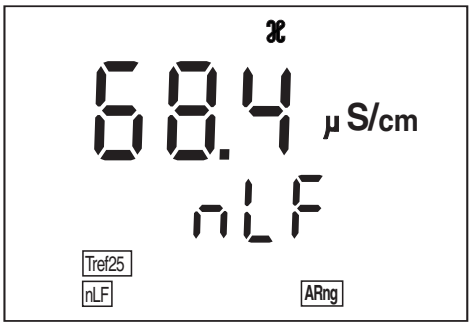
Selecting the nonlinear temperature compensation

You can select the nonlinear temperature compensation as follows:

1	Press the **<CAL>** key repeatedly until the status displays $\mathcal{X}$ and *tC* appear.



2	Press the **<RUN/ENTER>** key.
3	Press the **<CAL>** key repeatedly until *nLF* appears on the display.

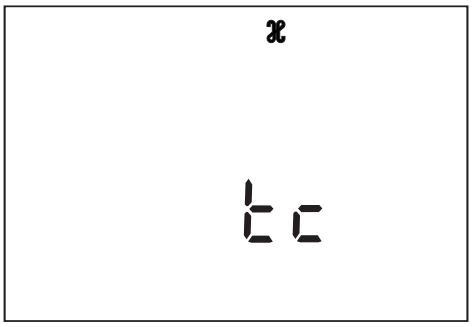


4	To return to the measuring mode: Press the **<M>** key. From now on, nLF will be used for the temperature compensation. *nLF* is displayed on the display.

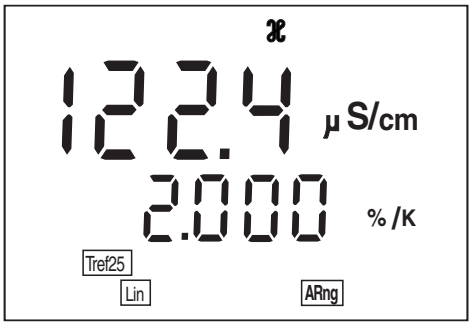
Selecting the linear temperature compensation

You can select the linear temperature compensation as follows:

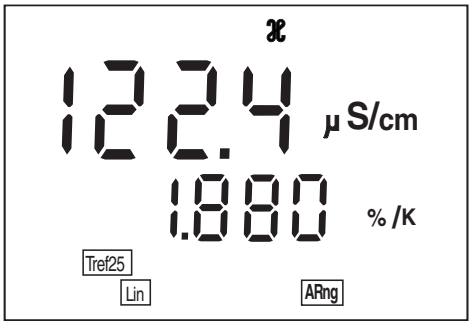
1	Press the **<CAL>** key repeatedly until *tc* appears on the display.



2	Press the **<RUN/ENTER>** key.
3	Press the **<CAL>** key repeatedly until the adjustable linear temperature coefficient (%/K) appears on the display.



4	Set the temperature coefficient with **<▲> <▼>** , e.g. 1.880 %/K.

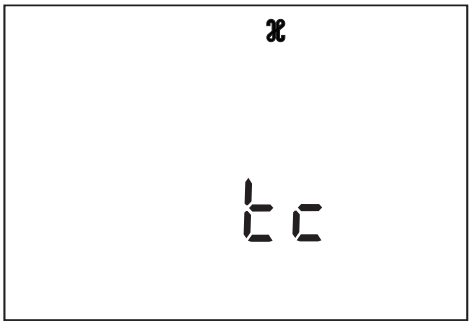


5	To return to the measuring mode: Press the **<M>** key. From now on, the adjusted linear temperature coefficient will be used for the temperature compensation. *Lin* is displayed on the display.

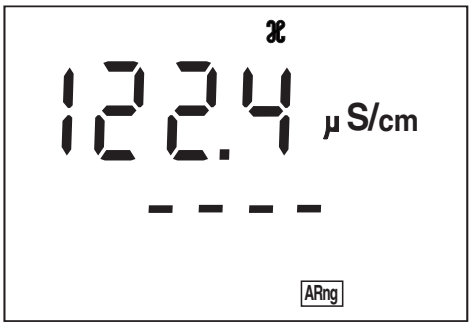
Switching the temperature compensation off

You can switch off the temperature compensation as follows:

1	Press the **<CAL>** key repeatedly until *tc* appears on the display.



2	Press the **<RUN/ENTER>** key.
3	Press the **<CAL>** key repeatedly until four bars appear in the lower line of the display.



4	The temperature compensation is switched off.
5	To return to the measuring mode: Press the **<M>** key. From now on, the instrument will measure without temperature compensation.

4.5 Calibration intervals (Int 3, Int 5)

For each measured variable, a time interval is stored. When it has expired, you will be reminded to calibrate. After a calibration interval has expired, the probe symbol of the relevant measured variable flashes. It is still possible to measure. By calibrating the relevant probe, the function is reset and the interval starts anew.

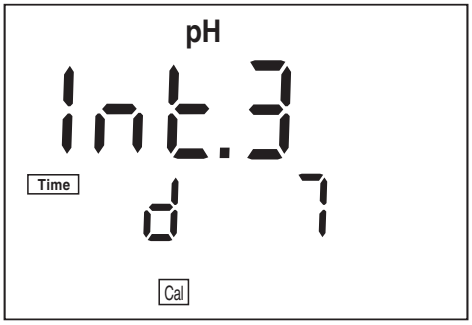
The following calibration intervals are set in the factory:

Measured parameter	Designation	Default setting
pH/ORP	*Int 3*	7 days *(d 7)*
Conductivity	*Int 5*	180 days *(d 180)*

Setting the calibration interval

You can change each of these intervals (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 *Int 3 or Int 5* and the required measured variable *pH* or $\mathcal{X}$ 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 values of the probes connected
- Temperature
- Temperature measuring procedure
- ID number

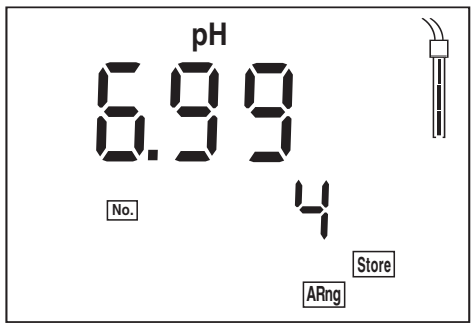
You can transmit measured values (data records) to the data storage in two ways:

- Save manually
- Switch on AutoStore (Int 1), (see page 47).

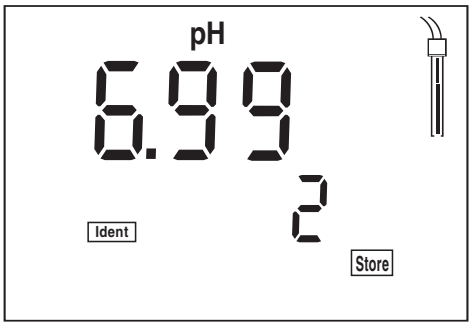
4.6.1 Saving manually

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.

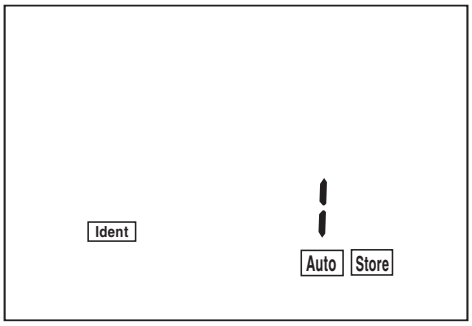
Setting the save interval

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 49) and
- Clear the memory (see page 54).

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.

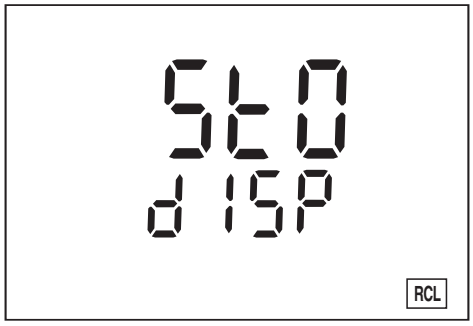
4.6.3 Outputting the data storage

You can output the contents of the data storage:

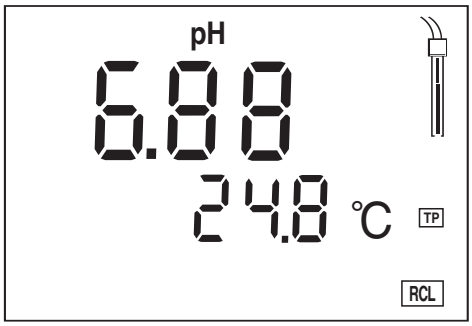
- Stored data on the display
- Calibration data on the display
- Stored data on the serial interface
- Calibration protocol to the interface

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:

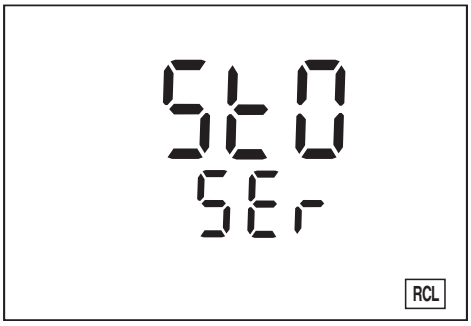
Display further data of the data record (ID number, date, time, storage location)	Press **<RUN/ENTER>**
Toggle between two saved measured variables	Press **<RUN/ENTER> + <M>**
Advance one data record (storage location)	Press **<▲>**
Go back one data record (storage location)	Press **<▼>**

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 *Sto SEr* 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>**.

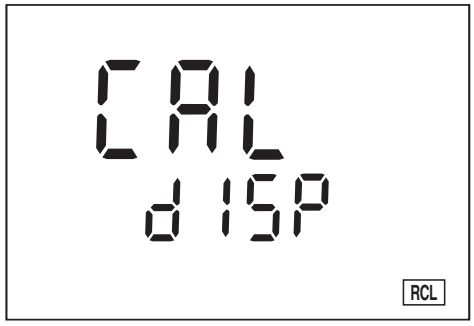
The transmitted data contains the entire contents of the storage in incrementing order of the location numbers.

Sample printout:

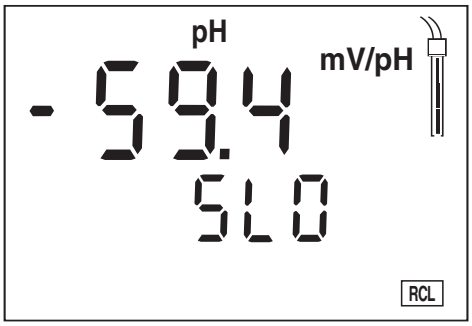
```
No.    1:
 09.03.99        17:10
pH 10.01         25    °C
Tman          AR
Ident :  1

No.    2:
 09.03.99        17:11
pH 10.01         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

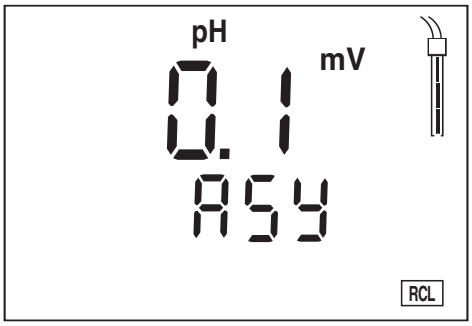
1	Press the **<RCL>** key repeatedly until *CAL disp* appears on the display.



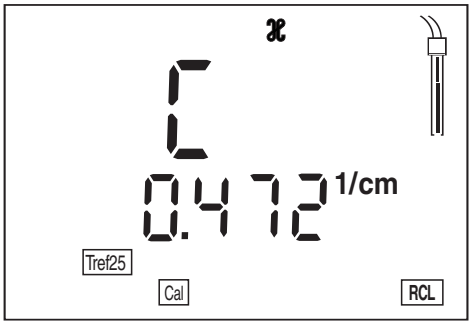
2	Press the **<RUN/ENTER>** key. The data of the last calibration of all measured variables appears in the following sequence: ● pH: Slope *SLO* and asymmetry *ASY* ● Cond: Cell constant *C* Information concerning the calibration procedure is output as well.



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



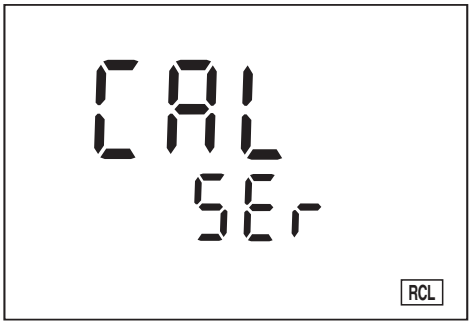
4	Press **<RUN/ENTER>** to display the cell constant. The displayed value is: ● the current, calibrated cell constant (**with** sensor symbol on the display) or ● the fixed cell constant *0.475 1/cm* (**without** sensor symbol on the display). In this case, the measuring parameters are initialized (see section 4.9 RESET).



5	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 Conductivity
Cal time: 14.12.00 / 11:37
Cal interval:  180d
Cal Std.:   0.01 mol/l KCL
            40.0 °C
Conduct./Tref25: 1413µS/cm
Cell Const :  0.478   1/cm
Probe :     +++
CALIBRATION ISE
Cal time: 01.10.01 / 15:30
Std 1   10,00  mg/l
```

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 47), 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 49), calibration data or saved measured values are output on the interface.

4.7.1 Data transmission interval (Int 2)

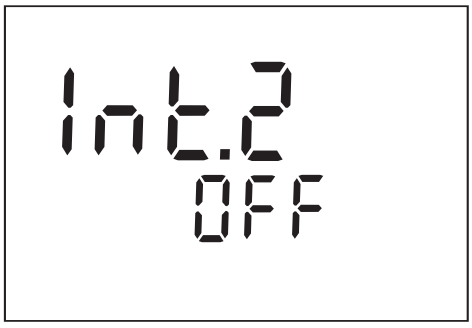
The interval to the data transmission (Int 2) determines the chronological interval between automatic data transmissions. After the selected interval expires, the current data record is transmitted to the interface.

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

Setting the Data transmission interval

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. *Int 2* 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)

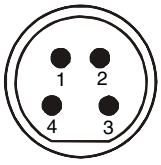
Via the RS 232 interface, you can transmit the data to a PC or an external printer. Use the AK340/B (PC) or AK325/S (ext. printer) cable to connect the interface to the instruments. The data output automatically switches to the RS*232* interface.

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

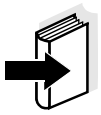


RS 232
REC

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

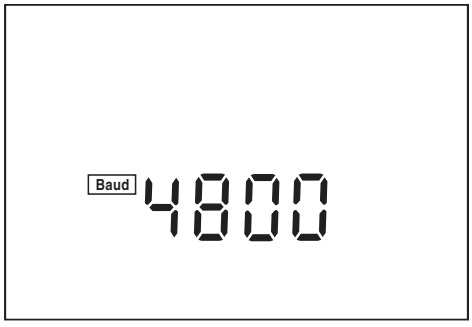
You can adapt the measuring instrument to your individual requirements. To do this, the following parameters can be changed (the status on delivery is marked in bold):

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 *Int 3* – $\mathcal{X}$: 1 ... **180** ... 999 d *Int 5*
Reference temperature	**– 25 °C (TREF25)*t25*** – 20 °C (TREF20)*t20*
Date/time	Any

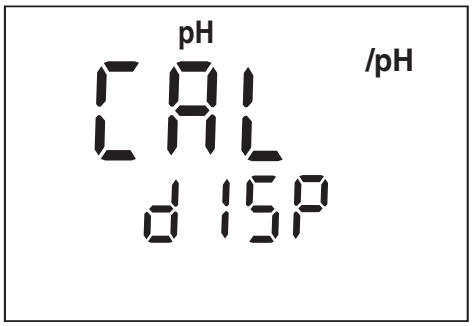
Note
You can leave the configuration menu at any time with **<M>**. The parameters that have already been changed are stored.

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

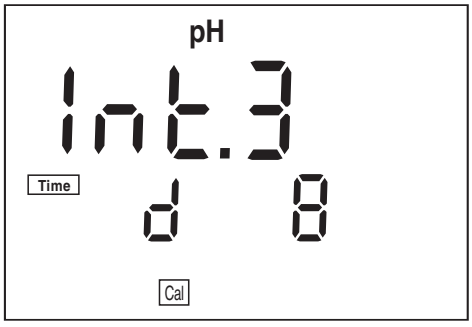


4	Select the required Baud rate with **<▲> <▼>**.
5	Confirm with **<RUN/ENTER>**. *CAL dISP* appears on the display.

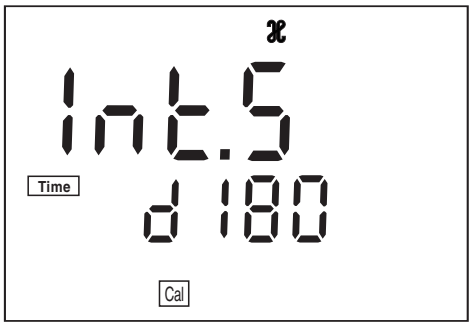


6	Select the required display during the pH calibration with **<▲> <▼>**. *mV*: Display of the current electrode voltage */pH*: Display of the buffer nominal value.
7	Confirm with **<RUN/ENTER>**. On the display, *Int 3* appears.

Calibration intervals pH



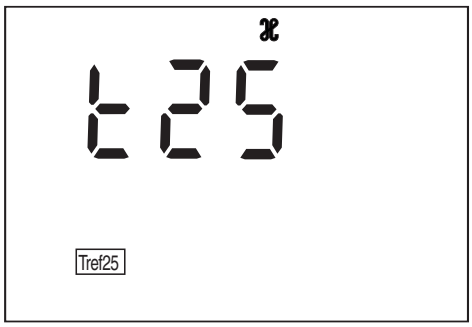
8	Set the required interval (in days) with **<▲> <▼>**.
9	Confirm with **<RUN/ENTER>**. *Int 5* and the measured variable $\mathcal{x}$ appears on the display.



10	Set the required interval (in days) with **<▲> <▼>**.

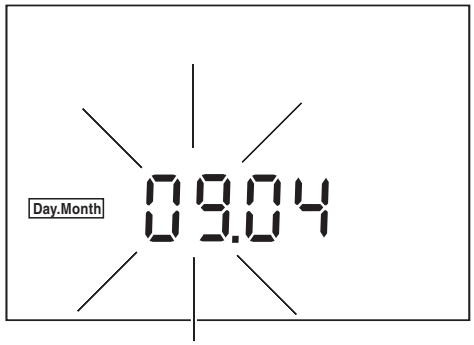
11	Confirm with **<RUN/ENTER>**. The reference temperature set for conductivity measurements appears on the display.

Switching over the reference temperature



12	Using **<▲> <▼>**, toggle between *t20* and *t25*.
13	Confirm with **<RUN/ENTER>**. The date flashes on the display.

Date and time



14	Set the date of the current day with **<▲> <▼>**.
15	Confirm with **<RUN/ENTER>**. The date (month) flashes on the display.
16	Set the current month with **<▲> <▼>**.
17	Confirm with **<RUN/ENTER>**. The year appears on the display.
18	Set the current year with **<▲> <▼>**.
19	Confirm with **<RUN/ENTER>**. The hours flash on the display.
20	Set the current time with **<▲> <▼>**.

21	Confirm with **<RUN/ENTER>**. The minutes flash on the display.
22	Set the current time with **<▲> <▼>**.
23	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

Cond

Measuring mode	$\mathcal{K}$
Cell constant	0.475 cm^{-1} (calibrated) 0.475 cm^{-1} (set up)
Temperature compensation	nLF
Reference temperature	Tref25
Temperature coefficient of the linear temperature compensation	2.000 %/K

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

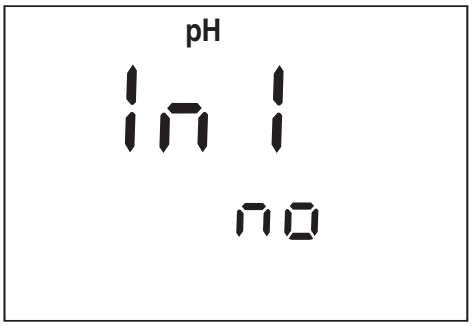
Configuration parameters

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

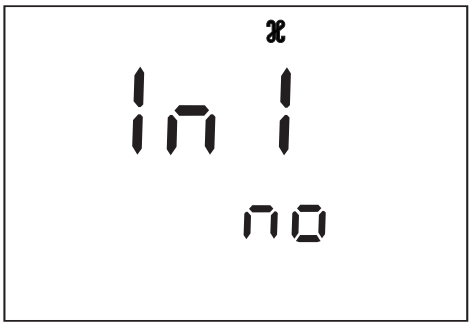
Baud rate	4800
Display during the pH calibration	Buffer nominal value
Interval 1 (automatic save)	OFF
Interval 2 (for data transmission)	OFF

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.

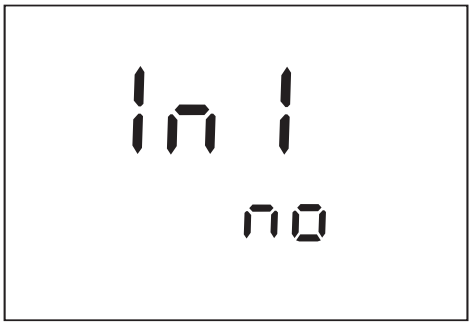


3	Using **<▲> <▼>**, toggle between *no* and *YES*. *YES*: Resetting the pH measuring parameters *no*: Retaining settings.
4	Confirm with **<RUN/ENTER>**. The measuring instrument switches to the setting to reset the Cond measuring parameters.



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

Resetting the configuration parameters



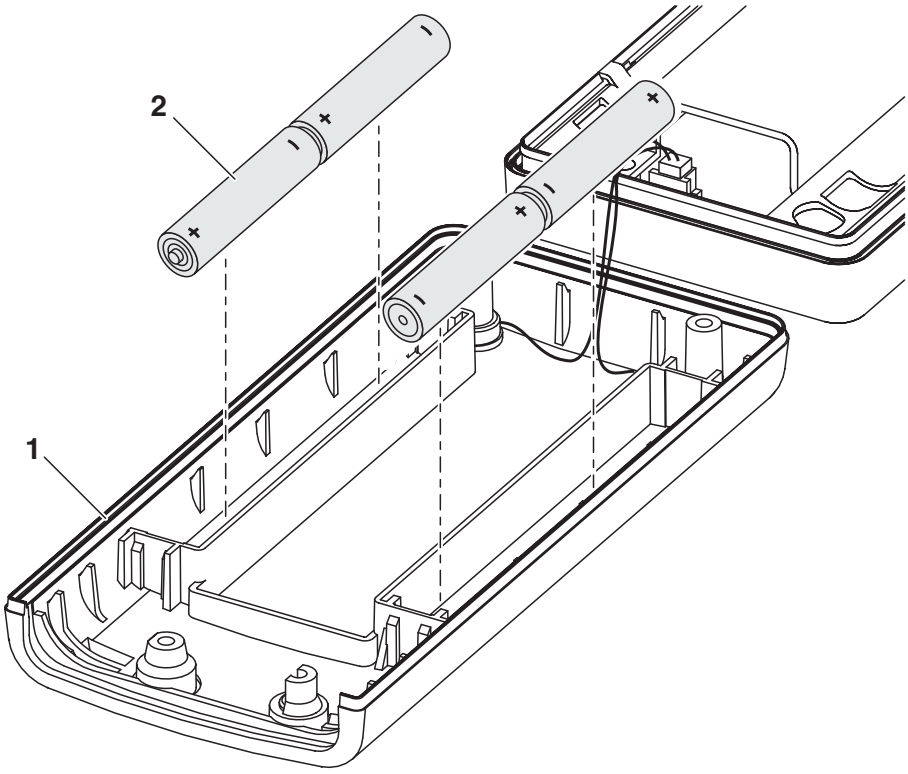
7	Using **<▲> <▼>**, toggle between *no* and *YES*. *YES*: Resetting the configuration parameters *no*: Retaining settings.
8	Confirm with **<RUN/ENTER>**. The measuring instrument automatically switches to the last active measuring mode.

5 Maintenance, cleaning, disposal

5.1 Maintenance

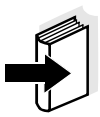
The measuring instrument is almost maintenance-free.
The only maintenance task is replacing the batteries.
LoBat on the display indicates that the batteries should be changed.
The batteries are then largely depleted.

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 ± signs on the batteries must correspond to the ± signs in the battery compartment. Only use leakproof alkaline manganese batteries.



Note
For maintenance of electrodes and measuring cells, 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 OFL

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	**Remedy**
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 Conductivity system messages

Error message OFL

Cause	Remedy
The measured value lies outside the measuring range	
– Measuring cell not connected	– Connect measuring cell
– Cable broken	– Replace measuring cell

Error message E3

Cause	Remedy
– Measuring cell contaminated	– Clean cell and replace it if necessary
– Unsuitable calibration solution	– Check calibration solutions

6.3 General errors

Display LoBat

Cause	Remedy
– Batteries almost empty	– Exchange the batteries (see section 5.1 MAINTENANCE)

Instrument does not react to keystroke

Cause	Remedy
– Operating condition undefined or EMC load unallowed	– Processor reset: Switch the instrument on while pressing the **<CAL>** key

Display to

Cause	Remedy
– Time-out of the interface	– Check the instrument that is connected

Probe symbol flashes

Cause	Remedy
– Calibration interval expired	– Recalibrate the measuring system

Message StoFull	Cause	Remedy
	– All memory locations are full	– 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	- 2.00 ... + 19.99	0.01
U [mV]	- 1999 ... + 1999	1
T [°C]	- 5.0 ... + 105.0	0.1

Precision of pH/ORP (± 1 digit)

pH (after calibration)	± 0.01
U [mV]	± 1
T [°C]	± 0.1

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

Cond measuring ranges

	Measuring range	Resolution
$\mathcal{X}$ [µS/cm]	0 ... 1999	1
$\mathcal{X}$ [mS/cm]	0.00 ... 19.99 0.0 ... 199.9 0 ... 500	0.01 0.1 1
SAL	0.0 ... 70.0 according to the IOT table	0.1
T [°C]	– 5.0 ... + 105.0	0.1

Precision of Cond (± 1 digit)

$\mathcal{X}$	No compensation: Accuracy ± 0.5 % Nonlinear compensation nLF : Accuracy / Sample temperature ± 0.5 % / 0 °C ... 35 °C according to EN 27 888; ± 0.5 % / 35 °C ... 50 °C extended nLF function acc. to WTW measurements Linear compensation Lin : Accuracy / Sample temperature ± 0.5 % / 10 °C ... 75 °C (The accuracy percentage always refers to the measured value.)
SAL	Range 0.0 ... 42.0 Accuracy / Sample temperature ± 0.1 / 5 °C ... 25 °C ± 0.2 / 25 °C ... 30 °C
T [°C]	± 0.1

Cell constant, calibration

C [cm^{-1}]	0.450 ... 0.500

Cond reference temperature

Tref	Can be set to 20 °C or 25 °C

Serial interface

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)	The following specifications apply to all plug-in power supplies: Max. overvoltage connection category II 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 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 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 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

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

$\mathcal{X}$	Conductivity value (international γ)
AR	AutoRead (drift control)
ARng	Automatic range switching Measuring instrument measures with highest resolution
ASY	Asymmetry
AutoCal TEC	Automatic pH calibration with WTW technical buffer solutions according to DIN 19267
C	Cell constant [cm^{-1}] (internat. k)
°C	Temperature unit, degrees Celsius
Cal	Calibration
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
Lin	Linear temperature compensation
LoBat	Batteries almost empty(Low Battery)
mV	Voltage unit
mV/pH	Unit of the electrode slope (internat. mV)
nLF	Nonlinear temperature compensation
OFL	Display range exceeded (Overflow)
pH	pH value
S	Slope (internat. k)
SAL	Salinity

SELV	Safety Extra Low Voltage
SLO	Slope setting on calibration
TC	Temperature coefficient (internat. α)
TP	Temperature measurement active (Temperature Probe)
T_{Ref} 20/T20	Reference temperature of 20 °C
T_{Ref} 25/T25	Reference temperature of 25 °C
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).

Cell constant, k Characteristic quantity of a conductivity measuring cell, depending on the geometry.

Conductivity Short form of the expression, specific electrical conductivity. It is a measured value of the ability of a substance to conduct an electric current. In water analysis, the electrical conductivity is a dimension for the ionized substances in a solution.

Conductometry Name of the conductivity measuring technique.

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.

Resistance Short name for the specific electrolytic resistance. It corresponds to the reciprocal value of the electrical conductivity.

Resolution Smallest difference between two measured values that can be displayed by a measuring instrument.

Salinity The absolute salinity S_A of seawater corresponds to the relationship of the mass of dissolved salts to the mass of the solution (in g/Kg). In practice, this dimension cannot be measured directly. Therefore, the practical salinity is used for oceanographic monitoring. It is determined by measuring the electrical conductivity.

Salt content General designation for the quantity of salt dissolved in water.

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 compensation Name of a function that considers the temperature influence on the measurement and converts it accordingly. Depending on the measured parameter to be determined, the temperature compensation functions in different ways. For conductometric measurements, the measured value is converted to a defined reference temperature. For potentiometric measurements, the slope value is adjusted to the temperature of the test sample but the measured value is not converted.

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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