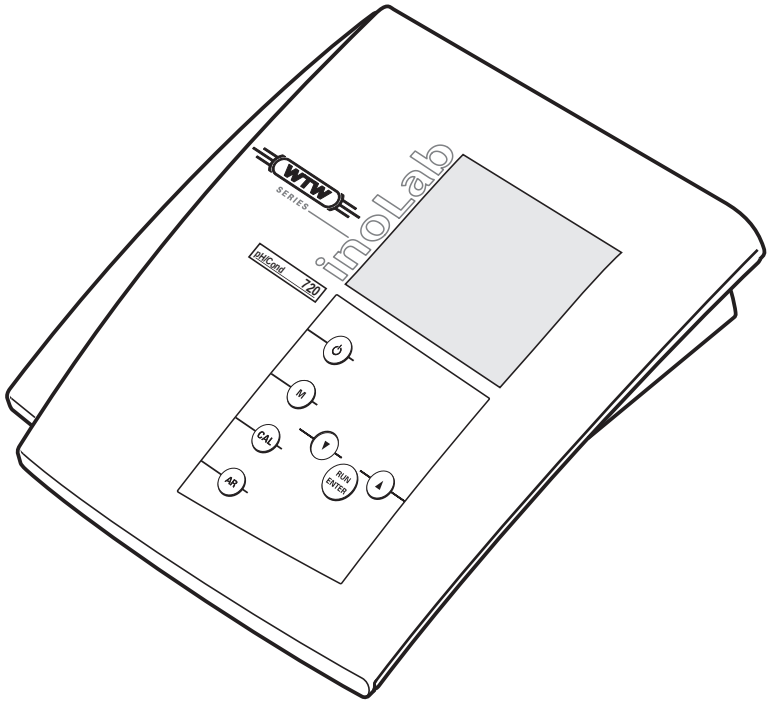
Operating manual

ba75441e

inoLab
pH/Cond 720



**Measuring Instrument
for pH, Redox,
and Conductivity**

ba75441e01 03/2004

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.
We cannot guarantee that there are absolutely no errors in this manual. We are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.

Warranty declaration

The designated instrument is covered by a warranty of three years from the date of purchase.
The instrument warranty extends to manufacturing faults that are determined within the period of warranty.
The warranty excludes components that are replaced during maintenance such as batteries, etc.

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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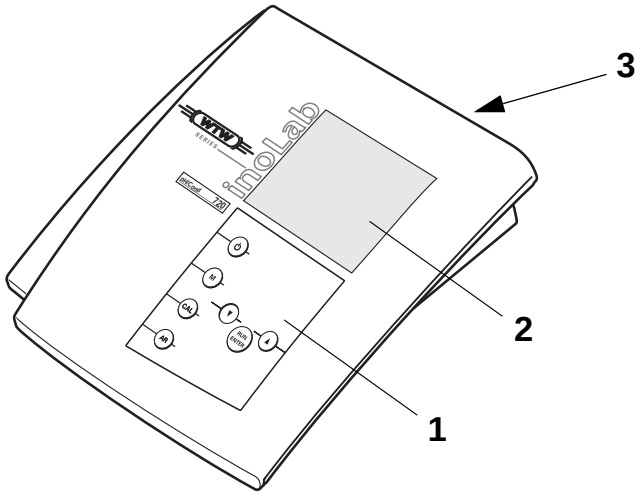
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1 Overview

The compact inoLab pH/Cond 720 precision measuring instrument lets you perform pH, Redox, and conductivity measurements rapidly and reliably. The inoLab pH/Cond 720 provides the highest degree of operating comfort, reliability and measuring safety for all applications.

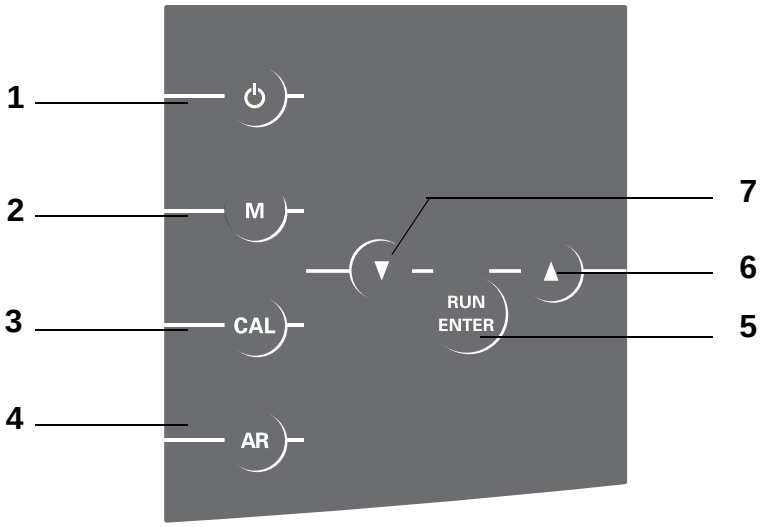
The proven MultiCal® calibration procedures and special *AutoRead* function support your work with the instrument.



1	Keypad
2	Display
3	Sockets

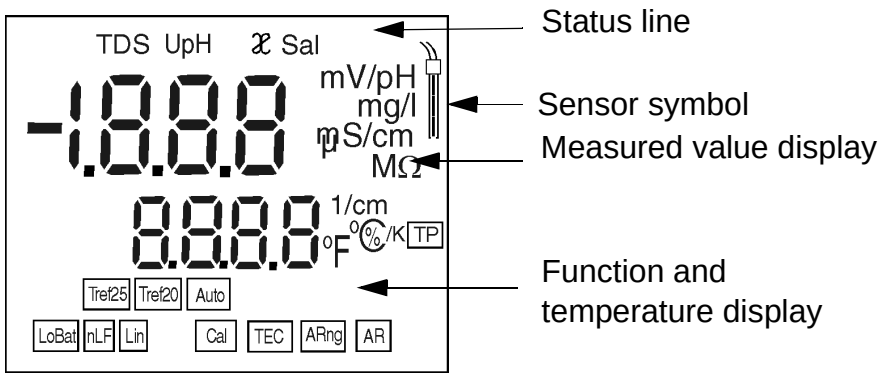
Note
The measuring instrument can also be delivered as part of a set.
Information on this and other accessories is available in the WTW catalog LABORATORY AND FIELD INSTRUMENTATION or via the Internet.

1.1 Keypad

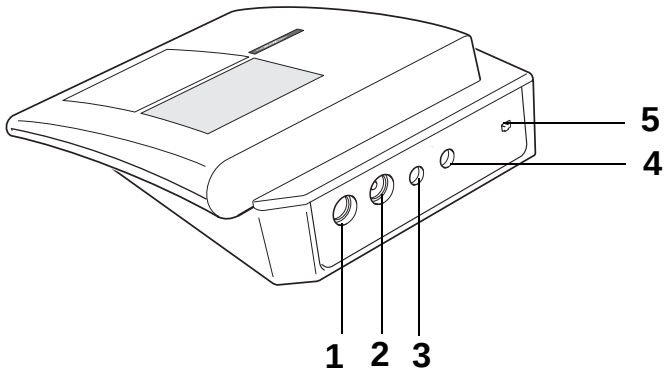


1	Measuring instrument ON/OFF
2	Select measuring mode
3	Call up calibration procedure
4	Activate/deactivate AutoRead
5	Confirm inputs, start AutoRead
6	Select measuring mode, increase values, scroll
7	Select measuring mode, reduce values, scroll

1.2 Display



1.3 Sockets



Connectors:

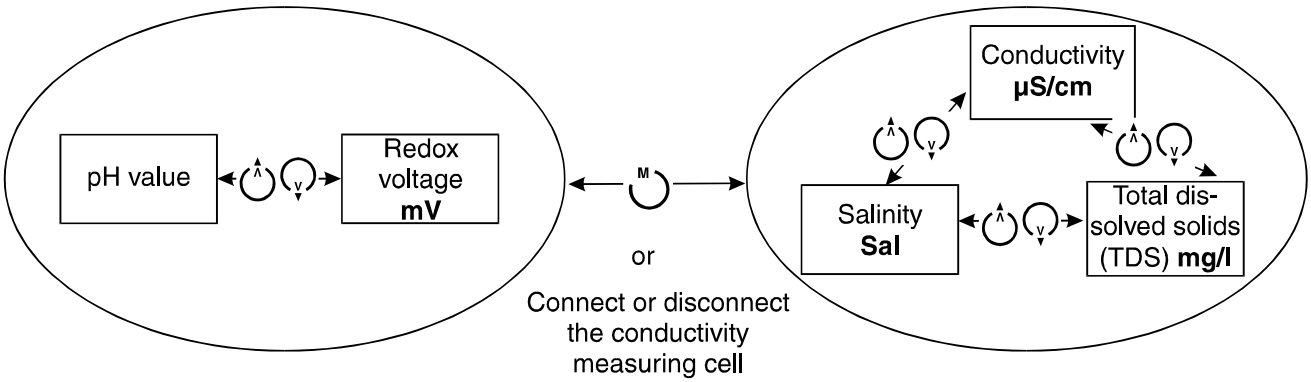
1	Conductivity measuring cell
2	pH/Redox electrode
3	Temperature probe
4	Reference electrode
5	Mains power supply (option)

Caution

Only connect probes to the instrument that cannot feed excessive voltages or currents (> SELV and > circuit with current limiter). Almost all commercial probes - especially WTW probes - meet these requirements.

1.4 Operating structure

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



Note

The conductivity, salinity and TDS measuring modes only appear if a conductivity measuring cell with temperature probe is connected to the instrument.

Note

When a conductivity measuring cell with temperature probe is connected, the measuring instrument recognizes the measuring cell and automatically switches to the previously selected conductivity measuring mode. As soon as the measuring cell is disconnected, the instrument switches to the pH or Redox measuring mode.

2 Safety

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

Target group

This measuring instrument was developed for use in the laboratory.
Thus, 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.

Symbols used



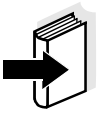
Caution
indicates instructions that have to be followed to prevent damage to your instrument.



Warning
indicates instructions that have to be followed to protect yourself and the instrument from dangerous electrical voltage.



Note
Indicates notes that draw your attention to special features.



Note
Indicates cross-references to other documents, e.g. application reports, operating manuals of combination electrodes, etc.

2.1 Authorized use

This instrument is authorized exclusively for measuring the pH, Redox, and conductivity in the laboratory.
The technical specifications as given in the 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 **unauthorized**.

2.2 General safety instructions

This instrument is constructed and tested in compliance with the EN 61010-1 safety regulations for electronic measuring instruments.
It left the factory in a safe and secure technical condition.

Function and operational safety

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

The smooth functioning and operational safety of the instrument can only be guaranteed under the climatic conditions specified in chapter 7 TECHNICAL DATA.

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.



Caution
The instrument is only allowed to be opened by personnel authorized by WTW.

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

If you are in doubt contact the supplier of the instrument.

Obligations of the operator

The operator of this 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 manufacturer

3 Commissioning

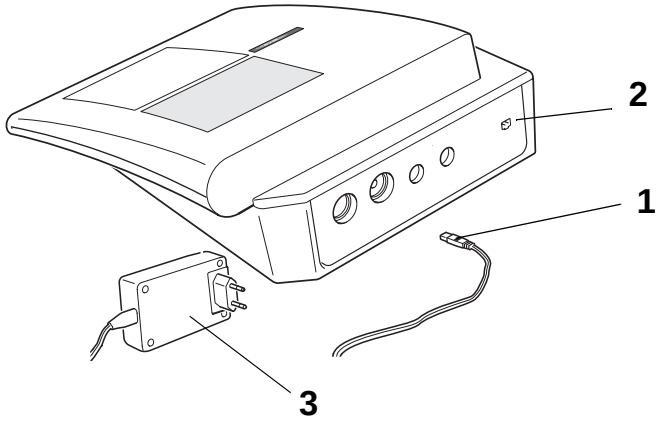
Note
You can adapt individual parameters to your requirements. To do so, change the settings according to section 4.7 CONFIGURATION.

Connecting the plug-in power supply (optional)

The measuring instrument works battery-powered. It can, however, also be supplied by the plug-in power supply which is available as an accessory.

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

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



1	Insert the plug (1) into the socket (2) of the pH meter.
2	Connect the original WTW plug-in power supply (3) to an easily accessible mains socket.

Scope of delivery

- Laboratory measuring instrument, inoLab pH/Cond 720
- Operating manual and short manual
- 4 x type AA Mignon 1.5 V batteries

4 Operation

4.1 Switch on the instrument

1	Place the instrument on a flat surface and protect it against intense light and heat.
2	Press the ⏻ key. The *display test* appears briefly on the display. The instrument then switches automatically to the measuring mode.

Note
The instrument has an energy saving feature to avoid unnecessary battery depletion.
The energy saving feature switches the instrument off if no key has been pressed for an hour.
The energy saving feature is not active if the instrument is supplied by the plug-in power supply.

4.2 Measuring the pH value/Redox voltage

Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Press the M key repeatedly until the pH/Redox measurement appears on the display.
2	Connect the electrode to the instrument.
3	Adjust the temperature of the buffer or test solutions or measure the current temperature if the measurement is made without a temperature probe.
4	Calibrate or check the instrument with the electrode
5	Select the measuring mode by pressing M.

Note
Incorrect calibration of the pH electrode will result in incorrect measured values. Therefore, regularly perform calibration before measuring.

Temperature probe

Measurements can be performed with and without a temperature probe. A connected temperature probe is indicated by TP on the display.

Note
If you use a pH electrode without a temperature probe, the instrument is able to use the temperature probe of a conductivity measuring cell that is also connected to the instrument and is immersed in the test sample. You have to set up this as described in section 4.7 CONFIGURATION. The TP display indicator flashes when the temperature probe of the conductivity cell is used.

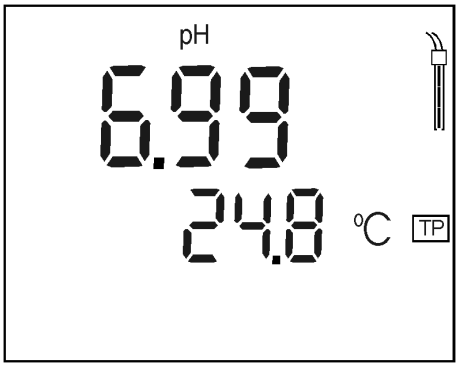
The temperature measurement is absolutely essential for a reproducible pH measurement. If the measurement is made without a temperature probe, proceed as follows:

1	Determine the current temperature using a thermometer.
2	Press and hold down the RUN ENTER key and set up the temperature using ▲▼.

Note
When calibrating without a temperature probe, set up the current temperature of the respective buffer solution manually using the ▲▼ keys while pressing and holding down the RUN ENTER key.

4.2.1 Measuring the pH value

1	Perform the preparatory activities according to section 4.2.
2	Immerse the pH electrode into the test sample.
3	Press the ▲ or ▼ key until *pH* appears in the status display. The pH value appears on the display.



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 values.

For identical measurement conditions, the following criterion applies:

- pH value: better than 0.02 (response time: > 30 s)

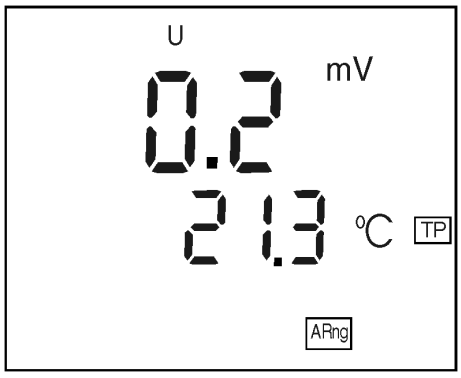
1	Call up the pH measuring mode by pressing ▲▼.
2	Immerse the pH electrode into the test sample.
3	Activate the AutoRead function by pressing AR. The current measured value is frozen (Hold function).
4	Start the AutoRead function by pressing RUN ENTER. AR flashes on the display until a stable measured value is reached.
5	If necessary, start the next AutoRead measurement by pressing RUN ENTER.
6	To terminate the AutoRead function: Press AR.

Note
The current AutoRead measurement (with acceptance of the current value) can be terminated at any time by pressing RUN/ENTER. It is only possible to change to another measuring mode after AutoRead has been terminated.

4.2.2 Measuring the Redox voltage

The instrument can measure the Redox voltage (mV) of a solution when connected with a Redox electrode, e.g. SenTix ORP.

1	Perform the preparatory activities according to section 4.2.
2	Immerse the Redox electrode into the test sample.
3	Press the ▲▼ key repeatedly until U appears in the status line. The Redox voltage (mV) of the sample appears on the display.
4	Wait for a stable measured value.



Note
The AutoRange function is always active and automatically switches to the measuring range with the highest resolution.

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

4.3 Calibrating for pH measurements

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 they are stored in the instrument.
Thus, you should calibrate at regular intervals.



Note
Always calibrate after connecting another pH electrode.

You can choose between 3 calibration procedures:

AutoCal TEC is specially adapted to the WTW technical buffer solutions as a fully automatic two-point calibration. The buffer solutions are automatically recognized by the instrument.

AutoCal DIN is specially adapted to permanently programmed buffer solutions according to DIN 19266 as a fully automatic two-point calibration. The buffer solutions are automatically recognized by the instrument.

ConCal is the conventional two-point calibration with 2 freely selectable buffer solutions or single-point calibration as the rapid method.

AutoRead

In calibration using AutoCal TEC and AutoCal DIN, the *AutoRead* function is automatically activated.
The current AutoRead measurement (with acceptance of the current value) can be terminated at any time by pressing RUN ENTER.

Calibration evaluation

After the calibration, the instrument automatically evaluates the current status. The asymmetry and slope are separately evaluated. 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 manual	-30 ... +30	-62 ... -61 or -56 ... -50
E3 Clear the fault according to chapter 6 WHAT TO DO IF...	< -30 or > 30	< -62 or > -50

Preparatory activities

1	Switch on the instrument by pressing ⏻.
2	Press the M key repeatedly until the pH/Redox measurement appears on the display.
3	Connect the pH electrode to the instrument.
4	Keep the buffer solutions ready.
5	Adjust the temperature of the solutions and measure the current temperature if the measurement is performed without a temperature probe.

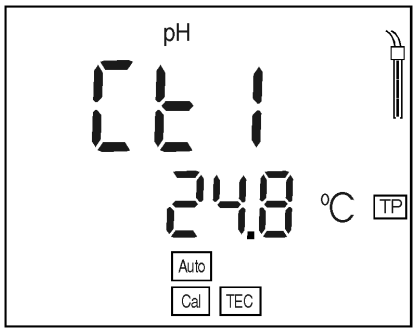
4.3.1 AutoCal TEC

Use any two of the WTW technical buffer solutions for this procedure (pH 2.00, 4.01, 7.00, or 10.01).

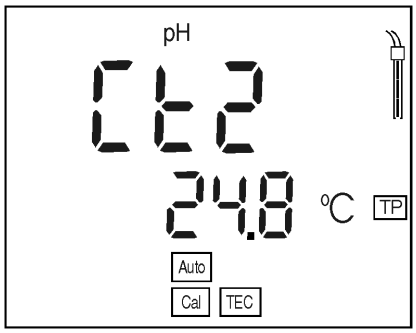
Note
The calibration for pH 10.01 is optimized for the WTW technical buffer solution TEP 10 Trace or TPL 10 Trace. Other buffer solutions can lead to an erroneous calibration. The correct buffer solutions are given in the WTW catalog or in the Internet.

Note
Steps 2 and 6 are not required if you use a temperature probe.

1	Press the CAL key repeatedly until the AutoCal TEC function display appears.



2	If necessary, set the temperature of the buffer solution by pressing ▲▼.
3	Submerse the pH electrode in the first buffer solution.
4	Press the RUN ENTER key. AR flashes on the display. The electrode voltage (mV) appears on the display. As soon as a stable value is recognized, Ct2 appears.



5	Thoroughly rinse the electrode with distilled water.
6	If necessary, set the temperature of the second buffer solution by pressing ▲ ▼.
7	Submerse the electrode in the second buffer solution.
8	Press the RUN ENTER key. AR flashes on the display. The electrode voltage (mV) appears on the display. As soon as a stable value is recognized, AR disappears. The probe symbol shows the electrode evaluation after the two-point calibration. The value of the slope (mV/pH) appears on the display.

Note
If the slope (*SLO*) is indicated on the display, you can change the unit of the slope with ▲ ▼.
The display in % refers to the Nernst slope, 59.2 mV/pH (100 x the slope determined/Nernst slope).

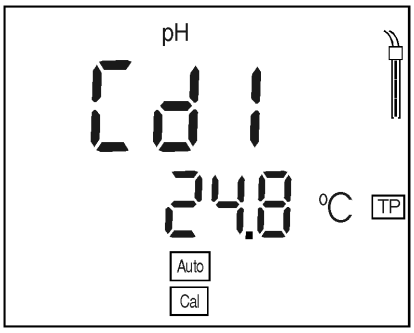
9	Press the RUN ENTER key. The value of the asymmetry (mV) appears on the display.
10	To return to the measuring mode: Press the M key.

4.3.2 AutoCal DIN

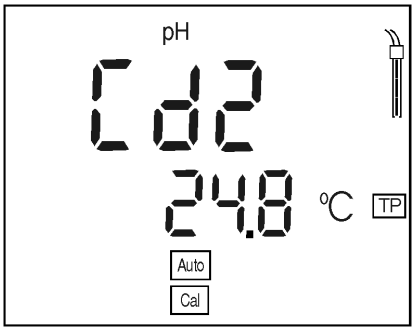
Use two different DIN buffer solutions (type A, C, D or F with the pH values 1.679, 4.006, 6.865, 9.180) for this procedure.

Note
Steps 2 and 6 are not required if you use a temperature probe.

1	Press the CAL key repeatedly until the AutoCal DIN function display appears.



2	If necessary, set the temperature of the buffer solution by pressing ▲▼.
3	Submerse the pH electrode in the first buffer solution.
4	Press the RUN ENTER key. AR flashes on the display. The electrode voltage (mV) appears on the display. As soon as a stable value is recognized, Cd2 appears.



5	Thoroughly rinse the electrode with distilled water.

6	If necessary, set the temperature of the second buffer solution by pressing ▲▼.
7	Submerse the electrode in the second buffer solution
8	Press the RUN ENTER key. AR flashes on the display. The electrode voltage (mV) appears on the display. As soon as a stable value is recognized, AR disappears. The sensor symbol shows the electrode evaluation after the two-point calibration. The value of the slope (mV/pH) appears on the display.

Note

If the slope (*SLO*) is indicated on the display, you can change the unit of the slope with ▲▼.
The display in % refers to the Nernst slope, 59.2 mV/pH (100 x the slope determined/Nernst slope).

9	Press the RUN ENTER key. The value of the asymmetry (mV) appears on the display.
10	To return to the measuring mode: Press the M key.

4.3.3 ConCal

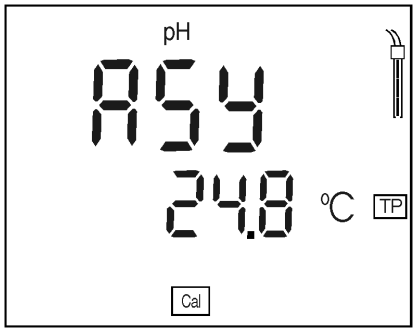
Two-point calibration

Use two buffer solutions for this procedure:

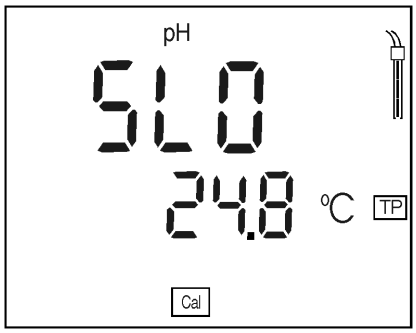
- pH 7.0 ± 0.5
- any other buffer solution

Note
Steps 2 and 9 are not required if you use a temperature probe.

1	Press the CAL key repeatedly until the ConCal function display appears.



2	If necessary, set the temperature of the buffer solution by pressing ▲▼.
3	Submerse the pH electrode in the pH 7.0 ± 0.5 buffer solution.
4	Press the RUN ENTER key. The measured pH value appears on the display.
5	Set the nominal pH value of the buffer solution (at the current temperature) by pressing the ▲▼ keys.
6	Press the RUN ENTER key. The value of the asymmetry (mV) and the sensor symbol appear on the display.
7	Press the RUN ENTER key. SLO(pe) appears on the display.



8	Thoroughly rinse the electrode with distilled water.
9	If necessary, set the temperature of the second buffer solution by pressing ▲ ▼.
10	Submerse the electrode in the second buffer solution.
11	Press the RUN ENTER key. The second measured pH value appears on the display.
12	Set the nominal pH value of the second buffer solution (at the current temperature).
13	Press the RUN ENTER key. The value of the slope (mV/pH) appears on the display. The sensor symbol shows the evaluation of the electrode after the two-point calibration.

Note
If the slope (*SLO*) is indicated on the display, you can change the unit of the slope with ▲ ▼.
The display in % refers to the Nernst slope, 59.2 mV/pH (100 x the slope determined/Nernst slope).

14	Press the RUN ENTER key. The value of the asymmetry (mV) appears on the display.
15	To return to the measuring mode: Press the M key.

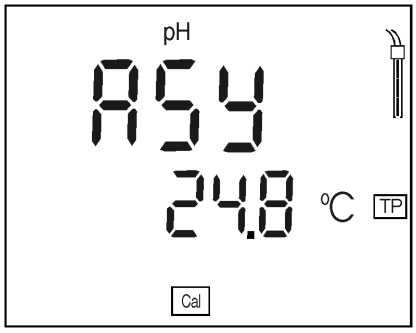
Single-point calibration

Use any buffer solution for this rapid method. The calibration will be the more exact the nearer the pH value of the buffer solution is to that of the test sample.

Note
Only the electrode asymmetry is determined in single-point calibration. The slope of the last two-point calibration is retained.

Note
Step 2 is not required if you use a temperature probe. The TP display indicates an active temperature measurement.

1	Press the CAL key repeatedly until the ConCal function display appears.



2	Set the temperature of the buffer solution by pressing ▲▼.
3	Submerse the pH electrode in the buffer solution.
4	Press the RUN ENTER key. The measured pH value appears on the display.
5	Set the nominal pH value of the buffer solution (at the current temperature) by pressing the ▲▼ keys.
6	Press the RUN ENTER key. The value of the asymmetry (mV) and the sensor symbol for the evaluation of the electrode appears on the display.
7	To return to the measuring mode: Press the M key.

4.4 Measuring the conductivity

The following parameters can be measured:

- Conductivity/resistance
  (how to switch over, see section 4.7 CONFIGURATION)
- Salinity
- Total dissolved solids (TDS)

The measuring instrument has the following functions:

- AutoRange (automatic selection of the measuring range),
- AutoRead (drift control) to check the stability of the measuring signal. This ensures the reproducibility of the measuring signal. How to switch the AutoRead function on/off see page 104.

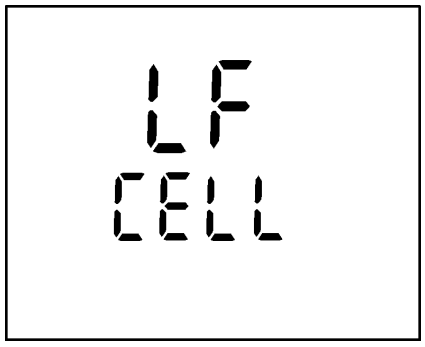
Preparatory activities

Perform the following preparatory activities when you want to measure:

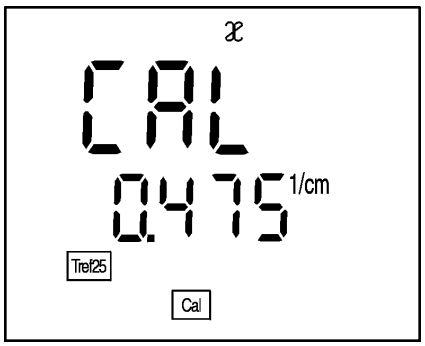
1	Connect the conductivity measuring cell with temperature probe to the measuring instrument. The instrument recognizes the measuring cell and automatically switches to the previously selected conductivity measuring mode. If the conductivity cell is already connected, press the (M) key repeatedly until the conductivity measuring mode appears.
2	Check the cell constant set up or calibrate the measuring instrument with the measuring cell. The calibration is described in section 4.5.1 DETERMINING THE CELL CONSTANT (CALIBRATION IN CONTROL STANDARD) from page 105 on.

Checking the cell constant

3	Press the CAL key repeatedly until *LF CELL* is displayed.



4	Press the RUN ENTER key. The previously selected cell constant ist displayed, e. g. 0.475 cm^{-1}.



5	To return to the measuring mode: press the M key when the correct cell constant ist displayed.
6	If a different cell constant is to be set, proceed according to section SECTION 4.5.2 SETTING UP THE CELL CONSTANT.

Note
An incorrect cell constant will result in incorrect measured values. Therefore, regularly check the cell constant set up and calibrate at regular intervals.

Temperature probe

The conductivity measuring cell has an integrated temperature probe that always measures the current temperature of the test sample.

If you want to use a WTW conductivity measuring cell without a temperature probe, you have to connect it with an adapter (available at WTW).

4.4.1 Conductivity / Specific resistance

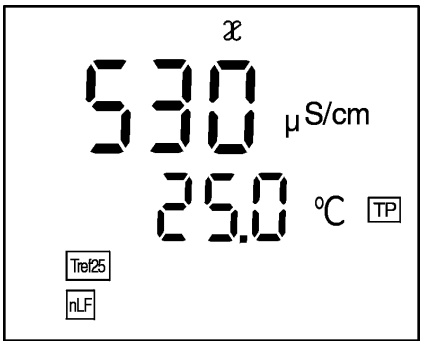
Note

You can display measured values in the units µS/cm (conductivity) or MΩ·cm (specific resistance). This setting is described in Abschnitt 4.7 CONFIGURATION.

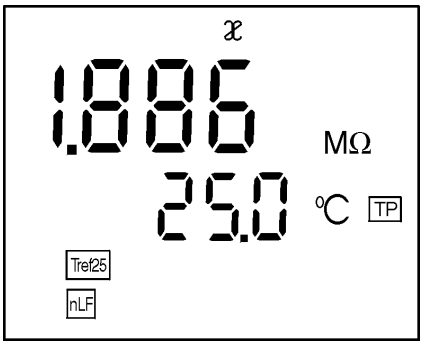
Thus, you can carry out conductivity measurements or measurements of the specific resistance:

1	Perform the preparatory activities according to section 4.4.
2	Immerse the conductivity measuring cell into the test sample.
3	Press the (M) key until 𝔵 appears in the status display. Depending on the setting, one of the following display indicators appears on the display:

Conductivity



Specific resistance

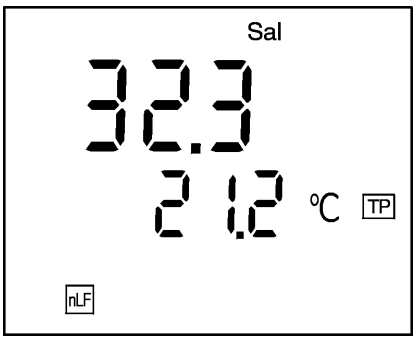


4	Wait for a stable measured value.

4.4.2 Salinity

To measure the salinity, proceed as follows:

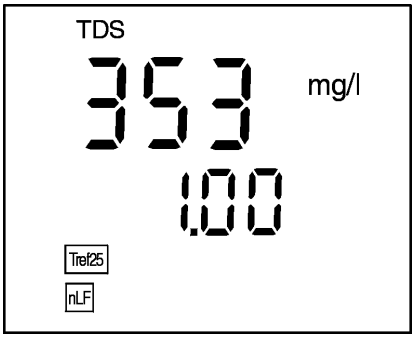
1	Perform the preparatory activities according to section 4.4.
2	Immerse the conductivity measuring cell into the test sample.
3	Press the ▲ ▼ key repeatedly until *Sal* appears in the status line. The salinity value of the sample appears on the display.
4	Wait for a stable measured value.



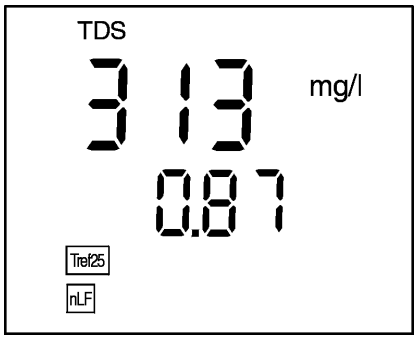
4.4.3 TDS (total dissolved solids)

To measure the TDS, proceed as follows:

1	Perform the preparatory activities according to section 4.4.
2	Immerse the conductivity cell into the test sample.
3	Press the ▲ ▼ key repeatedly until *TDS* appears in the status line. The TDS value of the sample appears on the display.
4	Press and hold down the RUN ENTER and set up the TDS factor (0.40 ... 1.00) using ▲ ▼.



5	Wait for a stable measured value.



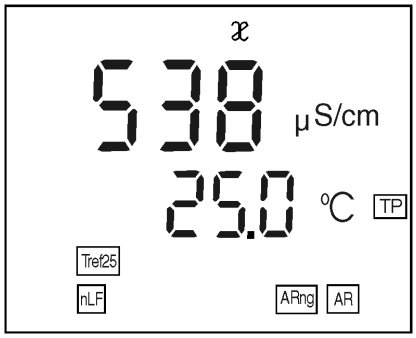
Note

Also refer to Application Report ... 084 KONDUCTOMETRICAL DETERMINATION OF THE TOTAL DISSOLVED SOLIDS (TDS).

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 values.

1	Call up the required measuring mode by pressing ▲▼.
2	Immerse the conductivity measuring cell into the test sample.
3	Activate the AutoRead function by pressing AR. The current measured value is frozen (Hold function).
4	Start the AutoRead function by pressing RUN ENTER. AR flashes on the display until a stable measured value is reached.



5	If necessary, start the next AutoRead measurement by pressing RUN ENTER.
6	To terminate the AutoRead function: Press the AR key.

Note

The current AutoRead measurement (with acceptance of the current value) can be terminated at any time by pressing RUN ENTER. It is only possible to change to another measuring mode after AutoRead has been terminated.

4.5 Determining/setting up the cell constant [C]

Why determine/set up the cell constant?

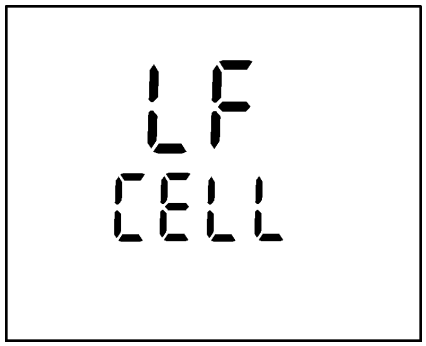
Due to ageing, the cell constant slightly changes. As a result, an inexact measured value is displayed. Calibration determines the current value of the cell constant and stores this value in the instrument.
Thus, you should calibrate at regular intervals (recommended interval: every 6 months).

You can determine the cell constant of the conductivity measuring cell in the range 0.450 ... 0.500 cm^{-1} or 0.800 ... 1.200 cm^{-1} by calibrating in the control standard or set it up manually in the range 0.250... 2.500 cm^{-1}. Additionally, you can select the fixed cell constants 0.100 cm^{-1} or 0.010 cm^{-1}.

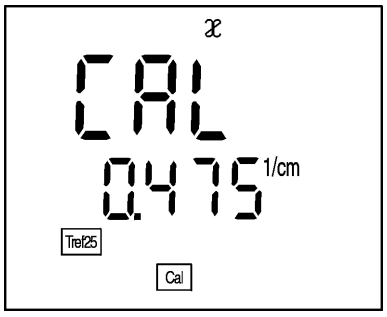
4.5.1 Determining the cell constant (calibration in control standard)

Determine the cell constant as follows:

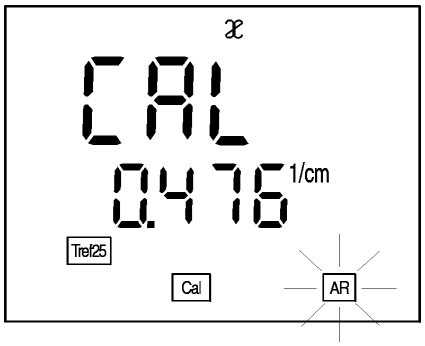
1	Press the CAL key repeatedly until *LF CELL* appears on the display.



2	Press the RUN ENTER key.
3	Press the CAL key repeatedly until the following is displayed.



4	Immerse the measuring cell into the 0.01 mol/l KCL control standard.
5	Press the RUN ENTER key to start the AR measurement to determine the cell constant. The AR flashes on the display until a stable signal is reached. The determined cell constant ist displayed. The measuring instrument automatically stores the cell constant.



6	To return to the measuring mode: press RUN ENTER or M.

Note

- This method of automatically determining the cell constant by calibrating in the 0.01 mol/l KCL control standard can only be used for measuring cells with a cell constant in the range 0.450 ... 0.500 cm^{-1} or 0.800 ... 1.200 cm^{-1}.
- If message E3 appears see chapter 6 WHAT TO DO IF...

Calibration evaluation

After calibrating, the instrument automatically evaluates the current condition of the calibration.
The evaluation appears on the display.

Display	Cell constant [cm^{-1}]
	0.450 ... 0.500 cm^{-1} 0.800 ... 1.200 cm^{-1}
E3 Perform error elimination according to chapter 6 WHAT TO DO IF...	outside of the ranges 0.450 ... 0.500 cm^{-1} or 0.800 ... 1.200 cm^{-1}

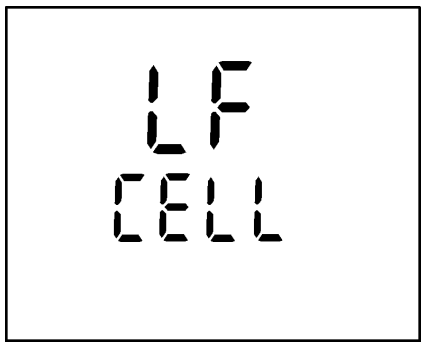
4.5.2 Setting up the cell constant

Setting up the cell constant manually

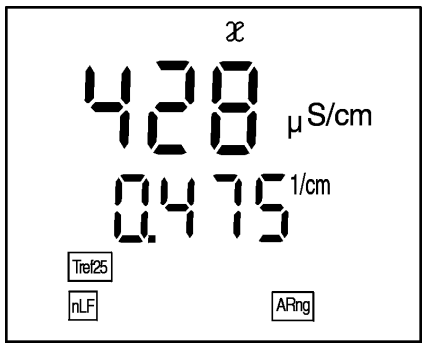
To set up the cell constant manually, proceed as follows:

Note
The cell constant to be set up must either be taken from the operating manual of the measuring cell or is printed on the measuring cell.

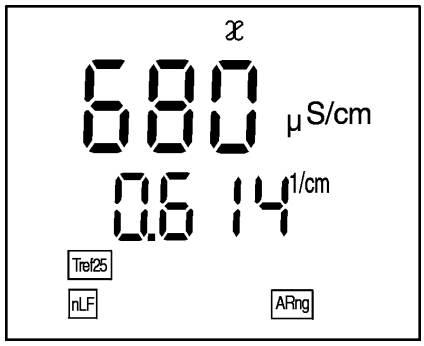
1	Press the CAL key repeatedly until *LF CELL* appears on the display.



2	Press the RUN ENTER key.
3	Press the CAL key repeatedly until the following display appears:



4	Set up the cell constant to be used by pressing ▲▼, e. g. 0.614 cm^{-1}.

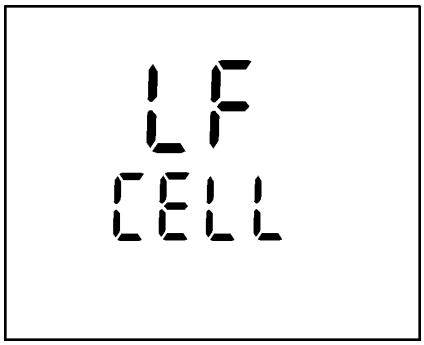


5	To return to the measuring mode: press the M key.

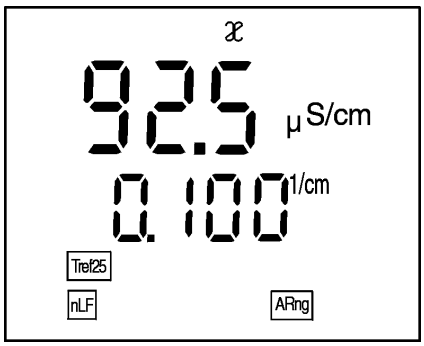
Selecting the 0.100 cm^{-1} cell constant

To select the 0.100 cm^{-1} cell constant proceed as follows:

1	Press the CAL key repeatedly until *LF CELL* appears on the display.



2	Press the RUN ENTER key.
3	Press the CAL key repeatedly until the 0.100 cm^{-1} cell constant appears on the display.

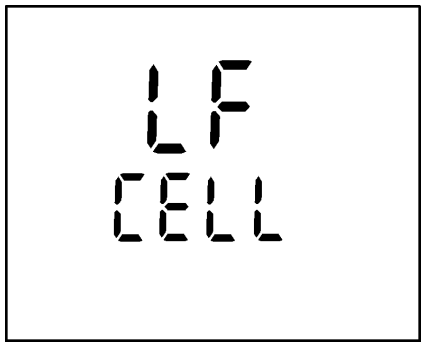


4	To return to the measuring mode: press the M key.

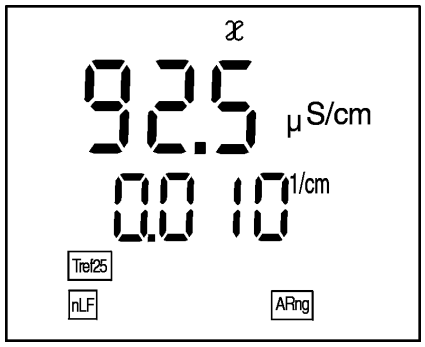
Selecting the 0.010 cm^{-1} cell constant

To select the 0.010 cm^{-1} cell constant proceed as follows:

1	Press the CAL key repeatedly until *LF CELL* appears on the display.



2	Press the RUN ENTER key.
3	Press the CAL key repeatedly until the 0.010 cm^{-1} cell constant appears on the display.



4	To return to the measuring mode: press the M key.

4.6 Setting up the temperature compensation TC

The calculation of the temperature compensation is based on the preset reference temperature, Tref 20 or Tref 25 (see section 4.7 CONFIGURATION).

You can select one of the following temperature compensations:

- **Non-linear temperature compensation** "**nLF**" according to DIN 38404 or EN 27 888
- **linear temperature compensation "Lin"** with a coefficient that can be set in the range 0.001 ... 3.000 %/K
- **no temperature compensation**

Note
Select the following temperature compensations to work with the test samples given in the table:

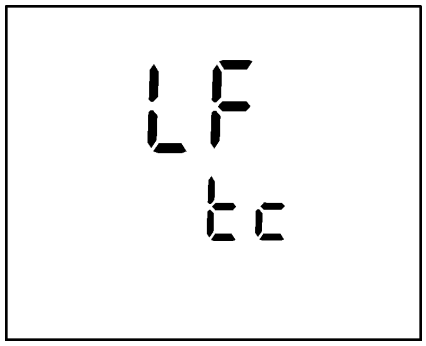
Application notes

Test sample	Temperature compensation TC	Display indicator
Natural water (ground water, surface water, 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

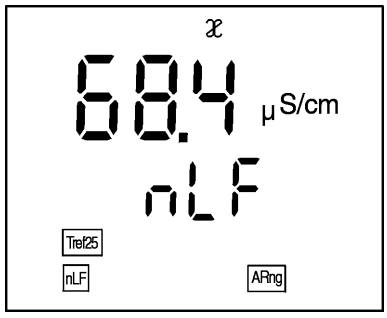
Selecting the non-linear temperature compensation

To select the non-linear temperature compensation proceed as follows:

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



2	Press the RUN ENTER key.
3	Press the CAL key repeatedly until nLF appears on the display.

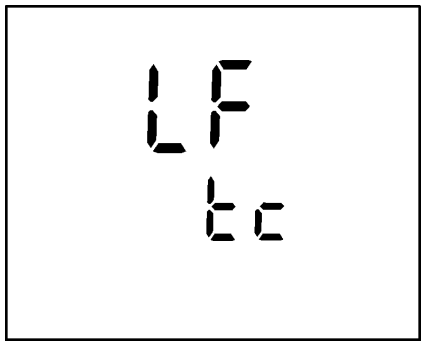


4	To return to the measuring mode: press the M key.

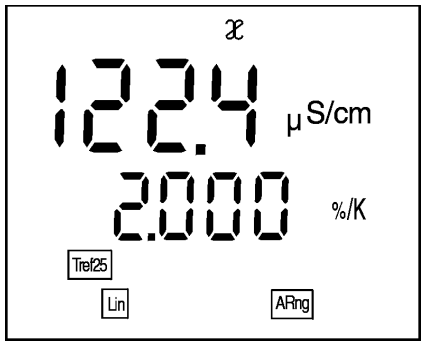
Selecting the linear temperature compensation

To select the linear temperature compensation proceed as follows:

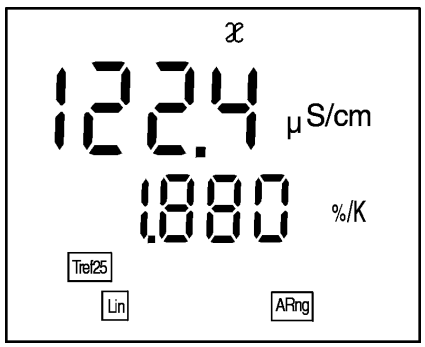
1. Press the CAL key repeatedly until *LF tc* appears on the display.



2. Press the RUN ENTER key.
3. Press the CAL key repeatedly until the adjustable linear temperature coefficient appears on the display.



4. Set up the temperature coefficient, e. g. 1.880 %/K using ▲ ▼.

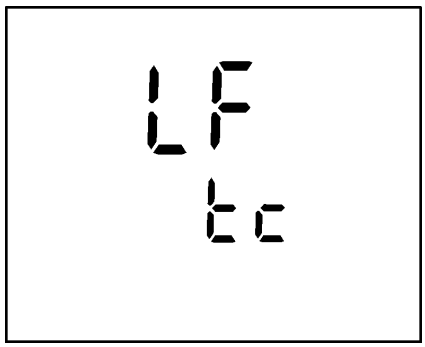


5. To return to the measuring mode: press the M key.

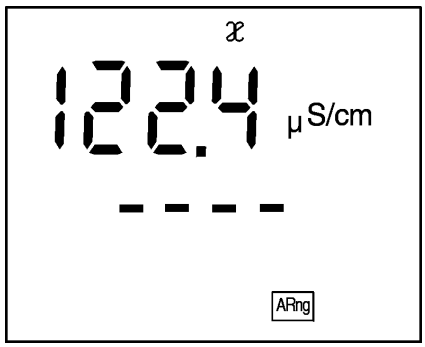
Switching off the temperature compensation

To switch off the temp. compensation proceed as follows:

1	Press the CAL key repeatedly until *LF tc* is displayed.



2	Press the RUN ENTER key.
3	Press the CAL key until the following display appears:



4	The temperature compensation is switched off.

4.7 Configuration

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

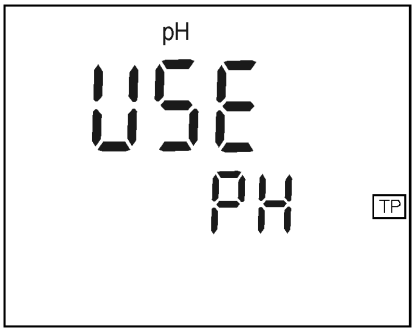
Temperature probe that is used for the pH measurement	**pH temperature probe**, LF temperature probe
Reference temperature	20 °C, **25 °C**
Representation of the measured value as conductivity or resistance	**Conductivity**, resistance
Temperature unit	**°C**, °F



Note
You can leave the configuration menu at any time. Parameters that have already been changed are stored.
To do this, press the M key.

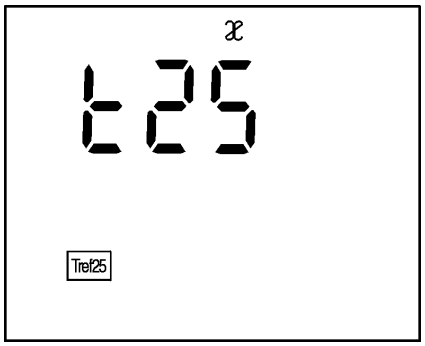
1	Switch off the instrument.
2	Press and hold down the M key.
3	Press the ⏻ key. The *display test* appears briefly on the display. The instrument then switches automatically to the setting of the temperature probe for the pH measurement.

Temperature probe



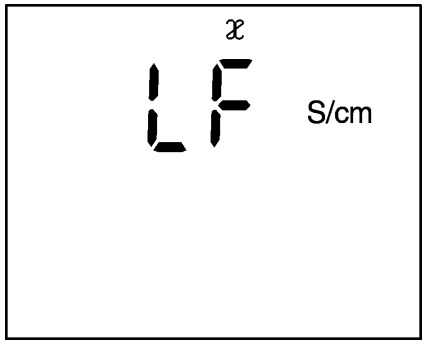
4	Set up pH TP or LF TP by pressing ▲ ▼.
5	Confirm with RUN ENTER. *t25* or *t20* appears on the display

Reference temperature



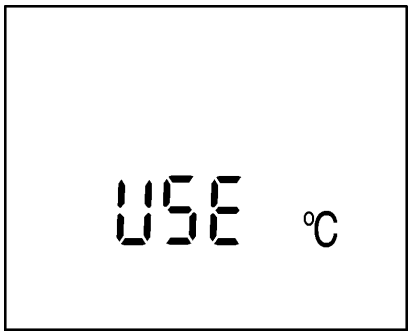
6	With ▲ ▼ select between *t25* Tref25 and *t20* Tref20 .
7	Confirm with RUN ENTER. *LF* appears on the display.

Conductivity or resistance measurement



8	With ▲ ▼ select between S/cm and MΩ.
9	Confirm with RUN ENTER. *USE* appears on the display.

Temperature unit



10	With ▲ ▼ select between *°C* and *°F .*
11	Confirm with RUN ENTER. The instrument automatically changes to the previously selected measuring mode.

4.8 Reset

Basic settings

You can reset (initialize) the settings for the pH and conductivity measurement separately.

pH measurement

The following functions for the pH measurement (pH InI) are reset to the values they had on delivery:

Measuring mode	pH
Asymmetry	0 mV
Slope	-59.16 mV/pH
Calibration procedure	AutoCal TEC
Temperature, manual	25 °C

Conductivity measurement

The following functions for the conductivity measurement (𝒳 InI) are reset to the values they had on delivery:

Measuring mode	𝒳
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
TDS factor	1.00

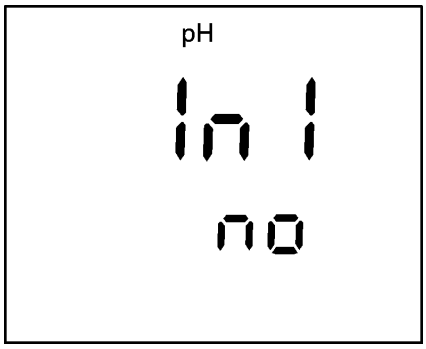
Note

After a reset, the calibration data are lost. Thus, calibrate after a reset.

Proceed as follows to reset the settings:

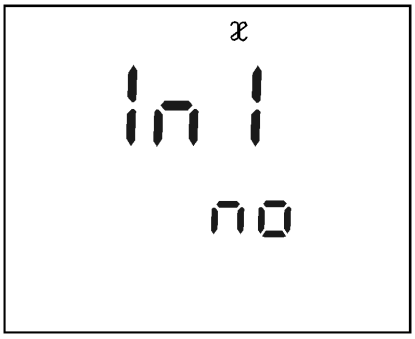
1	Press and hold down the RUN ENTER key.
2	Press the CAL key.

Resetting the pH settings



3	Toggle between no and yes by pressing ▲ ▼. yes: reset the settings for pH. no: retain settings.
4	Confirm with RUN ENTER. The instrument changes automatically to the settings for the conductivity measurement.

Resetting the conductivity settings



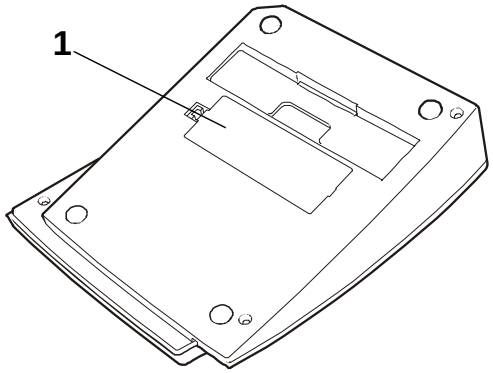
5	Toggle between no and yes by pressing ▲ ▼. yes: reset the settings for conductivity. no: retain settings.
6	Confirm with RUN ENTER. The instrument changes automatically to the previously selected measuring mode.

5 Maintenance, cleaning, disposal

5.1 Maintenance

The measuring instrument is almost maintenance-free. The only maintenance task is replacing the batteries:

1	Open the battery compartment (1) on the underside of the instrument.
2	Remove the four batteries from the battery compartment.
3	Insert four new batteries (Type Mignon AA) into the battery compartment.
4	Close the battery compartment (1).



Caution

Make sure that the poles of the batteries are the right way round.

The ± signs in the battery compartment must correspond to the ± signs on the batteries.

Only use leakproof alkaline manganese batteries.

Note

See the relevant operating manual of the electrodes and measuring cells for instructions on maintenance.

5.2 Cleaning

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



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

5.3 Disposal

Packing

The 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
In compliance with §14 of the BATTERY REGULATION, we would like to point out that 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 it 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 bubbles in front of the diaphragm	– Remove air bubbles
– Air in the diaphragm	– Extract air or moisten diaphragm
– Cable broken	– Replace electrode
– Gel electrolyte dried out	– Replace electrode

Error message, E3

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

Buffer solutions:	
– Incorrect buffer solutions	– Change calibration procedure
– Buffer solutions too old	– Only use 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

Sample:	
– pH value not stable	– Measure with air excluded if necessary
– Temperature not stable	– Adjust temperature if necessary

Electrode + 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 sample too large	– Adjust temperature of buffers or samples
– Measuring procedure not suitable	– Follow special procedure

6.2 Conductivity system messages

Error message, OFL

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

Error message, E3

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

6.3 General errors

LoBat

Cause	Remedy
– Batteries almost depleted	– Replace batteries (see section 5.1 MAINTENANCE)

Instrument does not react to keystroke

Cause	Remedy
– Operating state undefined or EMC electric stress unallowed	– Processor reset: Press the AR key and switch on instrument

You would like to know which software version is in the instrument

Cause	Remedy
– e.g. question of the WTW service department	– Press the AR key and switch on instrument. The software version is displayed.

7 Technical Data

7.1 General data

Ambient temperature

Storage temperature	- 25 °C ... + 65 °C
Operating temperature	0 °C ... + 55 °C
Allowable relative humidity	Annual mean: < 75 % 30 days/year: 95 % Other days: 85 %

Dimensions and weight

Length [mm]	230
Width [mm]	210
Height [mm]	70
Weight [kg]	Approx. 0.850

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
Protective class	3, EN 61010-1 A2:1995
Climatic class	2, VDI/VDE 3540

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 marks UL/CUL, CE

Energy supply	Batteries	4 x 1.5 V AA type alkaline manganese batteries
	Runtime	Approx. 3000 operating hours
	Mains power supply (option)	Connection max. overvoltage category II (valid for all plug-in power supplies): 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 (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 (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 (UK plug): FRIWO FW3288, 11.8453 Friwo Part No. 1816491 Input: 230V ~ / 50 Hz / 5.6 VA Output: 12 V = / 130 mA / 1.56 VA

7.2 pH/Redox measurement

Measuring ranges and resolution

pH	- 2.00 ... + 16.00
U [mV]	- 199.9 ... + 199.9 - 1999 ... + 1999
T [°C]	- 5.0 ... + 105.0
T [°F]	+ 23.0 ... + 221.0

Accuracy (± 1 digit)

pH (after calibration)	± 0.01
U [mV]	± 0.3 (at + 15 °C ... + 35 °C) ± 1
T [°C]	± 0.1
T [°F]	± 0.2

Temperature input

Manually [°C]	- 5 ... + 100

7.3 Conductivity measurement

Measuring ranges and resolution

κ [µS/cm]	0.000 ... 1.999 (only with 0.010 cm^{-1} cell constant) 0.00 ... 19.99 (only with 0.010 cm^{-1} constant and cell constant 0.100 cm^{-1}) 0.0 ... 199.9 0 ... 1999
κ [mS/cm]	0.00 ... 19.99 0.0 ... 199.9 0 ... 500
Spec. resistance [MΩ*cm]	0.000 ... 1.999 0.00 ... 19.99 0.0 ... 199.9 0 ... 1999
SAL	0.0 ... 70.0 according to the IOT table
TDS [mg/l]	0 ... 1999 Factor can be set in the range 0.40 ... 1.00
T [°C]	– 5.0 ... + 105.0
T [°F]	+ 23.0 ... + 221.0

Accuracy (± 1 digit)	$\mathcal{x}$	No compensation: Accuracy ± 0.5 % Non-linear compensation nLF : Accuracy Test sample temperature ± 0.5 % 0 °C ... 35 °C according to EN 27 888; ± 0.5 % 35 °C ... 50 °C extended nLF function according to WTW measurements Linear compensation Lin : Accuracy Test sample temperature ± 0.5 % 10 °C ... 75 °C (the accuracy percentage always refers to the measured value!)
	SAL	Range 0.0 ... 42.0 Accuracy Test sample temperature ± 0.1 5 °C ... 25 °C ± 0.2 25 °C ... 30 °C
	TDS [mg/l]	1
	T [°C]	± 0.1
	T [°F]	± 0.2
Cell constant, to be set	C [cm^{-1}]	0.010 0.100 0.250 ... 2.500
Cell constant, calibrated	C [cm^{-1}]	0.450 ... 0.500 0.800 ... 1.200
Reference temperature, selectable	T_{REF} [°C]	20 25

8 Lists

This chapter provides additional information and orientation aids.

Abbreviations The list of abbreviations explains abbreviations that appear on the display or when dealing with the instrument.

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 helps you find the topics that you are looking for.

Abbreviations

$\mathcal{X}$	Conductivity value
ABS	Plastic housing
AR	AutoRead (drift control)
ARng	Automatic range switching Measuring instrument measures with highest resolution
ASY	Asymmetry
AutoCal DIN	Automatic calibration with DIN buffer solutions
AutoCal TEC	Automatic calibration with WTW technical buffer solutions
C	Cell constant cm^{-1}
°C	Temperature unit, Celsius
Cal	Calibration
Cd...	Calibration with DIN buffer solutions (acc. to DIN 19 266)
CELL	Cell constant
ConCal	Conventional one/two point calibration
Ct...	Calibration with WTW technical buffer solutions
E3	Error message (see WHAT TO DO IF ...)
°F	Temperature unit, Fahrenheit
InI	Initialization Resets individual basic functions to the status they had on delivery
Lin	Linear temperature compensation
LoBat	Low Battery Batteries are almost empty

mV	Voltage unit
mV/pH	Unit of the electrode slope
nLF	Non linear temperature compensation
OFL	Overflow Display range exceeded
pH	pH value
S	Slope
Sal	Salinity
SELV	Safety Extra Low Voltage
SLO	Slope Slope setting on calibration
TC	Temperature coefficient
TDS	Total dissolved solids
TP	Temperature probe Temperature measurement active
Tref 20/T20	Reference temperature 20 °C
Tref 25/T25	Reference temperature 25 °C
U_{ASY}	Asymmetry potential

Glossary

Asymmetry Zero point of a pH electrode.

AutoRange Automatic selection of the measuring range.

AutoRead Monitors the electrode drift and releases the measured value only after the stability criterion has been reached. In this way, this procedure ensures the highest degree of precision and reproducibility.

Buffer solution Stable solution with a precisely known pH value.

Calibration, conductivity The cell constant is determined through calibration. To do so, the conductivity measuring cell is immersed into a series of aqueous salt solutions with exactly known electric conductivity. The relevant conductivity values are determined using the conductivity measuring instrument.

Cell constant Linear factor describing the geometrical dimensions of a measuring cell and its electrodes.

- With the value of the cell constant you can roughly describe the application range of a conductivity measuring cell.
- The cell constant is determined through calibration in one or several calibration solutions.

Conductivity The conductivity value is a sum parameter for the ion concentration of a test sample.

Control standard solution Solution with a known conductivity to determine or check the conductivity.

Diaphragm Contact point between the reference electrolytic solution and the sample.

Drift control See AUTOREAD.

MultiCal® Group term for the various WTW pH calibration procedures used for automatic calibration in buffer solutions.

Redox voltage Potentiometric quantity.

Reference temperature In order to compare values measured at different temperatures, the values have to be converted to a fixed temperature. This temperature is 25 °C, or, as an exception, 20 °C.

Resistance All substances (solids, liquids, or gases) with mobile charge carriers like for example electrons or ions have a finite ohmic resistance, which means they have an electric conductance that can be measured or an electric conducitivtiy.

Resolution Number of decimal places that appear for a measured value.

Salinity The salinity is a sum parameter especially for seawater; it gives the salt content of a solution (without dimension) in ‰.

Slope Specifies the voltage change per pH unit.

Temperature compensation (TC) The temperature has a very strong impact on the electrical conductivity. To be able to compare measured values, it is necessary to temper or convert the test sample to a reference temperature.

Test sample The substance to be measured. It can be liquid or solid.

Test solution Stable solution with a precisely known Redox voltage.

Total dissolved solids (TDS)

Mass that remains of the substances dissolved in an aqueous solution after a fixed filtering and drying procedure, as far as these substances are not volatile under the conditions of this procedure. The total dissolved solids refer to the volume of the filtered aqueous sample used und are given in mg/l.

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