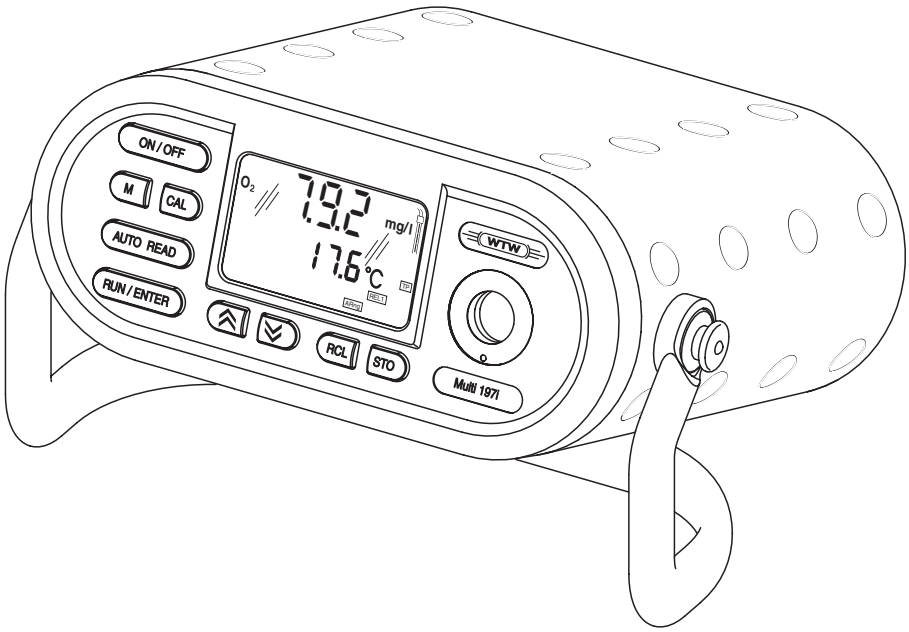
Operating manual

Multi 197i



Portable pH / oxygen / conductivity measuring instrument

ba75339e03 01/2005

Accuracy when going to press

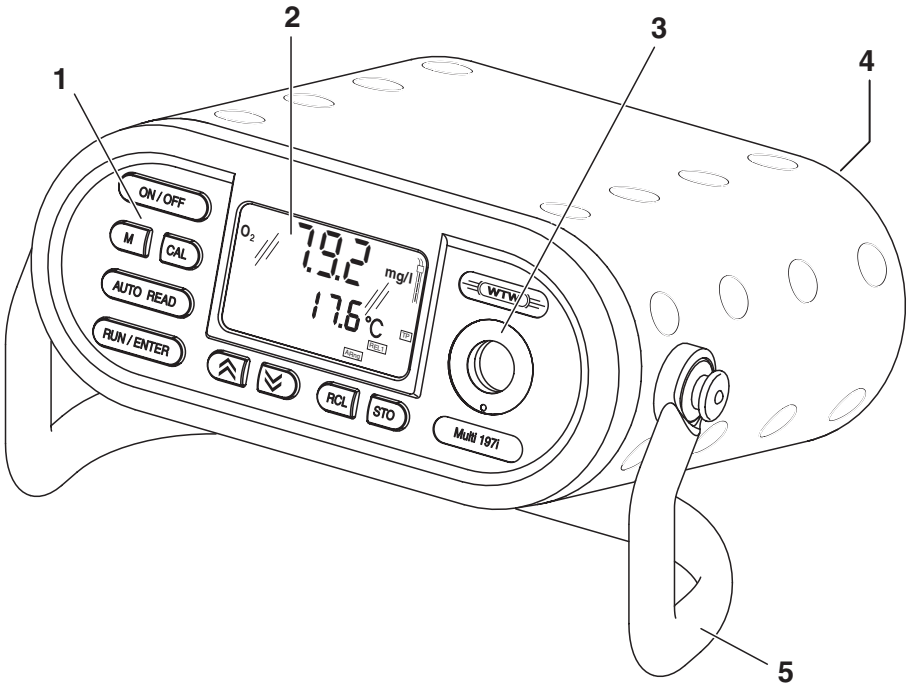
The use of advanced technology and the high quality standard of our instruments are the result of a continuous development. This may result in differences between this operating manual and your instrument. Also, we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are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

1 Overview

1.1 General features

The Multi 197i portable multiparameter measuring instrument enables you to carry out pH measurements, dissolved oxygen (D. O.) measurements and conductivity measurements quickly and reliably.
The Multi 197i provides the maximum degree of operating comfort, reliability and measuring certainty for all applications.

The proven MultiCal® and OxiCal® calibration procedures and the procedures to determine/set up the cell constant support you in your work with the meter. The special AutoRead function enables precise measurements.



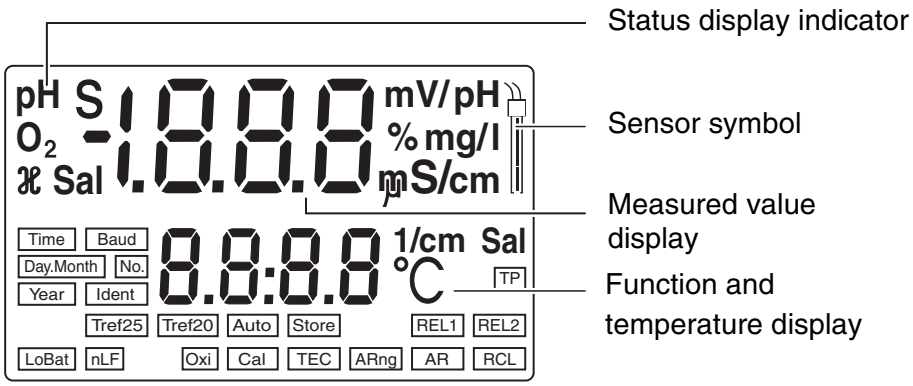
1	Keypad
2	Display
3	Integrated, exchangeable sensor quiver
4	Jack field
5	Carrying and positioning handle

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 Display



1.3 Keypad

Key functions

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

1.4 Jack field

Warning
Only connect sensors to the measuring instrument that cannot return any voltages or currents that are not allowed (> SELV and > current circuit with current limiting).
Almost all sensors - in particular WTW sensors - fulfill these conditions.

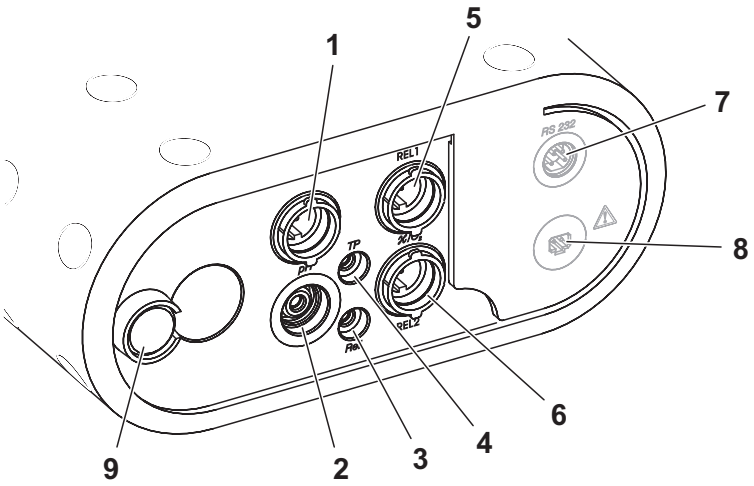
Maximum number of sensors to be connected

The following sensors can be connected to the Multi 197i (maximum configuration):

- One pH depth armature or one pH electrode (combination electrode or pH electrode + reference electrode). Please make sure that only one pH sensor is connected at the same time.
- One D. O. sensor
- One conductivity measuring cell
- Option: One external temperature sensor

Note
The pH depth armature is affected by other sensors if it is connected to them galvanically. For this reason, the pH depth armature cannot be operated in the same test sample together with another sensor on the instrument.

Connectors:



Sensor / Instrument	Socket / Position
pH depth armature	**1**
pH electrode or pH combination electrode	**2**
pH combination electrode with temperature sensor	**2** and **4**
Reference electrode	**3**
Temperature sensor, external	**3** and **4**
Oxygen sensor	**5** or **6**
Conductivity measuring cell	**5** or **6**
Printer or PC (serial interface, RS232)	**7**
Plug-in power supply unit	**8**
Watertight valve for internal pressure equalization	**9**

Note
The sensor sockets, **1** and **2** must not be assigned at the same time. On the two sockets, **5** and **6**, only different sensor types (Oxi and Cond) may be connected at the same time.

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.
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.

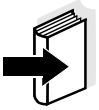
Safety instructions

The individual chapters of this operating manual use the following safety instruction 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
- measurement of the oxygen content and
- measurement of the conductivity, salinity and temperature

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 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.

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

- Multi 197i portable multiparameter measuring instrument with integrated rechargeable battery
- Carrying and positioning handle
- Carrying strap
- 2 sensor quivers (pH and Oxi-LF type)
- Plug-in power supply unit
- Operating manual

3.2 Power supply

Mains operation and charging the battery

You can either operate the measuring instrument with the integrated rechargeable battery or with the plug-in power supply. The plug-in power supply supplies the measuring instrument with low voltage (12 V DC). At the same time, the rechargeable battery is charged.

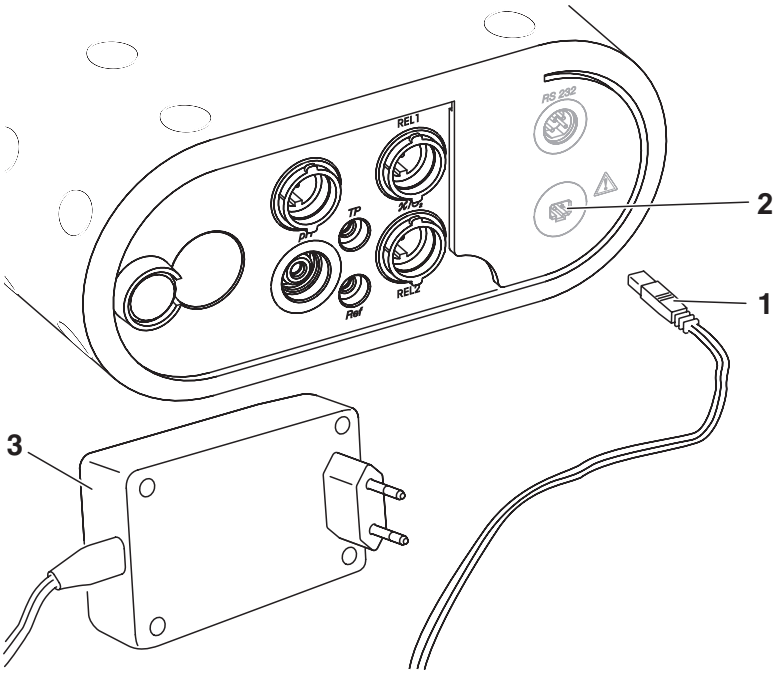
Charging time of the battery

approx. 16 hours. The battery is charged even when the instrument is switched off. The *LoBat* display indicator appears when the battery is nearly empty and has to be charged as soon as possible.

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).

Connecting the plug-in power supply unit



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

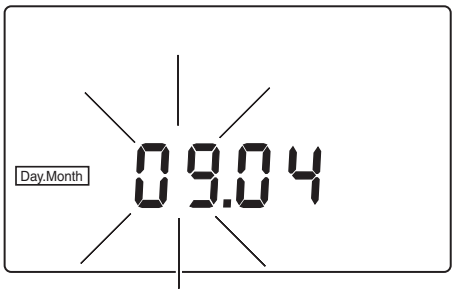
3.3 Initial commissioning

Perform the following activities:

- For mains operation and charging the battery: Connect the plug-in power supply (see section 3.2 POWER SUPPLY).
- Set the date and time.

Setting the date and time

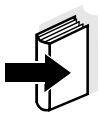
1	Press the **<M>** key and hold it down.
2	Press the **<ON/OFF>** key. The display test appears briefly on the display.
3	Press the **<RUN/ENTER>** key repeatedly until the date flashes on the display (*Day.Month* display indicator).



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 the measuring mode.

3.4 Sensor quiver

To store the sensors during field operation and to keep the sensor element moist, the quiver tip contains a sponge rubber insert that can be moistened with deionized water.



Note
For further details on proper storage, refer to the operating manual of the sensor.

Moistening the quiver insert

1	Press the quiver out of the holder from the back side of the instrument and pull it out completely.
2	Pull off the quiver tip and moisten the sponge rubber with deionized water.

Warning
Do not store pH electrodes in the quiver for more than 10 hours. To store them for a longer period of time, use the watering cap filled with potassium chloride (3 mol/l) of the electrode.

4 Operation

4.1 Operating structure

Active and inactive *REL* socket

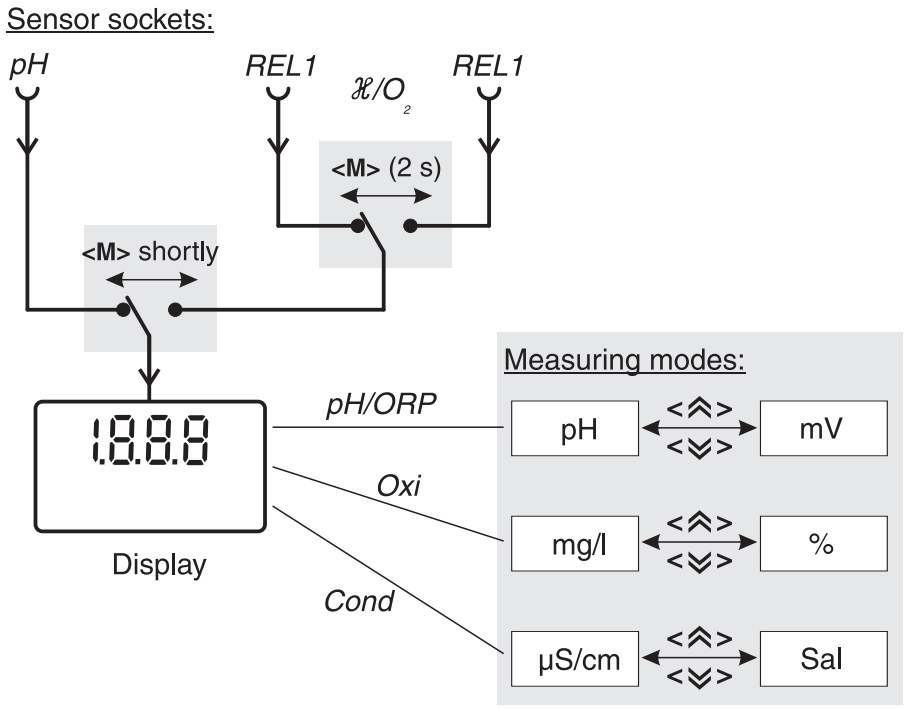
In addition to the pH/ORP sensor, the sensor on the *REL1* or *REL2* socket can be actuated (switched "active"). The other socket is not actuated ("inactive"). This switching over inside the instrument is made with the aid of a relay. The active *REL* socket is shown on the display.

The measured variable on the display can be selected as follows using the **<M>** key:

- **Press <M>** shortly: Switch between the pH/ORP sensor and the sensor at the active *REL* socket
- Press **<M>** for a longer period of time: Change the active *Rel* socket

Several measuring modes are available within a measured variable. Switch over between the measured variables with the **<▲>** or **<▼>** key.

The options are summarized in the following diagram:



Note
When a sensor is connected to the active *REL* socket, the measuring instrument recognizes the sensor or the measuring cell and automatically switches to the measuring mode that was last active. As soon as the sensor is disconnected from the active *REL* socket, the instrument switches to the *pH (mV)* measuring mode again.

4.2 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

Sensors on the socket			Measuring mode
pH	***REL (active)***	***REL (inactive)***	
			pH or ORP measurement - depending on the last selected setting
		☒	
☒			
☒		☒	
	☒		Last selected measuring mode. Only the last active *REL* socket is taken into account
☒	☒		
☒	☒	☒	

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).

4.3 pH value / ORP voltage

4.3.1 General information

Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect the pH depth armature or the pH electrode to the measuring instrument. If necessary, press the **<M>** key repeatedly until the *pH* (pH measurement) or *U* (measurement of the ORP voltage) display 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 an oxygen sensor or a conductivity measuring cell. The measuring instrument recognizes which sensors are connected and switches automatically to the correct mode for the temperature measurement.

The following cases are distinguishable.

Temperature sensor		Display	Mode
pH	***Cond or Oxi***		
yes	-	*TP*	Automatic with pH temperature sensor
yes	yes	*TP*	
-	-		Manual
-	yes	*TP* flashes	The temperature value of the second sensor (Cond or Oxi) in the same sample is taken over for the pH measurement*

* If you do not wish that, you can:

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

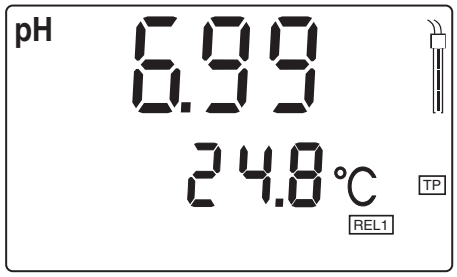
– use an electrode with a temperature sensor.

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.

4.3.2 Measuring the pH value

1	Perform the preparatory activities according to section 4.3.1.
2	Immerse the pH electrode in the test sample.
3	Press the **<▲> <▼>** keys repeatedly until *pH* appears on 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 sensor is free: Connect the second sensor (Oxi or Cond) and immerse it in the same sample. *TP* flashes, the temperature is automatically measured using the second sensor.

AutoRead AR (Drift control) and hold function

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. With the aid of the hold function the measured value display is frozen.

With identical measurement conditions, the following criterion is valid for the AutoRead function:

Reproducibility	**Response time**
Better than 0.02	> 30 seconds

For D. O. measurements, use the AutoRead function and hold function like this:

1	Call up the pH measuring mode with **<▲> <▼>**.

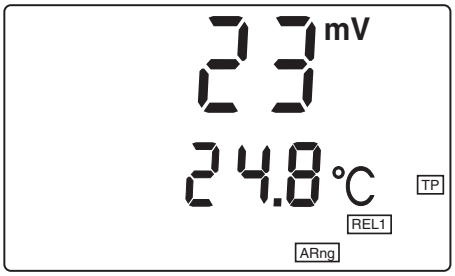
2	Activate the AutoRead function with **<AUTO READ>**. The current measured value is frozen (hold function).
3	Start AutoRead with **<RUN/ENTER>**. *AR* flashes until a stable measured value is reached. This measured value is transmitted to the interface.
4	If necessary, start the next AutoRead measurement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

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

4.3.3 Measuring the ORP voltage

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

1	Perform the preparatory activities according to section 4.3.1.
2	Submerse the ORP electrode in the sample.
3	Press the **<▲> <▼>** key 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.

4.3.4 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, i.e. after the calibration interval has expired

Calibration points

Calibration can be made with one or two buffer solutions (single-point or two-point calibration). The measuring instrument determines the following values and calculates the calibration lines as follows:

	Determined values	Values of the calibration lines
1-point	*ASY*	● Asymmetry = *ASY* ● Slope = Nernst slope (59.16 mV/pH at 25 °C)
2-point	*ASY* *SLO*	● Asymmetry = *ASY* ● Slope = *SLO*

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 4.9 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**. To do this, the instrument uses the Nernst slope (-59.2 mV/pH at 25 °C) and determines the asymmetry of the electrode.

AutoRead

The calibration procedure automatically activates the AutoRead function.
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 50.

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 OUTPUTTING THE CALIBRATION PROTOCOL ON THE INTERFACE, 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 4.8.2 before calibrating. After a valid calibration, the record is printed.

Sample printout:

```
CALIBRATION PROTOCOL
 02.03.02     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   10.01
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 calibrating, 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 Perform error elimination 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).

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).

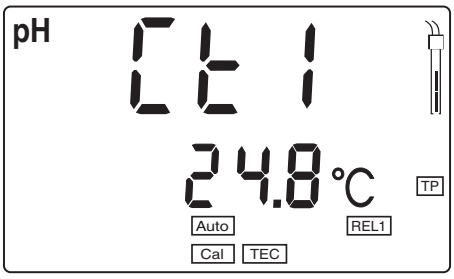
Note
The calibration for pH 10.01 is optimized for the WTW technical buffer solution TEP 10 Trace or TPL 10 Trace. Other buffer solutions can lead to an erroneous calibration. The correct buffer solutions are given in the WTW catalog or in the Internet.

Note
The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.9 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV.

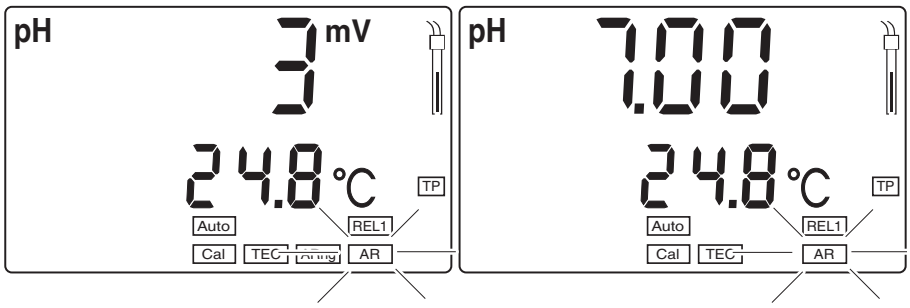
Note
Skip the steps 2 and 7 if you use a pH electrode with temperature sensor or the temperature sensor of a conductivity measuring cell or a D. O. sensor.

Starting the calibration

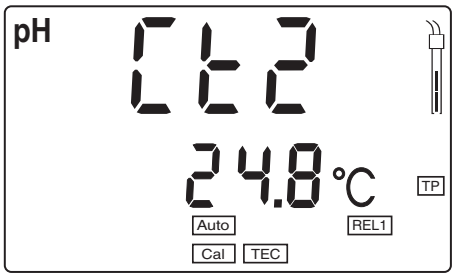
1	Press the **<CAL>** key. The *Ct1* display and the function display *AutoCal TEC* appears. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameters have been reset).



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:

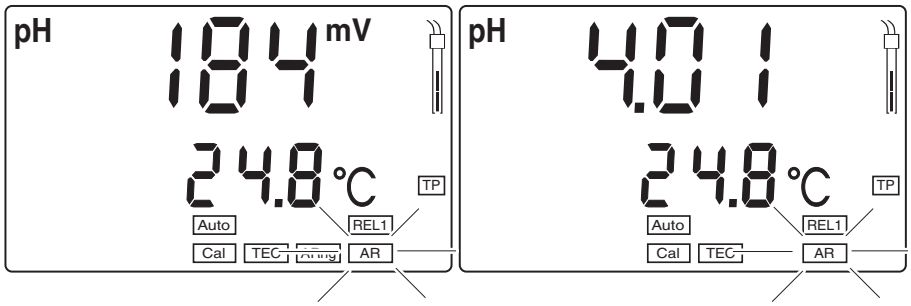


5	When the measured value is stable, *Ct2* appears.

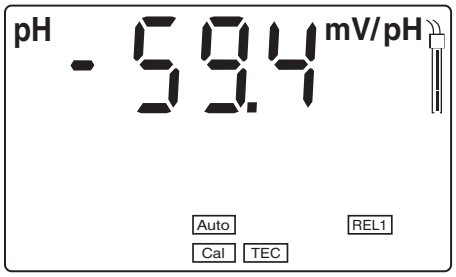


Note
At this point, the AutoCal TEC calibration can be terminated with **<M>**. This corresponds to a **single-point calibration**. To do this, the instrument uses the Nernst slope (-59.2 mV/pH at 25 °C) and determines the asymmetry of the electrode.

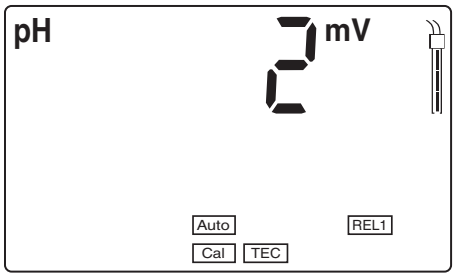
6	Thoroughly rinse the electrode with distilled water.
7	If required, enter the temperature of the second buffer solution with **<▲> <▼>** while keeping the **<RUN/ENTER>** key depressed.
8	Immerse the pH electrode into the second buffer solution.
9	Press the **<RUN/ENTER>** key. The *AR* display indicator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

4.4 Dissolved oxygen

4.4.1 General information

Note
D. O. measurements with the Multi 197i can only be carried out using a CellOx 325 or StirrOx G D. O. sensor. The stirrer of the StirrOx G D. O. sensor has to be supplied with voltage separately using the NT/pH Mix 540 power supply.

You can measure the following variables:

- D. O. concentration
- Oxygen saturation

The measuring instrument is supplied with the following functions:

- AutoRange (automatic switchover of the measurement range). If a measuring range is exceeded, AutoRange causes the measuring instrument to change automatically to the next higher measuring range and back again. Therefore, the instrument always measures in the measuring range with the highest possible resolution.
- The AutoRead function (drift control) for checking the stability of the measurement signal. This ensures the reproducibility of the measuring signal. For details of how to switch the AutoRead function on/off, see page 31.

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 the D. O. sensor to the measuring instrument. If the D. O. sensor is connected to the active *REL* socket, press the **<M>** repeatedly if necessary until the O_2 status display indicator appears. If the D. O. sensor is connected to the inactive *REL* socket, press the **<M>** key for 2 s, until the O_2 status display indicator appears.
2	Calibrate or check the measuring instrument with the sensor. How to calibrate is described in section 4.4.5 from page 21.
3	Use **<▲> <▼>** to toggle between the measuring modes, D. O. concentration (*mg/L*) and D. O. saturation (*%*).

Note
Incorrect calibration of D. O. probes will result in incorrect measured values.
Calibrate at regular intervals.

Temperature sensor

The D. O. sensor has an integrated temperature sensor that always measures the current temperature of the test sample.

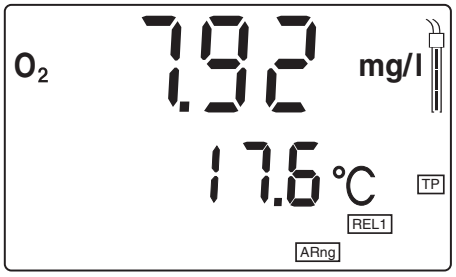
4.4.2 Measuring the D. O. concentration

When measuring the concentration of test samples with a salt content of more than 1 g/l, a salinity correction is required.

Note
How to enter the current salt content is described in section 4.4.6 ENTERING THE SALT CONTENT (SALINITY) on page 35. Switching the salt content correction on or off, see below.

To measure the D. O. concentration with and without salt content correction, proceed as follows:

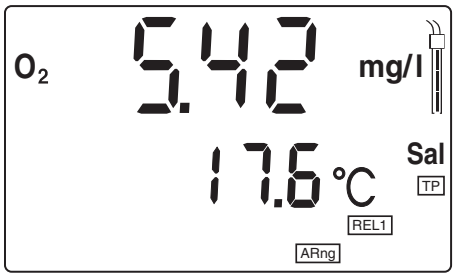
1	Perform the preparatory activities according to section 4.4.1.
2	Immerse the D. O. sensor in the test sample.
3	Press the **<▲> <▼>** key repeatedly until the D. O. concentration in *mg/l* appears on the display.



Switching on/off the salt content correction

Proceed as follows to switch on the salt content correction:

1	Perform the preparatory activities according to section 4.4.1.
2	Immerse the D. O. sensor in the test sample.
3	While pressing the **<RUN/ENTER>** key, switch on the salt content correction with **<▲>** . The *SAL* display indicator appears on the display. The specified salt content is taken into consideration during the measurement.

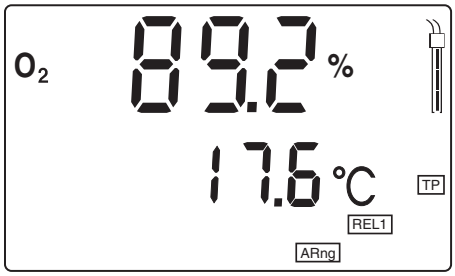


4	While pressing the **<RUN/ENTER>** key, switch off the salt content correction with **<▼>**. The *SAL* display indicator is no longer displayed.

4.4.3 Measuring the D. O. saturation

You can measure the D. O. saturation as follows:

1	Perform the preparatory activities according to section 4.4.1.
2	Immerse the D. O. sensor in the test sample.
3	Press the **<▲> <▼>** key repeatedly until the D. O. saturation in *%* appears on the display.



4.4.4 AutoRead AR (Drift control) and hold function

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. With the aid of the hold function the measured value display is frozen.

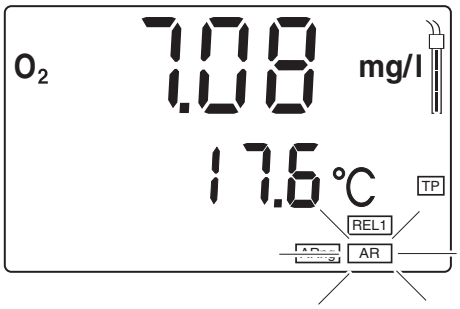
Criteria

With identical measurement conditions, the following criteria are valid for the AutoRead function:

Measuring mode	Reproducibility	Response time
D. O. concentration	better than 0.05 mg/l	> 10 seconds
Oxygen saturation index	better than 0.6 %	> 10 seconds

For D. O. measurements, use the AutoRead function and hold function like this:

1	Call up the measuring mode with **<M>** and/or **<▲> <▼>** .
2	Activate the AutoRead function with **<AUTO READ>**. 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 **<AUTO READ>** key.

4.4.5 D. O. calibration

Why calibrate?

D. O. probes age. This changes the slope of the D. O. sensor. Calibration determines the current slope of the sensor and stores this value in the instrument.

When to calibrate?

- After connecting another D. O. sensor
- When the sensor symbol flashes (after the calibration interval has expired).

Calibration procedure

The calibration is performed in water vapor-saturated air. Use the OxiCal®-SL air calibration vessel (accessory) for the calibration.

AutoRead

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

Displaying the calibration data

You can view the data of the last calibration on the display. The proceeding is described on page 50.

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 4.8.2 before calibrating. After a valid calibration, the record is printed.

Sample printout:

```
CALIBRATION PROTOCOL
 02.03.02     14:19
Device No.: 12345678
CALIBRATION 02
Cal time: 02.03.01 / 14:19
Cal interval:   14d
OxiCal        Tauto AR
Relative Slope:   0,88
Probe:     +++
```

Sensor evaluation

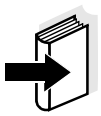
After the calibration, the measuring instrument evaluates the current status of the sensor against the relative slope. The evaluation appears on the display. The relative slope has no effect on the measuring accuracy. Low values indicate that the electrolyte will soon be depleted and the sensor will have to be regenerated.

Display	Relative slope
	S = 0.8 ... 1.25
	S = 0.7 ... 0.8
	S = 0.6 ... 0.7
E3 Perform error elimination according to chapter 6 WHAT TO DO IF...	S < 0.6 or S > 1.25

Starting the calibration

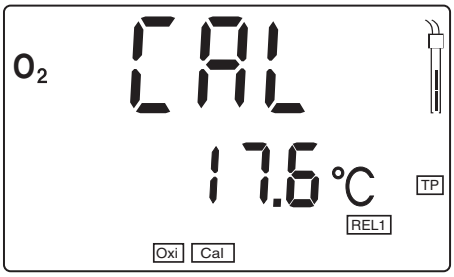
Proceed as follows to calibrate the instrument:

1	Perform the preparatory activities according to section 4.4.1.
2	Keep the OxiCal®-SL air calibration vessel ready.

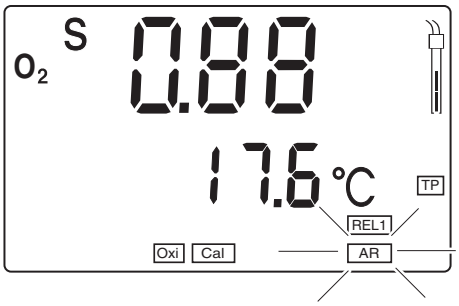


Note
The sponge in the air calibration vessel must be moist (not wet). Observe the instructions in the OxiCal®-SL operating manual.

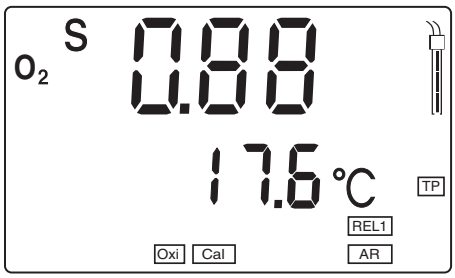
3	Put the D. O. sensor into the air calibration vessel.
4	Press the **<CAL>** key repeatedly until the calibration mode appears. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measuring parameters have been reset).



5	Press the **<RUN/ENTER>** key. AutoRead is active, *AR* flashes.



6	As soon as a stable value is achieved the *AR* display stops flashing. The calibration is finished then. The value of the relative slope appears on the display. The sensor symbol shows the sensor evaluation (see page 33).



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

Note
In chapter 6 WHAT TO DO IF... from page 67, you will find the measures to take for error elimination.

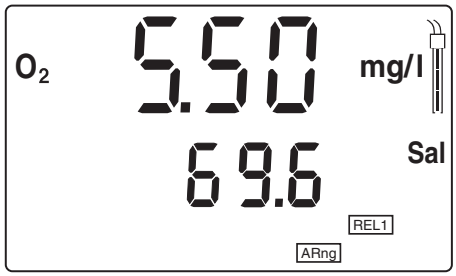
4.4.6 Entering the salt content (salinity)

A salt content correction is required in the oxygen concentration measurement of samples with a salt content of more than 1 g/l. To do this, you have to enter the salinity equivalent (the measured salinity) of the test sample (range 0.0 - 70.0) and to switch on the salinity correction.

Note
With the Multi 197i, you can measure the salinity. How to proceed is described in section 4.5.3 MEASURING THE SALINITY on page 38.

Entering the salt content

1	Determine the salinity of the test sample (any method, see also section 4.5.3 MEASURING THE SALINITY on page 38).
2	Press the **<CAL>** key repeatedly until *Sal* appears on the display.



3	Enter the salt content with **<▲>** **<▼>**.
4	Switch to the measuring mode with **<M>**.

Note
How to switch on the salt content correction is described on page 29.

4.5 Conductivity

4.5.1 General information

Note
Conductivity measurements with the Multi 197i 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.

The measuring instrument is supplied with the following functions:

- AutoRange (automatic switchover of the measurement range). If a measuring range is exceeded, AutoRange causes the measuring instrument to change automatically to the next higher measuring range and back again. Therefore, the instrument always measures in the measuring range with the highest possible resolution.
- The AutoRead function (drift control) for checking the stability of the measurement signal. This ensures the reproducibility of the measuring signal. For details of how to switch the AutoRead function on/off, see page 39.

Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect a conductivity measuring cell to the measuring instrument. If the conductivity measuring cell is connected to the active *REL* socket, press the **<M>** key repeatedly (if necessary) until the status display ℋ appears. If the conductivity measuring cell is connected to the inactive *REL* socket, press the **<M>** key for 2 s until the status display ℋ appears.
2	Check the selected cell constant or calibrate the measuring instrument with the measuring cell (see below).
3	Check the selected cell constant (see below) or calibrate the measuring instrument with the measuring cell (see section 4.5.5 on page 40).
4	Using **<▲ > <▼>**, toggle between the measuring modes, conductivity (ℋ 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

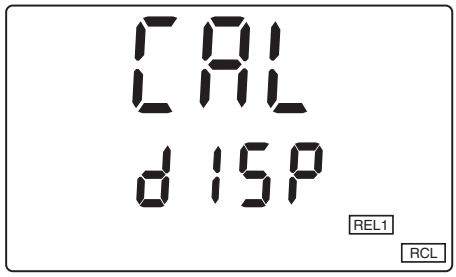
The nonlinear temperature compensation is set fixed and is shown on the display by *nLF*.

Reference temperature, Tref

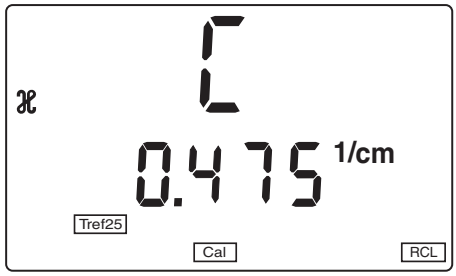
The reference temperature (Tref) can be switched between 20 °C and 25 °C. It appears on the display as *Tref20* or *Tref25*. To switch over the reference temperature, see SWITCHING OVER THE REFERENCE TEMPERATURE, page 60.

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 1/cm.

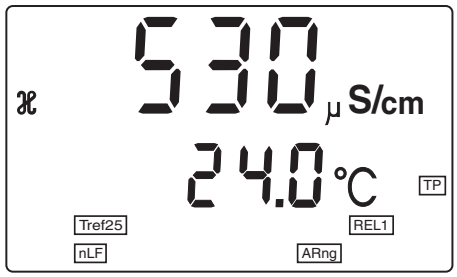


3	To return to the measuring mode: Press the **<M>** key when the correct cell constant is displayed.
4	If you want to recalibrate the cell constant, proceed according to section 4.5.5 DETERMINING THE CELL CONSTANT (CALIBRATION IN THE CONTROL STANDARD) .

4.5.2 Measuring the conductivity

You can carry out the conductivity measurements as follows:

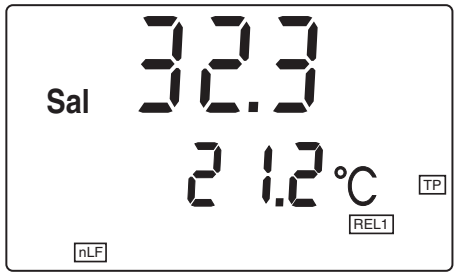
1	Perform the preparatory activities according to section 4.5.1 page 36.
2	Immerse the conductivity measuring cell in the test sample.
3	Press the **<▲> <▼>** keys until in the status display, ℵ and the unit µ*S/cm* appears. The conductivity value appears on the display.



4.5.3 Measuring the salinity

You can carry out the salinity measurements as follows:

1	Perform the preparatory activities according to section 4.5.1 page 36.
2	Immerse the conductivity measuring cell in the test sample.
3	Press the **<▲> <▼>** keys repeatedly until the *Sal* status display appears. The salinity value appears on the display.

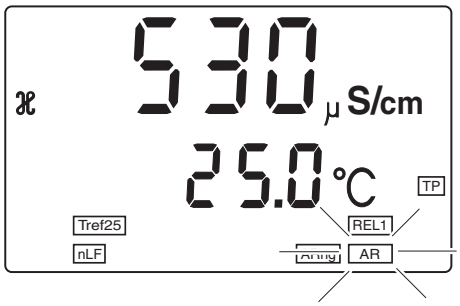


4.5.4 AutoRead AR (Drift control) and hold function

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. With the aid of the hold function the measured value display is frozen.

For conductivity measurements, use the AutoRead function and hold function like this:

1	Call up the measuring mode ϰ or *SAL* with **<M>** and/or **<▲ > <▼>**.
2	Immerse the conductivity measuring cell in the test sample.
3	Activate the AutoRead function with **<AUTO READ>**. 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 **<AUTO READ>** 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.

4.5.5 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 instrument is set to 0.475 cm^{-1} (conductivity measuring cell TetraCon 325).

AutoRead

In calibration, the *AutoRead* function is automatically activated. The *AR* display indicator flashes. The calibration process is finished when *AR* stops flashing.

Displaying the calibration data

You can view the data of the last calibration on the display. The proceeding is described on page 50.

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 4.8.2 before calibrating. After a valid calibration, the record is printed.

Sample printout:

```
CALIBRATION PROTOCOL
 14.04.02      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

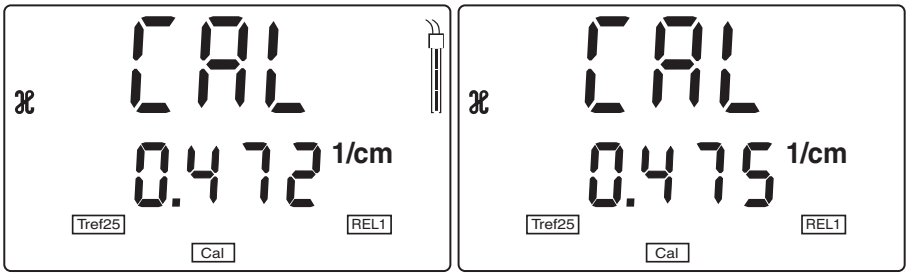
After the calibration, the measuring instrument automatically evaluates the current status of the calibration. The evaluation appears on the display.

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

Determining the cell constant

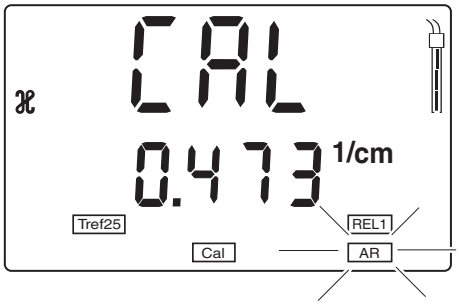
You can determine the cell constant (conductivity measuring cell TetraCon 325) as follows:

1	Press the **<CAL>** key repeatedly until the status display ℋ *CAL* appears.
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 error message E3 appears refer to chapter 6 WHAT TO DO IF...

4.6 Calibration intervals (Int 3, Int 4, 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 sensor symbol of the relevant measured variable flashes. It is still possible to measure. By calibrating the relevant sensor, the function is reset and the interval starts anew.

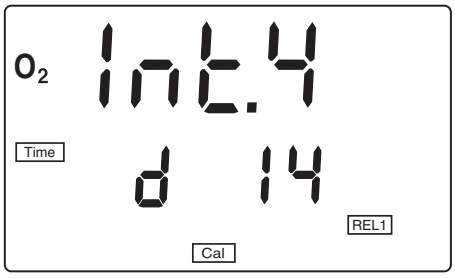
The following calibration intervals are set in the factory:

Measured parameter	Designation	Default setting
pH/ORP	*Int 3*	7 days
Dissolved oxygen	*Int 4*	14 days
Conductivity	*Int 5*	180 days

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 ... 5* together with the required measured variable (*pH*, O_2 or ℜ) appears. Example:



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

4.7 Saving data

The portable Multi 197i multiparameter measuring instrument has an internal data storage. It can store up to 500 datasets.
A complete data record consists of:

- Number of the storage location
- Date/time
- Measured values of the connected and active sensors
- Temperature values of the connected and active sensors
- Temperature measuring procedure
- ID number

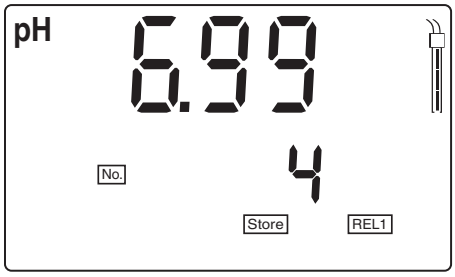
You can transmit measured values (data records) to the data storage in two ways:

- Save manually
- Switch on AutoStore (Int 1), see page 46

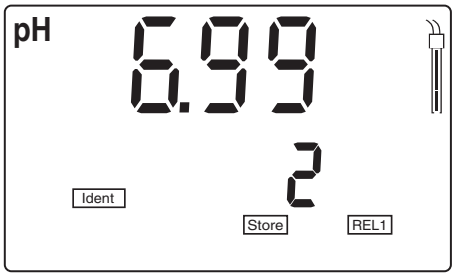
4.7.1 Saving manually

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

Message StoFul

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 4.7.3
Clearing the memory	see section 4.7.4

4.7.2 Switching on AutoStore (Int 1)

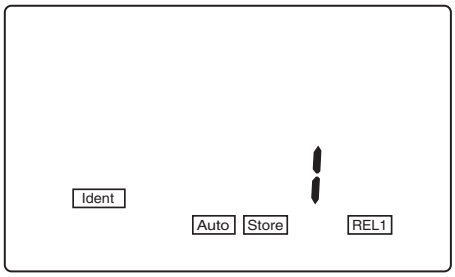
The save interval (Int 1) determines the chronological interval between automatic save processes. After the fixed interval has expired, the current data record is transmitted to the internal storage and to the interface.

Switching on AutoStore

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 start 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 48) 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 other 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.

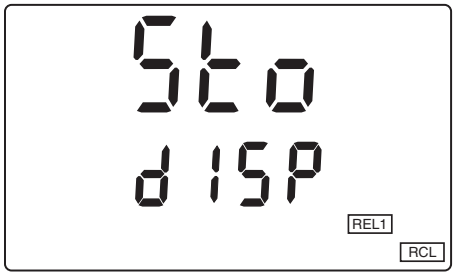
4.7.3 Outputting the data storage

You can output the contents of the data storage:

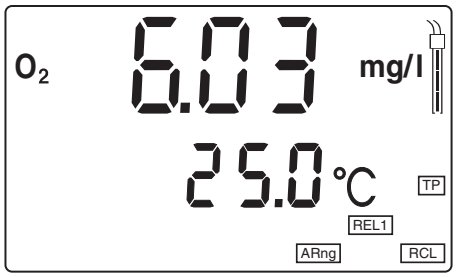
- Stored data on the display
- Calibration data on the display
- Stored data on the serial interface
- Calibration protocol on the interface

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:

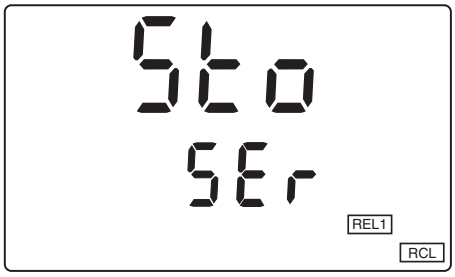
Display further data of the data record (ID number, date, time, storage location)	Press **<RUN/ENTER>**
Toggle between two saved measured variables	Press **<RUN/ENTER> + <M>**
Advance one data record (storage location)	Press **<▲>**
Go back one data record (storage location)	Press **<▼>**

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.

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

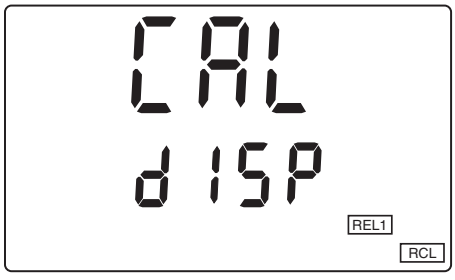
Note
You can cancel the transmission with **<M>** or **<RUN/ENTER>**.

Sample printout:

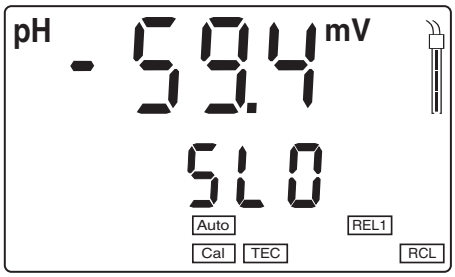
```
No.    1:
 09.03.02        17:10
pH 10.01         25    °C
Tauto          AR
Ident :  47

No.    2:
 09.03.02        17:12
  305 mV
Tauto
Ident :  6

No.    3:
 09.03.02        17:24
  7.88 mg/l      17.6°  C
Tauto
Ident :  81

No.    4:
 09.03.02        17:46
  7.11 mg/l      17.8°  C
Tauto
 SAL = 17.9
Ident :   4

No.    5:
 10.03.02        19:09
  2.40 mS/cm      25.3 °C
Tauto
nLF
Tref25  C = 0.475 1/cm
Ident :  10

No.    6:
 10.03.02        20:48
  2.46 mS/cm      25.6 °C
Tauto
nLF
Tref25  C = 0.475 1/cm
Ident : 1
...
```

Outputting the calibration data on the display

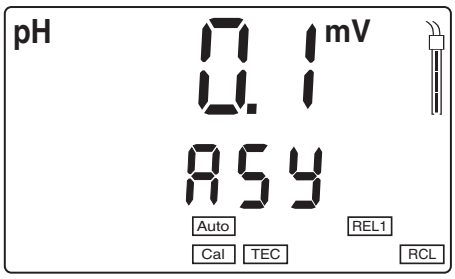
1	Press the **<RCL>** key repeatedly until *CAL disp* appears on the display.



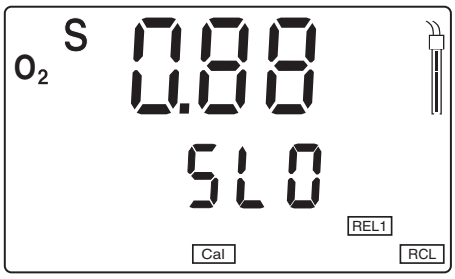
2	Press the **<RUN/ENTER>** key. The data of the last calibration of all measured variables appears in the following sequence: ● pH: Slope *SLO* and asymmetry *ASY* ● Oxygen: Relative slope *SLO* ● Cond: Cell constant *C* Information concerning the calibration procedure is output as well.



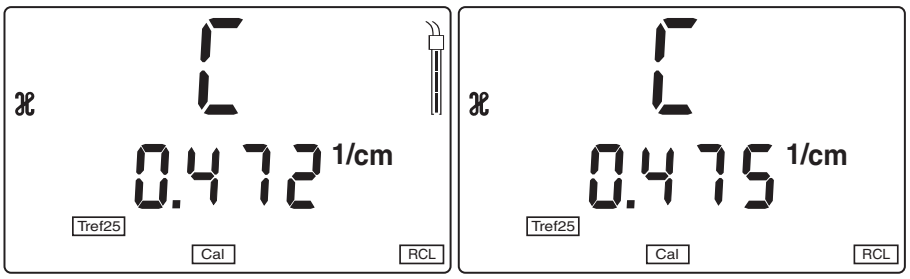
3	Press **<RUN/ENTER>** to display the value of the asymmetry (mV).



4	Press **<RUN/ENTER>** to display the relative slope of the D. O. sensor.



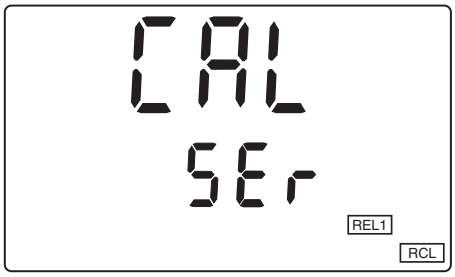
5	Press **<RUN/ENTER>** to display the cell constant. The displayed value is: ● the current, calibrated cell constant (**with** sensor symbol on the display) or ● the fixed cell constant *0.475 1/cm* (**without** sensor symbol on the display). In this case, the measuring parameters are initialized (see section 4.10 RESET).



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

Outputting the calibration protocol on the interface

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



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

Sample printout:

```
CALIBRATION PROTOCOL
 02.03.02     14:19
Device No.: 12345678

Calibration pH
Cal time: 01.03.02 / 15:20
Cal interval:   7d
AutoCal TEC   Tauto
Buffer 1   2.00
Buffer 2   4.01
Buffer 3   7.00 *
Buffer 4   10.01
C1      174.1 mV  25.0°C
C2     -133.3 mV  25.0°C
S1     -59.4 mV/pH
ASY1   -   4 mV
Probe:     +++

CALIBRATION 02
Cal time: 02.03.02 / 14:19
Cal interval:   14d
OxiCal        Tauto AR
Relative Slope:   0,88
Probe:     +++

Calibration Conductivity
Cal time: 14.01.02 / 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 :     +++
```

4.7.4 Clearing the memory

With this function, you can delete the 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.

4.8 Transmitting data

You have the following possibilities of transmitting data:

- One of the following options:
  - With the *AutoStore* function (page 46), the measured values of all connected and active sensors are stored periodically and output to the interface (save interval Int 1).
  - With the *Data transmission interval* (Int 2), the measured values of all connected and active sensors are periodically output to the interface (see below).
  - *AutoStore* (Int 1) covers the *Data transmission interval* (Int 2).
- Press the **<RUN/ENTER>** key
  This manually triggers a data transmission of the current measured value to the serial interface at any time - independently of the selected intervals.
- With the *Output data storage* function (page 48), calibration data or saved measured values are output on the interface.

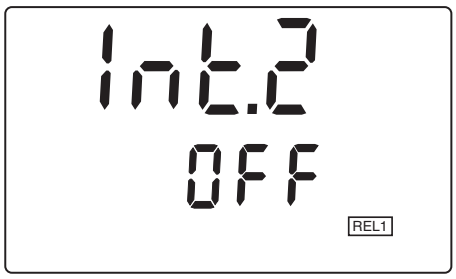
4.8.1 Data transmission interval (Int 2)

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

Setting the Data transmission interval

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).

4.8.2 PC/external printer (RS232 interface)

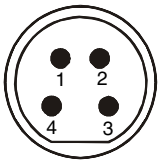
Via the RS 232 interface, you can transmit the data to a PC or an external printer.
Use the AK340/B (PC) or AK325/S (ext. printer) cable to connect the interface to the devices.

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 at the PC/printer:

Baud rate	selectable between: 1200, 2400, **4800**, 9600
Handshake	RTS/CTS + Xon/Xoff
PC only:	
Parity	none
Data bits	8
Stop bits	2

Socket assignment



RS 232
REC

1 CTS
2 RxD
3 Ground
4 TxD

4.8.3 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.

4.9 Configuration

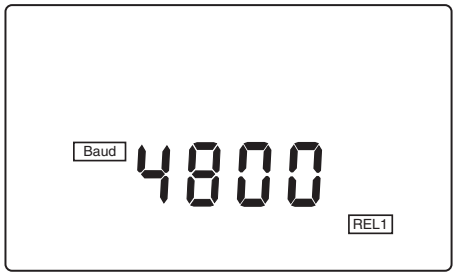
You can adapt the measuring instrument to your individual requirements. To do this, the following parameters can be changed (the status on delivery is marked in bold):

Baud rate	1200, 2400, **4800**, 9600
Air pressure display	Current value in mbar (no input possible)
Calibration intervals	– pH: 1 ... **7** ... 999 d*Int 3* – O_2 1 ... **14** ... 999 d*Int 4* – ℜ: 1 ... **180** ... 999 d*Int 5*
Date/time	Any

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

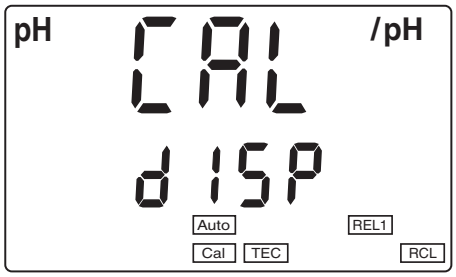
1	Switch off the measuring instrument.
2	Press the **<M>** key and hold it down.
3	Press the **<ON/OFF>** key. The display test appears briefly on the display. The measuring instrument then switches automatically to the setting of the baud rate.

Baudrate



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

Display during the pH calibration



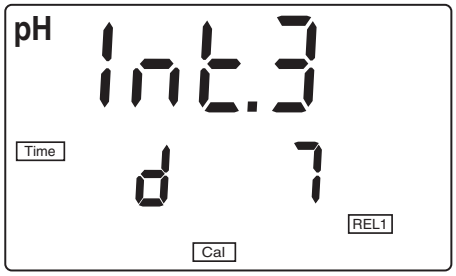
6	Select the required display during the pH calibration with **<▲> <▼>**. *mV*: Display of the current electrode voltage */pH*: Display of the buffer nominal value.
7	Confirm with **<RUN/ENTER>**. *P* appears on the display.

Displaying the air pressure

The air pressure in mbar is only displayed if a D. O. sensor is connected to the active *REL* socket. Otherwise, "---" appears.

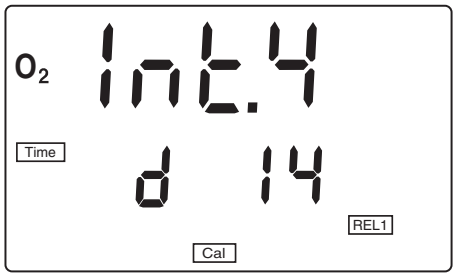
8	Confirm with **<RUN/ENTER>**. *Int 3* and the measured variable pH appear on the display.

pH calibration interval



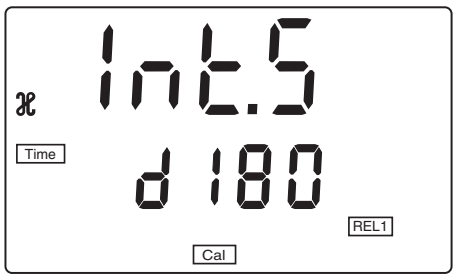
9	Set the required interval in days (d) with **<▲> <▼>**.
10	Confirm with **<RUN/ENTER>**. *Int 4* and the measured variable O_2 appear on the display.

Dissolved oxygen calibration interval



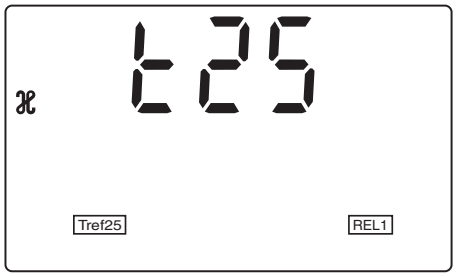
11	Set the required interval in days (d) with **<▲> <▼>**.
12	Confirm with **<RUN/ENTER>**. *Int 5* and the measured variable ℜ appears on the display.

Conductivity calibration interval



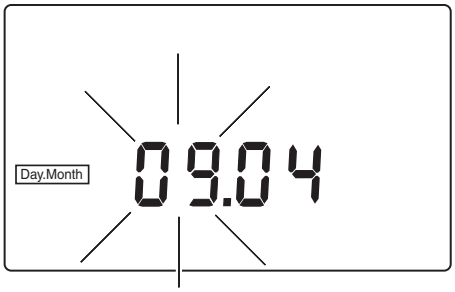
13	Set the required interval in days (d) with **<▲> <▼>**.
14	Confirm with **<RUN/ENTER>**. The reference temperature set for conductivity measurements appears on the display.

Switching over the reference temperature



15	Using **<▲> <▼>**, toggle between 25 °C *(Tref25)* and 20 °C *(Tref20)*.
16	Confirm with **<RUN/ENTER>**. The date flashes on the display.

Date and time



17	Set the date of the current day with **<▲> <▼>**.
18	Confirm with **<RUN/ENTER>**. The date (month) flashes in the display.
19	Set the current month with **<▲> <▼>**.
20	Confirm with **<RUN/ENTER>**. The year appears on the display.
21	Set the current year with **<▲> <▼>**.
22	Confirm with **<RUN/ENTER>**. The hours flash on the display.
23	Set the current time with **<▲> <▼>**.
24	Confirm with **<RUN/ENTER>**. The minutes flash on the display.
25	Set the current time with **<▲> <▼>**.
26	Confirm with **<RUN/ENTER>**. The measuring instrument switches to the last active measuring mode.

4.10 Reset

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

Measurement parameters

The following measurement parameters (pH/O_2/ ⌘ InI) can be reset to the delivery status:

pH

Measuring mode	pH
Asymmetry	0 mV
Slope	-59.16 mV

O_2

Measuring mode	D. O. concentration
Relative slope	1.00
Salinity (value)	0.0
Salinity (function)	Off

⌘

Measuring mode	⌘
Cell constant	0.475 cm^{-1} (fixed)

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

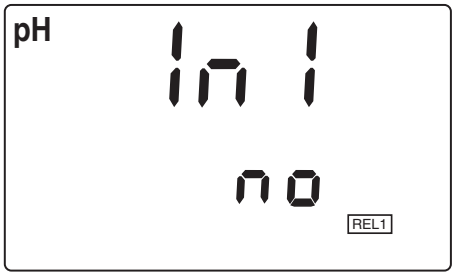
Configuration parameters

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

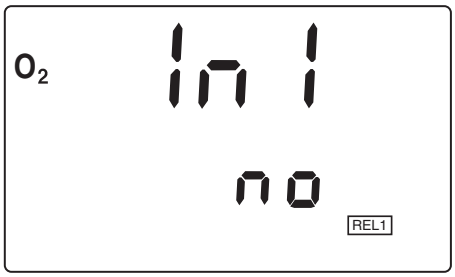
Baud rate	4800
Display during the pH calibration	Buffer nominal value
Interval 1 (automatically saved)	OFF
Interval 2 (for data transmission)	OFF

Resetting the measuring parameters

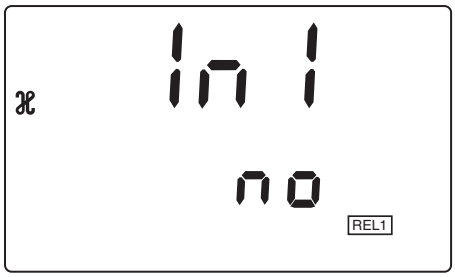
1	Press the **<RUN/ENTER>** key and hold it down.
2	Press the **<CAL>** key. The setting to reset the pH measuring parameters appears on the display.



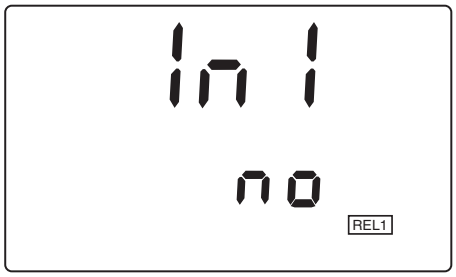
3	Using **<▲> <▼>**, switch between *no* and *YES*. *YES*: Resetting the pH measuring parameters *no*: Retaining settings.
4	Confirm with **<RUN/ENTER>**. The measuring instrument switches to the setting to reset the O_2 measuring parameters.



5	Using **<▲> <▼>**, switch between *no* and *YES*. *YES*: Resetting the O_2 measuring parameters. *no*: Retaining settings.
6	Confirm with **<RUN/ENTER>**. The measuring instrument switches to the setting to reset the Cond measuring parameters.



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



Resetting the configuration parameters

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

5 Maintenance, cleaning, disposal

5.1 Maintenance

The measuring instrument is maintenance-free.

5.2 Cleaning

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

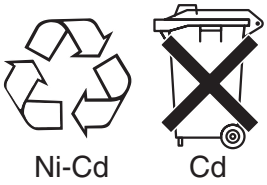
Warning
The housing components are made out of synthetic materials (polyurethane, ABS and PMMA). Thus, avoid contact with acetone and similar detergents that contain solvents. Remove any splashes immediately.

5.3 Disposal

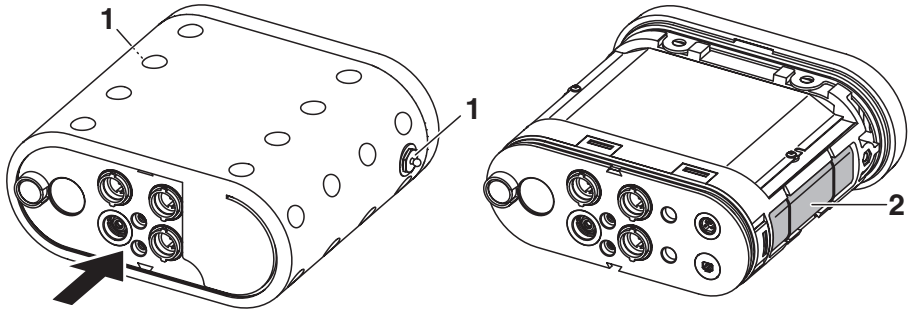
Packing

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

Rechargeable battery



Remove the rechargeable battery from the instrument and dispose of it at a suitable facility according to local legal requirements. It is illegal to dispose of the rechargeable battery with household refuse. Proceed as follows to disassemble the rechargeable battery:



1	Remove the carrying and positioning handle or the carrying strap.
2	Unscrew the fixing elements (1) using a hexagon key.
3	Remove the instrument from the enclosure by vigorously pressing against the socket field.
4	Take out the rechargeable battery (2) and cut off the battery cable.

Measuring instrument Dispose of the measuring instrument without the rechargeable battery as electronic waste at an appropriate collection point.

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 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 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 sample
– Measurement procedure not suitable	– Follow special procedure

6.2 Oxi system messages

Error message OFL

Cause	Remedy
Display range exceeded	
Oxygen sensor	
– Not connected	– Connect the sensor
– Cable broken	– Replace sensor
– Depleted	– Replace sensor
– Short-circuit between gold and lead electrode	– Clean sensor and replace it if necessary

Error message E3

Cause	Remedy
Invalid calibration	
Oxygen sensor	
– Electrolyte solution depleted	– Regenerate sensor
– Membrane contaminated	– Clean membrane
– Electrode system poisoned	– Regenerate sensor
– Obsolete	– Replace sensor
– Broken	– Replace sensor

Error message E7

Cause	Remedy
Membrane damaged	
– Membrane damaged	– Regenerate sensor
– Membrane head screwed on not tight enough	– Screw membrane head tight

***AR* flashes continuously**

Cause	Remedy
No stable measured value	
– Membrane contaminated	– Clean membrane

Measured value too low

Cause	Remedy
– Insufficient flow	– Provide flow to the sensor

Measured value too high

Cause	Remedy
– High amount of dissolved substances	– Correct solubility function using the salinity equivalent
– Air bubbles bump on the membrane with high velocity	– Avoid direct flow to the membrane
– The carbon dioxide pressure is too high (> 1 bar)	– Measuring not possible

6.3 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

6.4 General errors

Display *LoBat*

Cause	Remedy
– Battery almost empty	– Charge the battery (see section 3.2)

Instrument does not react to keystroke

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

Display to

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

Sensor symbol flashes

Cause	Remedy
– Calibration interval expired	– Recalibrate the measuring system

Message StoFul

Cause	Remedy
– All memory locations are full	– Output data storage and clear data storage

You want to know which software version is in the instrument

Cause	Remedy
– E. g., a question by the WTW service department	– Simultaneously press the **<CAL>** and **<ON/OFF>** keys and release them again. The software version is displayed.

7 Technical data

7.1 General data

Dimensions approx. 90 x 200 x 190 mm

Weight approx. 1.5 kg (without plug-in power supply)

Mechanical structure Type of protection IP 67

Electrical safety Protective class III

Test certificates CE

Ambient conditions

Storage	- 25 °C ... + 65 °C
Operation	-10 °C ... + 55 °C
Climatic class	2

Power supply

Rechargeable battery	Nickel-cadmium(NiCad) rechargeable battery
Operational life	approx. 600 hours with one charging
Plug-in power supply unit (charging device)	The following applies to all plug-in power supplies:Connection max. Overvoltage category II Plug-in power supply unit (Euro, US , UK, Australian plug) FRIWO FW7555M/09, 15.1432 Friwo Part. No. 1883259 Input: 100 ... 240 V ~ / 50 ... 60 Hz / 400 mA Output: 9 V = / 1,5 A

Serial interface

Connection of the cable AK 340/B or AK 325/S

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

Guidelines and norms used

EMC	EC guideline 89/336/EEC EN 61326-1:1998 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
IP protection	EN 60529:1991

7.2 Measuring ranges, resolutions, accuracies

7.2.1 pH/ORP

Variable	Measuring range	Resolution	Accuracy (± 1 Digit)
pH	- 2.00 ... + 19.99	0.01	± 0.01 *
U [mV]	- 1999 ... + 1999	1	± 1
T [°C]	- 5.0 ... + 105.0	0.1	± 0.1

** when measuring in a range of ± 2 pH around a calibration point*

Manual temperature input

Variable	Range	Increment
T_{manual} [°C]	- 20 ... + 130	1

7.2.2 Dissolved oxygen

Measuring ranges and resolutions

Variable	Measuring range	Resolution
Concentration [mg/l]	0 ... 19.99 0 ... 90.0	0.01 0.1
Saturation [%]	0 ... 199.9 0 ... 600	0.1 1
T [°C]	0 ... 50.0	0.1

Accuracies

Variable	Accuracy (± 1 Digit)
Concentration [mg/l]	± 0.5 % of measured value at ambient temperature of 5 °C ... 30 °C
Saturation [%]	± 0.5 % of measured value when measuring in the range of ± 10 K around the calibration temperature
T [°C]	± 0.1

Correction functions

Temperature compensation	Accuracy better than 2 % at 0 ... 40 °C
Salinity correction	0 ... 70.0 SAL
Air pressure correction	Automatic through integrated pressure sensor in the range of 500 ... 1100 mbar

7.2.3 Conductivity

Measuring ranges and resolutions

Variable	Measuring range	Resolution
ϰ [µS/cm]	0 ... 1999	1
ϰ [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

Accuracies

Variable	Accuracy (± 1 Digit)	
ϰ [µS/cm] / [mS/cm] (nonlinear compensation)	Accuracy ± 0.5 % ± 0.5 %	Sample temperature 0 °C ... 35 °C according to EN 27 888; 35 °C ... 50 °C extended nLF function according to WTW measurements
SAL (range 0.0 ... 42.0)	Accuracy ± 0.1 ± 0.2	Sample temperature 5 °C ... 25 °C 25 °C ... 30 °C
T [°C]	± 0.1	

Cell constant, calibrating

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

Reference temperature

Tref	Can be set to 20 °C or 25 °C

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 helps you to find the topics that you are looking for.

Abbreviations

$\mathfrak{X}$	Conductivity value (international γ)
AR	AutoRead (drift control)
ARng	Automatic range switching Measuring instrument measures with highest resolution
ASY	Asymmetry
AutoCal DIN	Automatic pH calibration with buffer solutions prepared according to DIN 19 266
AutoCal TEC	Automatic pH calibration with WTW technical buffer solutions according to DIN 19267
C	Cell constant [cm^{-1}] (internat. k)
°C	Temperature unit, degrees Celsius
Cal	Calibration
Cd...	Display indicator during calibration for pH measurements. Indicates the selection of the buffer data record for buffer solutions prepared according to DIN 19 266
Cm...	Display indicator during calibration for pH measurements. Indicates the selection of buffer data records for buffer solutions of the Merck company
ConCal	Conventional single-point or two-point calibration for pH measurements
Ct...	Display indicator during calibration for pH measurements. Indicates the selection of the buffer data records for WTW technical buffer solutions
E3	Error message see chapter 6 WHAT TO DO IF...
InI	Initialization Resets individual basic functions to the status they had on delivery
LoBat	Battery nearly empty (Low Battery)
mV	Voltage unit
mV/pH	Unit of the electrode slope (internat. mV)

nLF	Nonlinear temperature compensation
OFL	Display range exceeded (Overflow)
OxiCal	Automatic calibration for D. O. measurements
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 sensor)
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.

D. O. partial pressure — Pressure caused by the oxygen in a gas mixture or liquid.

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 sensor. 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.

OxiCal® WTW name for a procedure to calibrate D. O. measuring systems in water vapor saturated air.

Oxygen saturation Short name for the relative D. O. saturation.
Note: The D. O. saturation value of air-saturated water and the D. O. saturation value of oxygen-saturated water are different.

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.

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).

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.
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.
Setting the 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 conductimetric 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.
Slope	The slope of a linear calibration function.
Slope (relative)	Designation used by WTW in the D. O. measuring technique. It expresses the relationship of the slope value to the value of a theoretical reference sensor of the same type of construction.
Standard solution	The standard solution is a solution where the measured value is known by definition. It is used to calibrate a measuring system.
TDS	Total dissolved solids
Temperature coefficient	Value of the slope of a linear temperature function.
Temperature function	Name of a mathematical function expressing the temperature behavior of a test sample, a sensor or part of a sensor.

A

B

C

D

E

I

J

K

M

O

P

R

S

T