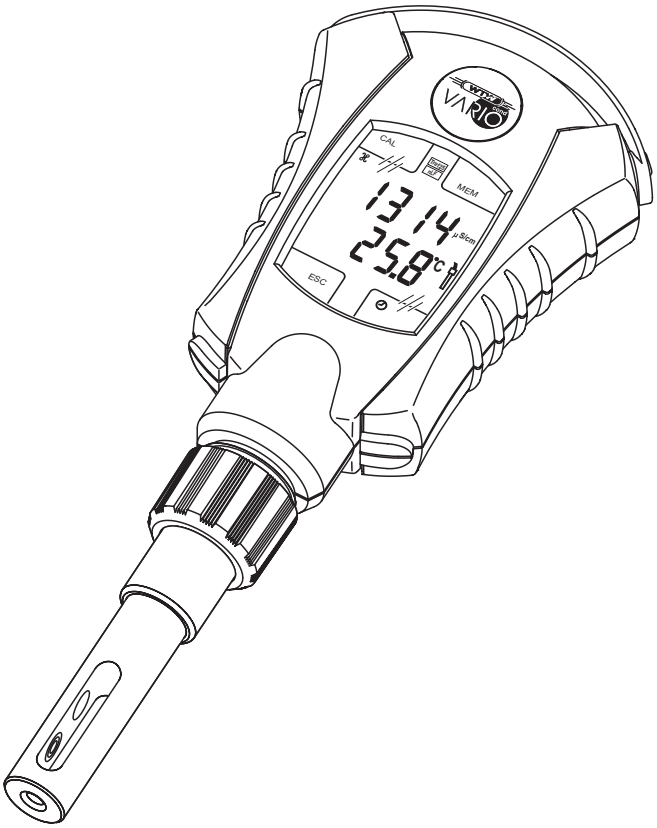
Operating manual

ba75468e

VARIO Cond



Hand-held conductivity meter

ba75468e01 07/2004

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. 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.

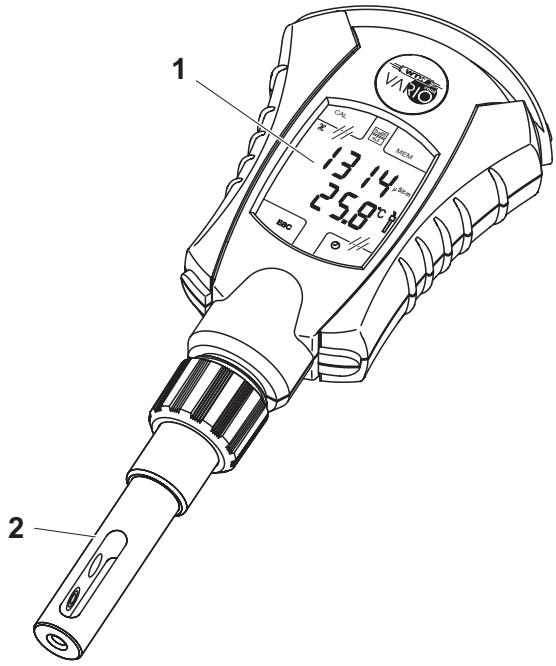
1 Overview

The VARIO Cond hand-held meter and a suitable sensor module enable you to measure the conductivity, specific resistance, salinity or TDS (total dissolved solids) of a solution very easily.

Depending on the measuring range expected, the following sensor modules are suitable for operation with the VARIO Cond hand-held meter.

Measuring range	Sensor module
1 µS/cm ... 200 mS/cm	TetraCon V
0.01 µS/cm ... 200 µS/cm	LR01 V

All functions and settings are operated via the touch screen.



1	Display (touch screen)
2	Sensor module

Note
You will find additional information on measuring cells and other accessories in the WTW catalog or on the Internet (http://www.wtw.com).

2 Safety

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

User qualification

The meter was developed for work in the laboratory.
We assume that, as a result of their professional training and experience, the operators will know the necessary safety precautions to take when handling chemicals.

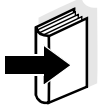
Safety instructions

The individual chapters of this operating manual use safety instructions such as the label shown below to indicate various hazards or dangers:

Caution
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 meter consists exclusively of the measurement of the conductivity, salinity, temperature and TDS (total dissolved solids).
The technical specifications as given in chapter 7 TECHNICAL DATA must be observed. Only the operation and running of the meter 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 meters (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 meter 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 meter 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 meter:

- 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 this meter 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

- VARIO Cond hand-held meter
- Sensor module (TetraCon V or LR01 V)
- Microfiber cleaning cloth
- Accompanying documents:
  - Manual for commissioning
  - Short instructions to be glued in the lid of the case
  - CD-ROM with a description of all instrument functions
- Transport case with insert

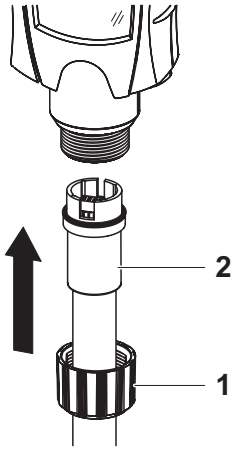
3.2 Initial commissioning

Perform the following activities:

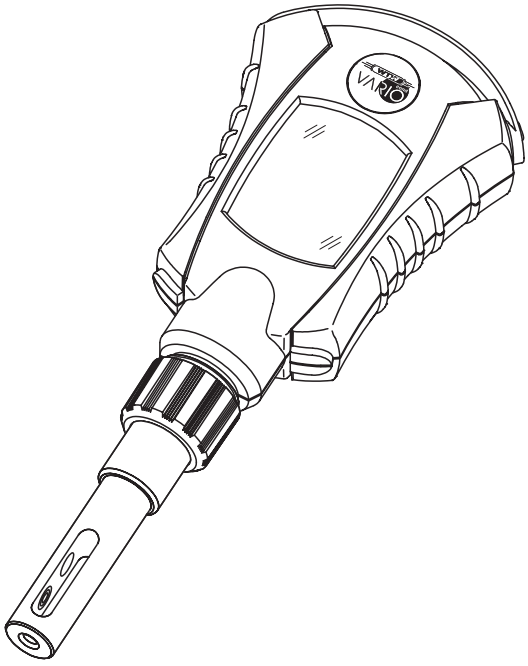
- Connect the sensor module to the meter (see section 3.3)
- Switch on the meter (see section 4.2)
- Set the date and time (see section 4.10.1)
- Calibrate the meter with the sensor module (see section 4.4)

3.3 Connecting the sensor module

1	Unscrew the coupling ring (1) from the meter.
2	Place the sensor module (2) in a straight position to the meter (turn the wide cut-out to the front) and plug it in carefully with slight force.



3	Using the coupling ring (1), screw the sensor module tight. The instrument is ready for operation.



3.4 Storing the meter and sensor module

To maintain the operability of the meter and sensor module for a long time, leave the sensor module connected to the meter as possible and avoid to plug it on or off when it is not necessary. Thus, the watertight plug-in connector will be well protected.

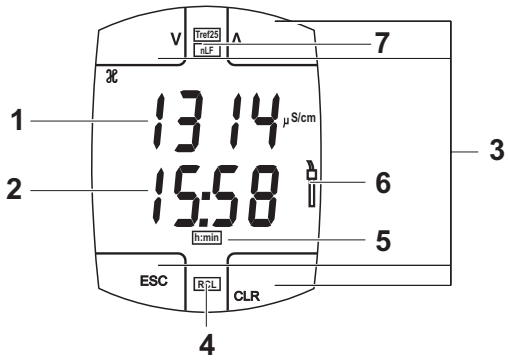
In order to store an already used sensor module separately from the meter, protect the socket of the sensor module with the original protective cap.

4 Operation

4.1 Operating elements

The entire operation is carried out via the touch sensitive surface of the display (touch screen). A slight pressure on the surface suffices to start a function. Any pressure on the surface is confirmed by an acoustic signal.

Display elements



1	Upper display line - example: stored conductivity value
2	Lower display line - example: storing time
3	Function keys
4	Status display indicators on the current function of the meter: Example: **RCL** = read out memory
5	Additional information Example: h:min = unit of the indication in the second line
6	Sensor symbol
7	Status display of stored measuring data Example: Tref25, nLF

Touch screen

The touch screen contains 8 touch sensitive tactile areas that start different functions when being pressed, depending on the operating situation.
The function of the keys is connected to the display indication in this area.

Touch screen operation

In this operating manual, keys are indicated by angle brackets **<..>**.
The touch screen symbol (example **<** **>**) shows you which area you have to press. Function keys are indicated by the relevant name or symbol.
The keys can have different functions with a long and short keystroke.
In this operating manual, the key symbol (e. g. **< ESC >**) generally means a short keystroke (shorter than 1 sec). A long keystroke (approx. 1 sec) is indicated by a line after the key symbol (e. g. **< ESC ▬ >**).

Operating examples:

Symbol	Meaning
< **>**	Press any spot on the display shortly. (Example: switch on the meter)
< **▬>**	Press any key in the upper display line for a longer time (approx. 1 sec). (Example: switch over the measured value display between conductivity, specific resistance etc.)
< CAL >	Press "CAL" shortly.
<⊘>	Press the "Clock symbol" shortly.
< ESC ▬ >	Press "ESC" for a longer time (approx. 1 sec). (Example: switch off the meter)
<Λ> or **<V>**	Press **<Λ>** or **<V>** shortly. Increase or reduce the displayed value by 1.
<Λ▬> or **<V▬>**	Press **<Λ>** or **<V>** for a longer time (approx. 1 sec). Increase or reduce the displayed value consecutively.

Note
Any keystroke is confirmed by an acoustic signal.
With a short keystroke you hear a short sound, after a long keystroke you hear a longer sound.

4.2 Switching on the meter

1	Switch on the meter with **<** **>**. After a short display test, a measured value is displayed. If no sensor module is connected, the *Err4* error message appears on the display (see chapter 6 WHAT TO DO IF...).

Note
The meter has an energy saving feature to avoid unnecessary battery depletion. The energy saving feature switches the meter off if no entry is made during the specified switch off-interval (see section 4.11).

4.3 Measuring

4.3.1 General information

Depth of immersion

For measurements in a measuring solution we recommend an immersion depth of approx. 36 mm for optimum and reproducible measurement results. The sensor module may only be submersed in a measuring solution up to below the coupling ring. If it is submersed deeper, liquid can penetrate the meter and damage it.

AutoRead (drift control)

The AutoRead function (drift control) checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of measured values. The AutoRead function is automatically active. The unit of the measured value flashes on the display as long as the stability criterion is not met. A stable measured value is achieved when the unit of the measured parameter no longer flashes.

Temperature compensation

The meter has a linear and nonlinear temperature compensation (see section 4.5 SETTING THE TEMPERATURE COMPENSATION). The temperature compensation can be switched off.

Reference temperature Tref

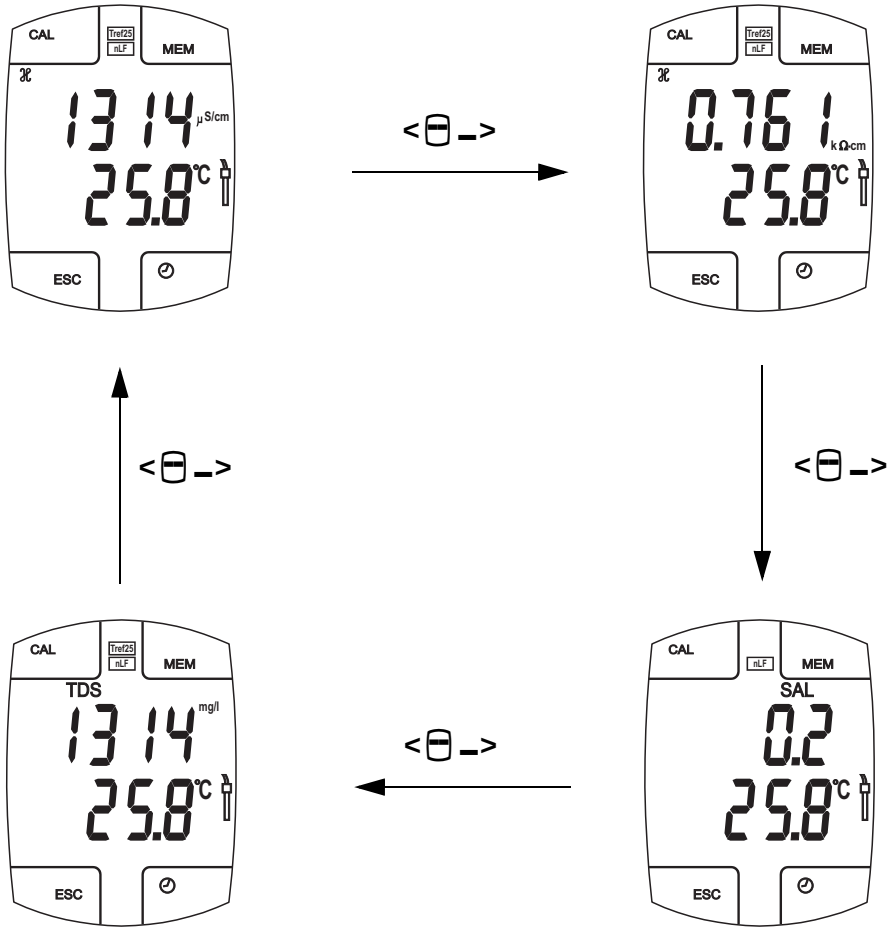
The reference temperature (Tref) can be switched over between 20 °C and 25 °C. It appears on the display as *Tref20* or *Tref25*. To switch over the reference temperature, see section 4.6 SETTING THE REFERENCE TEMPERATURE.

Caution
Special measuring media (e.g. strong acids and lyes, organic solvents) or too high temperatures shorten the lifetime considerably or cause damage. The warranty does not cover damage caused by such measuring media and mechanical damage.

4.3.2 Carrying out measurements

1	Make sure a valid calibration exists for the measuring system (see section 4.4.2), or that the cell constant is correctly adjusted (see section 4.4.2).
2	Immerse the sensor module in the test sample. The display shows the main measured value (conductivity, specific resistance, salinity or TDS) and the measured temperature value. The unit of the measured value display flashes (AutoRead) as long as the measured value is not stable.
3	If necessary, switch over the display between conductivity, specific resistance, salinity and TDS with **<** ⊖ **>** [**<**Measured value**>**].

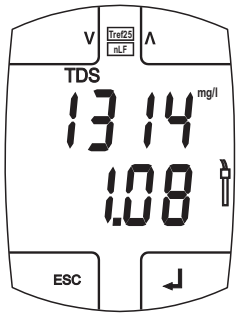
Setting menu, measured parameter



4	Wait for a stable measured value. As soon as the measured value is stable, the unit of the measured parameter no longer flashes.

4.3.3 Setting the TDS factor

1	If necessary, press **<⊟ ▁>** [**<**Measured value**>**] repeatedly until the measured parameter TDS is displayed (see section 4.3.2).
2	Using **<⊟ >** [**<**Temperature**>**], display the adjusted TDS factor.
3	Using **<⊟ >** [**<**TDS factor**>**], select the TDS factor. The TDS factor flashes.



4	Using **<Λ>** or **<V>**, set the TDS factor (0.40 ... 1.00). The measured TDS value display is always updated while doing so.
5	Confirm the TDS factor with **<↵>**. The TDS factor no longer flashes.
6	Using **<⊟ >** [**<**TDS factor**>**], display the measured temperature value.

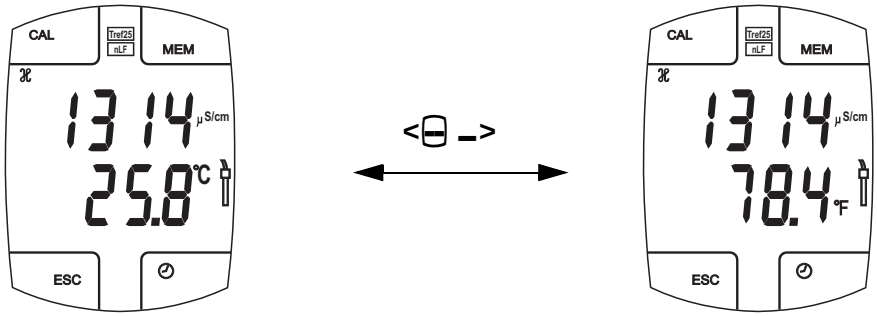
4.3.4 Switching over the temperature unit

For reproducible conductivity measurements, it is essential to measure the temperature of the test sample. A temperature sensor is integrated in the sensor module.

You can switch the temperature display from °C to °F:

1	Toggle the display between °C and °F with **<⊟ –>** [**<**Temperature**>**].

Setting menu of the temperature unit



4.4 Adjusting/calibrating the cell constant

Why adjust/ calibrate the cell constant?

The actual cell constant of the sensor module can slightly differ from the nominal value of the cell constant.
Depending on the required measuring accuracy, you can measure with the nominal value of the cell constant that was set in the factory (see chapter 7 TECHNICAL DATA), or adjust the value of the cell constant.

You have the following options to adjust the value of the cell constant:

- (Determining and) Adjusting the cell constant manually
  The cell constant can be adjusted in the following ranges:
  - TetraCon V 0.450 ... 0.500 cm^{-1}
  - LR01 V 0.090 ... 0.110 cm^{-1}
- Calibrating the cell constant (automatic determination)
  This method can be selected for the TetraCon V sensor module (range that can be calibrated: 0.450 ... 0.500 cm^{-1}).
  Calibration is carried out in the 0.01 mol/l KCl control standard.

Cell constants outside the above mentioned ranges cannot be adjusted or calibrated.

Both the calibration data and the value of the manually adjusted cell constant are stored in the sensor module and can be selected and used for measurements.

Note
Aging slightly changes the characteristics of the cell, 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.

When to adjust/ calibrate the cell constant?

- If the measuring accuracy with the nominal value of the cell constant that was set in the factory does not suffice (see chapter 7 TECHNICAL DATA)
- After the calibration interval has expired (when the sensor symbol flashes)

Calibration interval

The interval for the determination of the cell constant is set to 180 days in the factory. You can select the interval in the range of 1 ... 999 days (see section 4.8).
You should calibrate at regular intervals (we recommend: every 6 months).

AutoRead (drift control)

The calibration procedure automatically activates the *AutoRead* function. The display of the unit flashes during the AutoRead measurement. The current AutoRead measurement can be terminated at any time (without accepting the current value) by pressing **< ESC >**.

Calibration data

The calibration data is stored in the sensor module. It contains the value of the determined cell constant. The value of the determined cell constant is displayed after a valid calibration and is accessible any time.

Calibration status

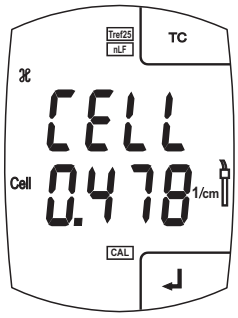
The meter has a simple display of the calibration status.

Display indication	Calibration status
	A valid calibration is available.
 flashes	Prompt to calibrate or adjust the cell constant. It is still possible to measure. Causes: – The calibration interval has expired – The cell constant that can be calibrated was reset to the delivery condition (e. g. after a reset) – The last calibration was erroneous (error message, *Err3*)
No sensor symbol on the display.	The meter measures with an adjusted cell constant

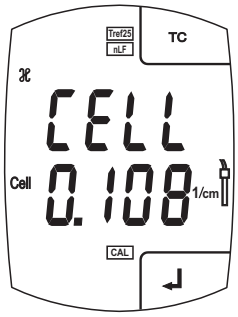
4.4.1 Adjusting the cell constant manually

You can adjust the cell constant manually as follows:

1	Open the setting menu for the cell constant with **< CAL >**. The display shows the setting last selected.
2	If necessary, press **<** ⊖ **>** repeatedly until the *CELL* display appears.

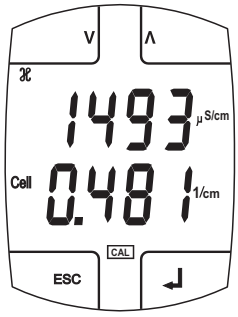


Example of the sensor module, TetraCon V

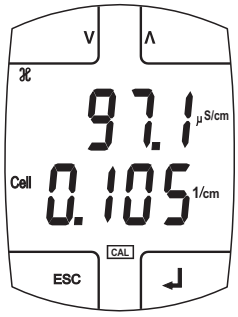


Example of the sensor module, LR01 V

3	Confirm the displayed cell constant with ↵ . The displayed cell constant is used immediately. or Select the cell constant setting with <⊖ ▂>. The cell constant flashes.



Example of the sensor module, TetraCon V



Example of the sensor module, LR01 V

4	Adjust the cell constant with **<Λ>** or **<V>**.

Note

You can terminate the setting of the cell constant with **< ESC >**.
The data of the terminated setting is not used.
The cell constant adjusted before remains active.

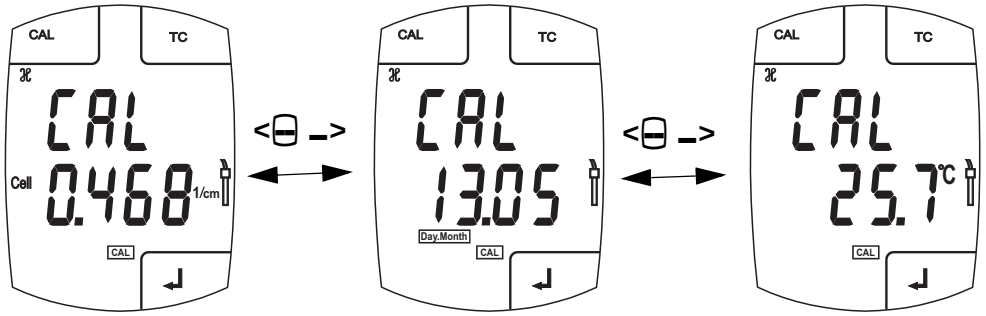
5	Confirm the adjusted cell constant with ↵ . The cell constant no longer flashes.
6	Return to the measuring mode with **<↵>**. The adjusted cell constant is used.

4.4.2 Determining the cell constant (calibration in the control standard)

Note
This method of automatically determining the cell constant by calibration in the 0.01 mol/l KCL control standard solution can only be used for measuring cells with cell constants in the range 0.450 ... 0.500 cm $^{-1}$ (sensor module TetraCon V).

This is how you can determine the cell constant:

1	Open the setting menu for the cell constant with **< CAL >**. The display shows the setting last selected.
2	If necessary, press **<⊖ –>** repeatedly until the *CAL* display appears.



3	If necessary, switch between the cell constant last calibrated, the date of the calibration and the calibration temperature with **<⊖ >**.

Note
You can return to the measuring mode with **<↵>**.
The displayed calibrated cell constant is used immediately.

4	To calibrate: Immerse the sensor module in the control standard solution.
5	Start the measurement with **< CAL >**. The calibrated cell constant is displayed. The unit of the measured value display flashes (AutoRead) as long as the measured value is not stable.

Note
You can terminate the calibration with **< ESC >**.
The data of the terminated calibration is not used.

6	Wait until the measured value is stable. The unit of the measured value display stops flashing.
7	Return to the measuring mode with **<↵>**. The calibrated cell constant is used.

Note
If no valid calibration can be accomplished, the *Err3* error message appears on the display. Measuring is not possible in this condition. Possible causes and actions for error elimination can be found in chapter 6 WHAT TO DO IF....

4.5 Setting the temperature compensation

The calculation of the temperature compensation is based on the preset reference temperature, *Tref20* or *Tref25* (see section 4.6 SETTING THE REFERENCE TEMPERATURE).

You can select one of the following temperature compensation methods:

- **Nonlinear temperature compensation (*nLF*)**
- **Linear temperature compensation (*Lin*)** with selectable coefficients of 0.001 ... 3.000 %/K
- **No temperature compensation (- - - -)**

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

Application tips

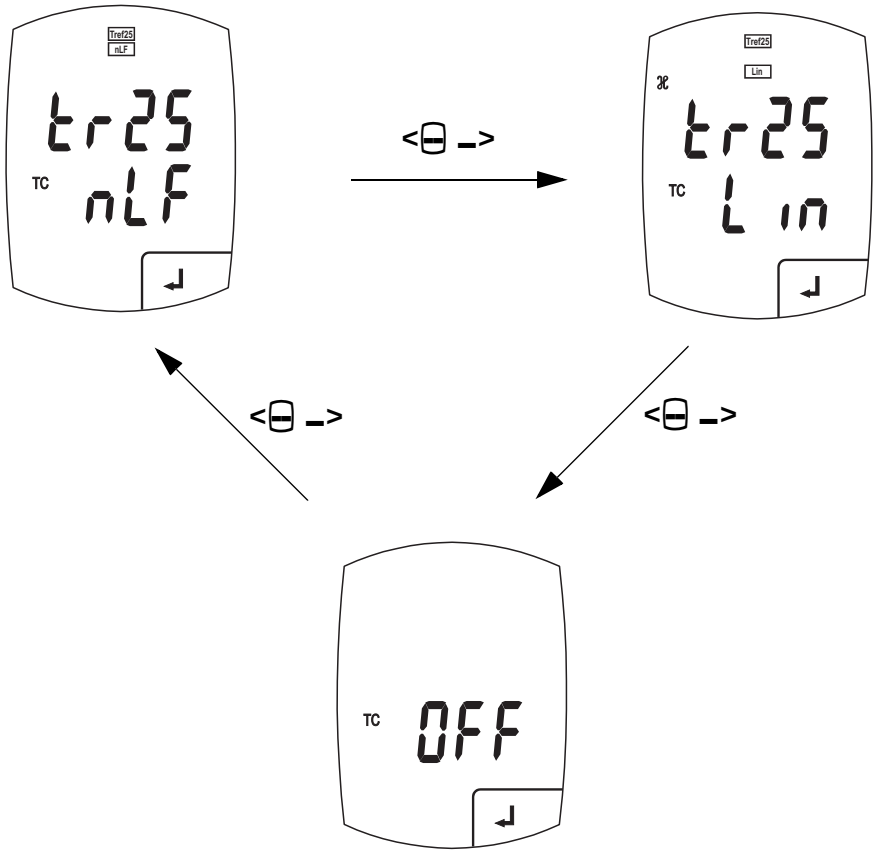
Measuring solution	Temperature compensation (TC)	Display indicator
Natural water (ground water, surface water and drinking water)	nLF according to ISO 7888, EN 27888(*)	nLF
Ultrapure water	nLF according to ISO 7888, EN 27888(*)	nLF
Other aqueous solutions	Set linear temperature coefficient 0.001 ... 3.000 %/K	Lin
Salinity (seawater)	Automatic nLF according to IOT	Sal, nLF

(*) Corresponds to DEV C8

4.5.1 Selecting the temperature compensation

1	Open the setting menu for the cell constant with **<CAL>**. The display shows the setting last selected.
2	Open the setting menu for the temperature compensation with **<TC>**. The display shows the setting last selected.
3	If necessary, press **<⊖ ▬>** repeatedly until the *nLF, Lin* or *OFF* display appears. – *nLF* = nonlinear temperature compensation – *Lin* = linear temperature compensation – *OFF* = temperature compensation switched off

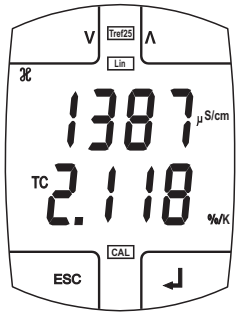
Setting menu for the temperature compensation



4	– Confirm the setting with **<↵>**. in the *nLF* menu --> back to the measuring mode – in the *Lin* menu --> the menu for setting the temperature coefficient opens up (see section 4.5.2) – in the *OFF* menu --> back to the measuring mode The displayed setting is used immediately.

4.5.2 Setting the linear temperature coefficient

1	Select the linear temperature compensation (*Lin* menu) (see section 4.5.1).
2	Open the setting of the linear temperature coefficient with **<⊟>**.



3	Set the temperature coefficient with **<Λ>** or **<V>**.

Note
You can terminate the setting of the temperature coefficient with **< ESC >**.
The data of the terminated setting is not used.
The temperature coefficient set before remains active.

4	Confirm the adjusted value with **<↵>**.
5	Return to the measuring mode with **<↵>**. The adjusted temperature coefficient is used.

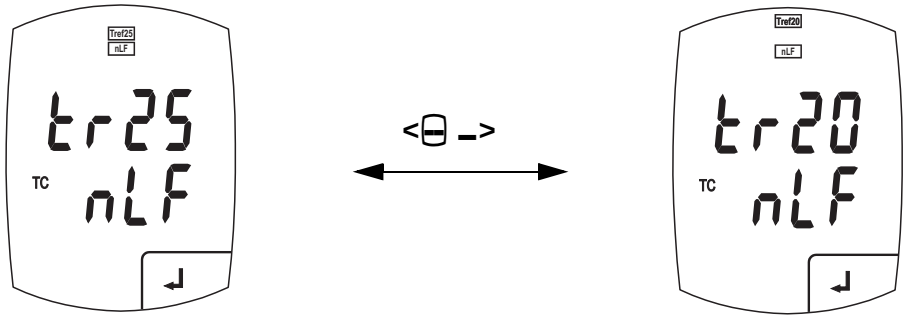
4.6 Setting the reference temperature

The setting is only effective if the linear or nonlinear temperature compensation is switched on.

You can set the reference temperature as follows:

1	Open the setting menu for the cell constant with **<CAL>**. The display shows the setting last selected.
2	Open the setting menu for the temperature compensation with **<TC>**. The display shows the setting last selected.
3	If necessary, select the *nLF* or *Lin* temperature compensation with **<⊖ ▬>**.The display shows the reference temperature set last.

Setting menu of the reference temperature

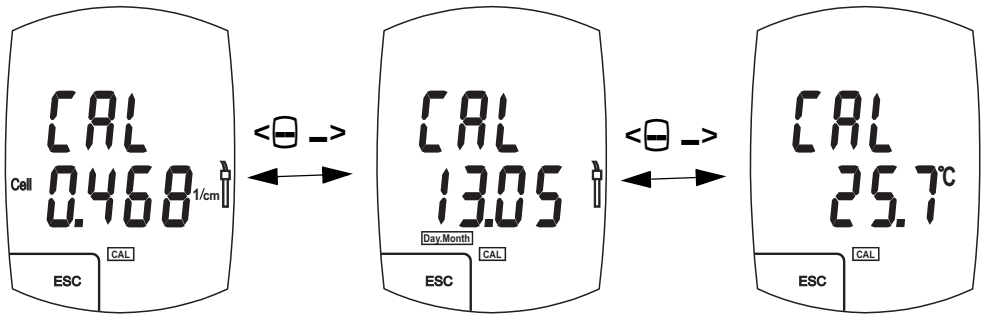


4	Using **<⊖ ▬>**, switch between *tr20* and *tr25*. – *tr20* = reference temperature 20 °C – *tr25* = reference temperature 25 °C The adjusted reference temperature is used.
5	Confirm the setting with **<↵>**. – in the *nLF* menu --> back to the measuring mode – in the *Lin* menu --> the menu for setting the temperature coefficient opens up (see section 4.5.2)

4.7 Calibration data

The calibrated cell constant is displayed after calibration (see section 4.4.2) and is accessible any time.

1	Switch on the meter with **<** ▯ **>**. The display test is displayed.
2	During the display test: Display the calibrated cell constant with **< CAL >**.



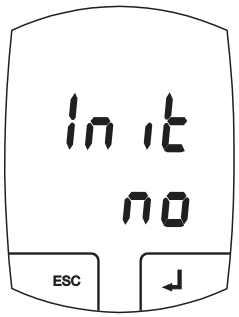
3	If necessary, switch between the cell constant last calibrated, the date of the calibration and the calibration temperature with **<▭ –>**.

4.8 Setting the calibration interval

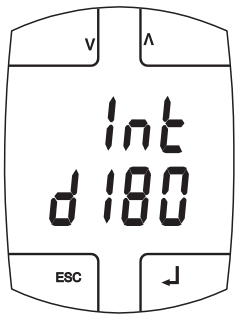
The calibration interval determines how many days after the last calibration the instrument should remind you to recalibrate.

The sensor symbol on the display flashes when the calibration interval has expired.

1	Open the *Init* initialization menu with **< CAL ▂ >**.



2	Press **<↵>** to confirm *NO* for the initialization. The setting of the calibration interval is displayed. The display flashes.



3	Set the calibration interval in days (d) with **<Λ>** and **<V>**.
4	Confirm the setting with **<↵>**.
5	Switch to the measuring mode with **<↵>**.

4.9 Saving

The VARIO Cond meter has a data memory. Up to 50 measurement datasets can be stored in it.

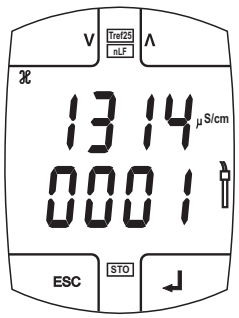
A dataset consists of:

- Main measured value (conductivity, specific resistance, salinity or TDS)
- Measured temperature value
- Time and date
- ID number (0000 - 9999)

4.9.1 Saving measured data

You can save measured data as follows:

1	Open the save menu with **< MEM >**. The memory number of the next free memory location is displayed under the current measured value. The STO status indicator appears.
2	Switch to the display of the ID number with **<↵>**. The ID number that was last entered appears on the display.
3	If necessary, edit the four-digit ID number with **<⌫>** and **<⌫>** [**<**ID number**>**].



4	Using **<Λ>** and **<V>**, enter the required ID number (0 ... 9999). The selected display flashes.
5	Confirm the ID number with **<↵>**.
6	Save the measurement dataset with **<↵>**. or Cancel the storing procedure without storing by pressing **< ESC >**.

If all storage locations are occupied, the StoFull message appears. You have the following options:

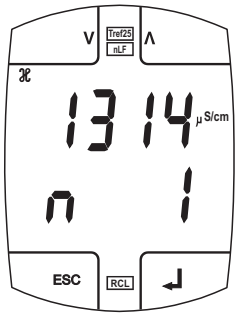
Save the current measured value. The oldest measured value (storage location 1) will be overwritten by this	Press **<↵>**
Return to the measuring mode without saving	Press **< ESC >**
Erase the entire memory	See section 4.9.3

4.9.2 Displaying measured data from the memory

Stored measurement datasets always have the main measured value in the upper display line and a variable display of further elements of the measurement dataset in the lower line.

Display stored datasets as follows:

1	Display the memory with **< MEM ▁>**. The RCL status indicator appears on the display. The measurement dataset that was saved last is displayed.
2	Scroll through the stored datasets with **<Λ>** and **<V>**.
3	If necessary, display further elements of the dataset (ID number, date, time, temperature) with **<⊖ ▁>** [element of the measurement dataset]. When scrolling further, this element is displayed in the second line together with the measured value.



4	Scroll through the stored datasets with **<Λ> <V>**.

5	If necessary, display further elements of the dataset (ID number, date, time, temperature) with **<⊖ ▂>** [element of the measurement dataset].
6	Switch to the measuring mode with **< ESC >**.

4.9.3 Erasing measured data from the memory

To erase all datasets proceed as follows:

1	Display the memory with **< MEM ▂>**. The RCL status indicator appears on the display. The measured value that was saved last is displayed.
2	Erase the entire memory with **< CLR >**. A security prompt appears.
3	Confirm the deletion with **<↵>**. After the deletion, *NO DATA* appears on the display.
4	Switch to the measuring mode with **< ESC >**.

4.10 Clock

The meter has a clock.
When saving measured values and calibrating, the date and current time are automatically saved as well.

The clock has the following additional functions:

- Alarm function (see section 4.10.2).
- Stopwatch (see section 4.10.3) and
- Timer (see section 4.10.4).

Note
The automatic switch-off (section 4.11) is not activated as long as the clock is indicated on the display.

4.10.1 Displaying and setting the date and time

The correct setting of the date and time is important for the following functions and displays:

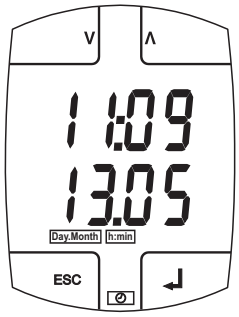
- Current date and time
- Calibration date
- Alarm function
- Identification of stored measured values.

Therefore, check the time regularly.

Note
The date and time are reset to 01.01.2004, 00:00 hours with a battery change. Set the clock after each battery change.

Setting the date and time

1	Switch on the meter with **<** **>**. After a short display test, a measured value is displayed.
2	Press **<** **>** to indicate the time and date on the display. The status indicator appears.
3	Select the hours or minutes with **<** **>** or **<** **>** [**<**Hours**>** or **<**Minutes**>**]. The h:min symbol flashes.



4	Set the time with **<V>** and **<Λ>**.
5	Select the [**<**Day**>** or **<**Month**>**] with **<** ⊟ **>** or **<** ⊟ **>.** The Day.Month symbol flashes.
6	Set the date with **<V>** and **<Λ>**.
7	Confirm the setting with **<** ↵ **>**. The year is displayed.
8	Set the year with **<V>** and **<Λ>**.
9	Confirm the setting with **<** ↵ **>**. The time and date are displayed again.
10	Switch to the measured value display with **< ESC >**. or Set the alarm time (see section 4.10.2).

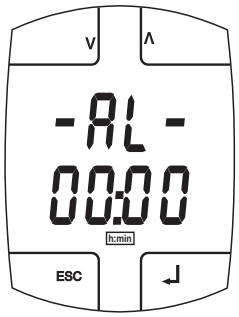
4.10.2 Alarm function

With the alarm function you set a point of time (alarm time) at which an alarm signal should sound. Prerequisite is the correct setting of the time (see section 4.10.1).

The alarm signal also sounds when the meter is switched off.

Setting the alarm time

1	Switch on the meter with **<** **>**. After a short display test, a measured value is displayed.
2	Press **<** **>** to indicate the time and date on the display. The status indicator appears.
3	Indicate the alarm time with **<** **>**. The alarm time appears on the display.
4	Select the hours or minutes with **<** **>** or **<** **>** [**<**Hours**>** or **<**Minutes**>**]. The selected display flashes.



5	Set the alarm time with **<V>** and **<Λ>**.
6	Confirm with **<** **>**. The alarm time is set.

Switching on the alarm function

7	Switch to the date and time display with **<↵>**. The alarm function is switched on. The ⊘ status indicator flashes. or Switch to the date and time display with **< ESC >**. The alarm time is stored. The alarm function is switched off.
8	When the alarm time is due and the alarm function is switched on, an alarm signal can be heard for one minute and the measured value display flashes. Switch off the alarm signal with **<** 🗑 **>**.
9	Switch to the date and time display with **<↵>**. The alarm function is switched off.

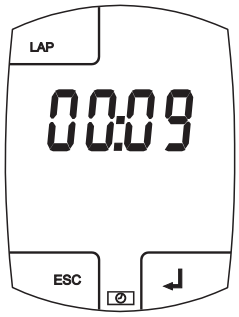
Switching off the alarm function

1	Display the alarm time (see above).
2	Switch off the alarm function with **< ESC >**. The display shows the date and time. The alarm function is switched off.

4.10.3 Stopwatch

With the stopwatch, you measure time periods of up to 59:59 (minutes:seconds). In the case of longer periods the stopwatch starts counting at 00:00 again.

1	Display the stopwatch with **<⊘▁>**. The ⊘ status indicator appears. The stopwatch is on 00:00.
2	Start the stopwatch with **<↵>**. The stopwatch starts counting the seconds.

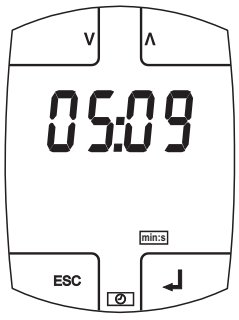


3	Display the current time as an intermediate time with **< LAP >**. The intermediate time is displayed under the running stopwatch.
4	Stop the stopwatch with **<↵>**.
5	Let it continue with **<↵>**. or Reset the stopwatch to 00:00 with **< RESET >**. or Terminate the stopwatch and switch to the measuring mode display with **< ESC >**.

4.10.4 Timer

The timer function can count down the seconds of a specified time interval (timer intervall) of maximum 59:59 (minutes:seconds). When the specified timer interval has expired, an alarm signal sounds for one minute and the display flashes.

1	Display the stopwatch with **<⏲▬>**. The ⏲ status indicator appears. The stopwatch is on 00:00.
2	Select the minutes or seconds with **<▭▬>** or **<▭▬>** [**<**Minutes**>** or **<**Seconds**>**]. The selected display flashes.



3	Set the timer interval (minutes:seconds) with **<V>** and **<Λ>**. The stopwatch has been converted to a timer.
4	Confirm the setting with **<↵>**.
5	Start the timer with **<↵>**.
6	If necessary, display the remaining time as an intermediate time with **< LAP >**.

7	If necessary, stop the timer before the time has expired with **<↵>** and make it continue with **<↵>**.
8	As soon as the time has expired the alarm signal sounds. Switch off the alarm signal with **<** ▤ **>**. The timer goes on counting with a negative sign.
9	Stop the timer with **<↵>**.

Note
If the timer has been stopped you can

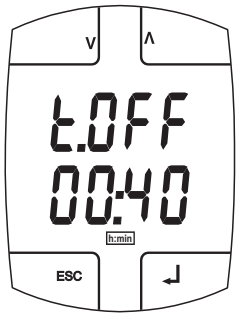
- Reset the timer to the adjusted timer interval with **< RESET >**.
- Terminate the timer and switch to the measured value display with **< ESC >**.

4.11 Switch-off interval

The automatic switch-off function switches off the meter automatically if no entry is made for a specified time (switch-off interval). This saves the battery of the meter.

You can specify the switch-off interval yourself. The switch-off interval is from 10 minutes minimum to 24 hours maximum.

1	Switch on the meter with **<** ▤ **>**. The display test is displayed.
2	During the display test (approx. 2 sec.): Display the switch-off interval with **< MEM >**.



3	Select a switch-off interval with **<V>** and **<Λ>**.
4	Confirm the setting with **<↵>**. The display switches to the measured value display. The automatic switch-off function switches off the meter if no entry is made during the switch-off interval.

4.12 Reset

The following parameters are stored in the sensor module. The reset function resets them to the delivery condition.

Sensor module, TetraCon V

Parameter	Adjustable values	Delivery condition
Measuring mode	χ , Spec. resistance, Sal, TDS	χ , with adjusted cell constant
Cell constant, to be calibrated	0.450 ... 0.500	0.475
Cell constant, to be adjusted	0.450 ... 0.500	0.475
Temperature compensation	nLF, Lin, Off	nLF
linear TC	0.001 ... 3.000 %/K	2.000 %/K
Tref	20 °C, 25 °C	25 °C

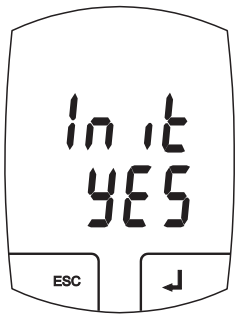
Sensor module, LR01 V

Parameter	Adjustable values	Delivery condition
Measuring mode	χ , Spec. resistance, Sal, TDS	χ , with adjusted cell constant
Cell constant, to be adjusted	0.090 ... 0.110	0.100
Temperature compensation	nLF, Lin, Off	nLF
linear TC	0.001 ... 3.000 %/K	2.000 %/K
Tref	20 °C, 25 °C	25 °C

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

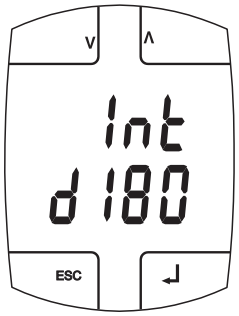
Resetting the measuring parameters

1	Start the *INIT* initialization menu with **< CAL ▬ >**.
2	For initialization, select *YES* with **<⊖ >**.



3	Confirm with **<↵>**. The reset is performed. The measuring instrument switches to the setting of the calibration interval (see section 4.8). The display flashes.

Setting the calibration interval



4	Terminate the setting with **< ESC >**. or Set the calibration interval in days (d) with **<Λ>** and **<V>**.
5	Confirm the setting with **<↵>**.
6	Switch to the measuring mode with **<↵>**.

5 Maintenance, cleaning, disposal

5.1 Maintenance

The meter is almost maintenance-free.
The only maintenance activity is exchanging the battery when it is depleted (*LoBat* display indicator).

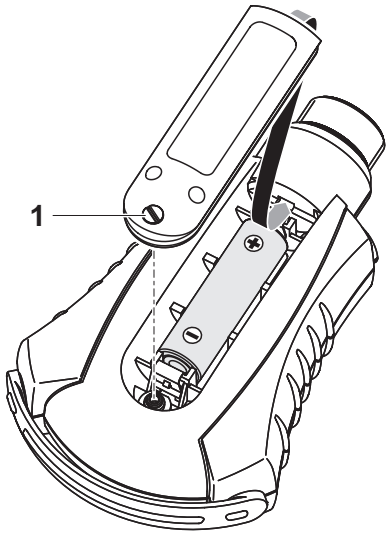
5.2 Battery exchange

The *LoBat* display indicator indicates that the battery should be changed. The battery is then largely depleted.

Stored calibration data and measuring data are retained when the battery is exchanged.

Caution
Only use leakproof alkaline manganese batteries.

Replacing the battery



1	Unscrew the screw (1) on the back of the meter and remove the lid of the battery compartment by pulling at the screw.
2	Remove the depleted battery from the battery compartment.

3	Place the new battery (type Mignon AA) in the battery compartment. Make sure that the poles of the battery are the right way round. The ± signs on the battery must correspond to the ± signs in the battery compartment.
4	Close the battery compartment.
5	After the battery exchange the meter switches itself on automatically. The display to set the time is displayed (see also section 4.10.1).

5.3 Cleaning

Occasionally wipe the outside of the meter with a damp, soft cloth.

Caution

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.

Cleaning the touch screen

Activate the cleaning mode so the instrument will not interpret the contact with the touch screen as entries.

1	Switch the meter off with **< ESC ▁ >**.
2	Switch the meter on with **< ▯ ▁ >**. *CLR PAD* is displayed. The cleaning mode is active. Short touches do not start any functions.
3	Clean the touch screen.
4	Switch to the measuring mode with **< ▯ ▁ >**.

Cleaning the sensor module

We recommend to clean the sensor module thoroughly, especially before measuring low conductivity values. Before measuring, thoroughly rinse the sensor with deionized water.

Contamination	Cleaning agent	Reaction time at room temperature
Water-soluble substances	Deionized water	Any
Fats and oils	Warm water and household washing-up liquid	Any
Heavy contamination	Methylated spirits	Max. 5 minutes
Lime and hydroxide coatings	Acetic acid (10 %)	Any

5.4 Transport

Activate the cleaning mode. Thus, the instrument will not interpret any contact with the touch screen as an entry while being transported, e. g. in a pocket (see chapter 5.3).

5.5 Disposal

Dispose of the meter without the battery and the sensor module as electronic waste at an appropriate collection point.

6 What to do if...

Error message	Cause	Remedy
0FL, UFL	– The measured value lies outside the measuring range	
	– Sensor module defective	– Replace sensor module

Error message	Cause	Remedy
Err3	– Erroneous calibration	– Recalibrate
	– The data of the sensor module is outside the specified characteristics.	– Reset to default setting (see section 4.12)
	– Sensor module contaminated	– Clean and replace sensor module if necessary
	– Moisture in the plug connection	– Dry plug and socket
	– Calibration solution not suitable	– Check calibration solution

Error message	Cause	Remedy
Err4	No sensor module	– Connect sensor module – Check the plug connection – Switch the meter off and then on again. – Perform a processor reset (see section 6.1) – Replace sensor module

Error message	Cause	Remedy
Err5	Sensor module defective or Wrong sensor module	– Check the plug connection – Switch the meter off and then on again. – Perform a processor reset (see section 6.1) – Replace sensor module

No stable measured value

Cause	Remedy
– Sensor module contaminated	– Clean sensor module
– Temperature not stable	– Adjust temperature if necessary
– Conductivity too low	– Use suitable sensor module
– Organic liquids	– Use suitable measuring system

Indication, LoBat

Cause	Remedy
– Battery almost empty	– Exchange the battery (see section 5.2)

Meter does not react to keystroke

Cause	Remedy
– Operating condition undefined or EMC load unallowed	– Perform a processor reset (see section 6.1)

Sensor symbol flashes

Cause	Remedy
– Calibration interval expired	– Recalibrate the measuring system

Message, StoFull

Cause	Remedy
– All memory locations are full	– Clear the memory (see section 4.9.3)

6.1 Processor reset:

The processor reset is a simple action that can be helpful in the case of error messages or error modes.

1	Press **<** ⟲ **>** and **<** ⟲ **>** at the same time and release them again. Stored data and calibration values are retained.

7 Technical data

7.1 Measuring instrument

Dimensions approx. 140 x 80 x 33 mm (without sensor module)

Weight approx. 115 g (without sensor module, without battery)

Mechanical structure

Type of protection	IP 65 (hose-proof)

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

Battery	1 x 1.5 V, type Mignon/AA
Battery life time	Maximum approx. 500 operating hours

Guidelines and norms used

EMC	EC guideline 89/336/EEC EN 61326-A1:1998
Instrument safety	EC guideline 73/23/EEC EN 61010-1 A2:1995
Climatic class	VDI/VDE 3540
IP protection	EN 60529:1991

FCC Class A Equipment Statement

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

Measuring ranges and resolution

$\mathcal{X}$ [µS/cm]	0.00 ... 19.99 (only with sensor module, LR01 V) 0.0 ... 199.9 0 ... 1999
$\mathcal{X}$ [mS/cm]	0.00 ... 19.99 0.0 ... 199.9
Spec. resistance [kΩ*cm]	0.000 ... 1.999 0.00 ... 19.99 0.0 ... 199.9 0 ... 1999
Spec. resistance [MΩ*cm]	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 between 0.40 ... 1.00
T [°C] T [°F]	– 5.0 ... + 105.0 23.0 ... + 212.0

Accuracy (± 1 digit)

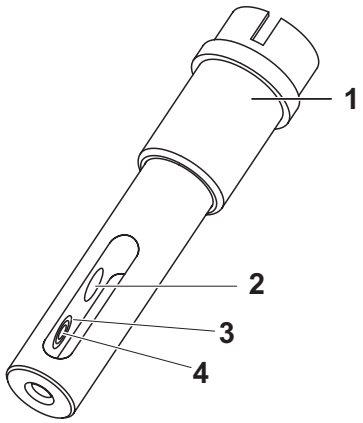
$\mathcal{X}$, Specific resistance	No compensation: Accuracy ± 0.5 % Nonlinear compensation nLF : Accuracy — Temperature of test sample ± 0.5 % — 0 °C ... 35 °C acc. to ISO 7888, EN 27888(*) ± 0,5 % — 35 °C ... 50 °C enhanced nLF function acc. to WTW measurements Linear compensation Lin Accuracy — Temperature of test sample ± 0.5 % — 10 °C ... 75 °C (The accuracy percentage always refers to the measured value.)

(*) Corresponds to DEV C8

Accuracy (± 1 digit)	SAL	Range 0.0 ... 42.0 Accuracy ± 0.1 ± 0.2 — Temperature of test sample 5 °C ... 25 °C 25 °C ... 30 °C
	TDS [mg/l]	1
	T [°C] T [°F]	± 0.1 ± 0.54
Cell constant, calibrated	C [cm^{-1}]	0.450 ... 0.500
Cell constant, adjusted	C [cm^{-1}]	0.090 ... 0.110 0.450 ... 0.500
Reference temperature	Tref	Can be set to 20 °C or 25 °C
Memory locations	50	

7.2 Sensor module

7.2.1 Sensor module TetraCon V



1	Plug head connector
2	Temperature sensor
3	Current electrode (ring)
4	Voltage electrode

Electrodes

Number of electrodes	4
Electrode material	Graphite

Material

Shaft	Epoxy, black
Connection head	PVC

Dimensions

Shaft diameter	15.3 mm
Shaft length	54 mm
Diameter of plug head connector	19 mm
Total length of sensor	91.5 mm

Depth of immersion

min.: 36 mm
max.: 75.5 mm (T < 50 °C)
max.: 54.0 mm (50 °C < T < 100 °C)

Connection technique

Vario plug head connector with integrated data storage

Cell constant

0.475 cm^{-1} ± 1.5 %

Application range

1 µS/cm .. 200 mS/cm

Temperature measurement

Thermistor type	Integrated NTC (30 kΩ / 25 °C)
Material of thermistor enclosure	Graphite
Working temperature	-5 .. +100°C
Thermistor response behavior	t_{99} < 20 sec.
Sensor accuracy	± 0.2 K

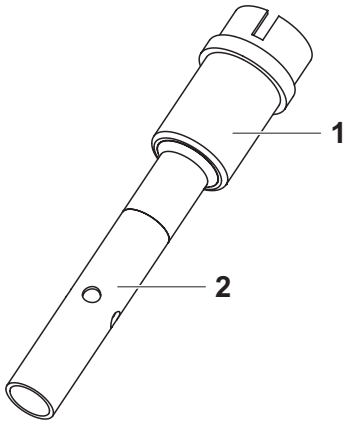
Storage medium

Air

Accessories

Designation		Order number
E/SET	Calibration set	300 572

7.2.2 Sensor module LR01 V



1	Plug head connector
2	Sensor module with temperature sensor

Electrodes

Number of electrodes	2
Electrode material	Stainless steel 1.4571

Material

Shaft	Stainless steel 1.4571
Connection head	PVC

Dimensions

Shaft diameter	12 mm
Shaft length	69 mm
Diameter of plug head connector	15 mm
Total length of sensor	106.5 mm

Depth of immersion

min.: 30 mm
max.: 90.5 mm (T < 50 °C)
max.: 69.0 mm (50 °C < T < 100 °C)

Connection technique

Vario plug head connector with integrated data storage

Cell constant

0.100 cm^{-1} ± 1.5 %

Application range

0.01 µS/cm .. 200 µS/cm

Temperature measurement

Thermistor type	Integrated NTC (30 kΩ / 25 °C)
Material of thermistor enclosure	Graphite
Working temperature	-5 .. +100°C
Thermistor response behavior	t_{99} < 20 sec.
Sensor accuracy	± 0.2 K

Storage medium

Air

Accessories

Designation		**Order number**
KS 100 µS	Calibration standard, 100 µS	300 578
KS 5 µS	Calibration standard, 5 µS	300 580
D 01/T	Flow-thru vessel	302 750

8 Lists

This chapter provides additional information and orientation aids.

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

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

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

Abbreviations

$\mathcal{X}$	Conductivity value
°C	Temperature unit, Celsius
°F	Temperature unit, Fahrenheit
AR	AutoRead (drift control)
C	Cell constant cm^{-1}
Cal	Calibration
CELL	Cell constant
E3	Error message see CHAPTER 6 WHAT TO DO IF...
Ident	ID number
Init	Initialization Resets individual basic functions to the status they had on delivery
Int	Interval
Lin	Linear temperature compensation
LoBat	Batteries almost empty (Low Battery)
nLF	Nonlinear temperature compensation
OFL	Display range exceeded (Overflow)
SAL	Salinity
TC	Temperature coefficient
TDS	Total dissolved solids
Tref 20/T20	Reference temperature 20 °C
Tref 25/T25	Reference temperature 25 °C
UFL	Value is below the display range (Underflow)

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.

AutoRead WTW name for a function to check the stability of the measured value.

Calibrating 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).

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

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 sensor module.
- 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.

Drift control See AUTOREAD.

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 medium The substance to be measured. It can be liquid or solid.

Measuring solution / test sample Designation of the sample ready to be measured. Normally, a test sample is made by processing the original sample. The test sample and original sample are identical if the test sample was not processed.

Measuring system The measuring system comprises all the devices used for measuring, e. g. meter and sensor. In addition, there is the cable and possibly an amplifier, terminal strip and armature.

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.

Reset Restoring the original condition of all settings of a measuring system.

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 or an electric conductivity that can be measured.

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

Salinity The salinity is a sum parameter especially for seawater.
It quotes the salt content.

Standard solution The standard solution is a solution where the measured value is known by definition. It is used to calibrate a measuring system.

Temperature 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.

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 and are given in mg/l.

9 Index