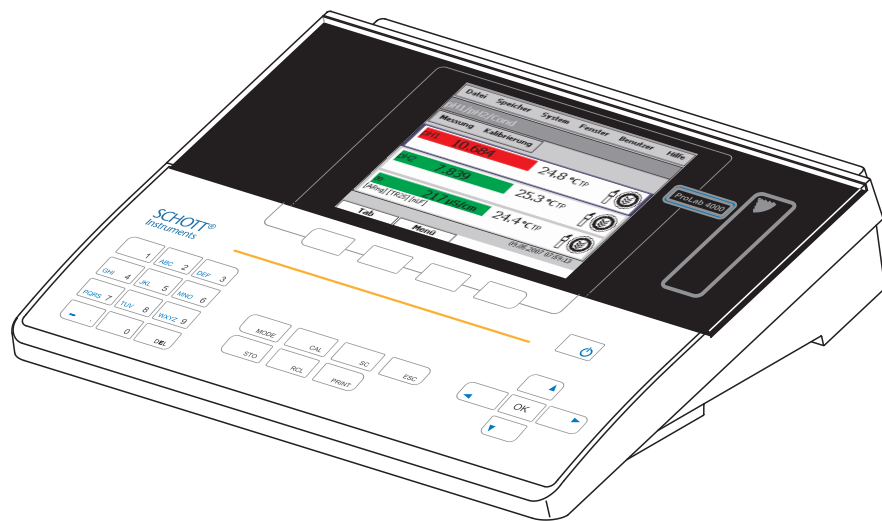


Operating manual

SCHOTT®  
Instruments

# ProLab 4000



**pH/ISE/Conductivity measuring instrument  
with automatic sensor recognition  
and electronic access control**

---

**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.

**Warranty**

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

The meter warranty covers manufacturing faults that are discovered within the warranty period.

The warranty does not cover components that are replaced during maintenance work, e. g. batteries.

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

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

**CE conformity  
Radio data transmission**

SI Analytics GmbH hereby declares that the ProLab 4000 meter is in compliance with the basic requirements and the other relevant regulations of the directive 1999/5/EC.

The EC declaration of conformity can be requested from SI Analytics GmbH.

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**KONFORMITÄTSERKLÄRUNG  
DECLARATION OF CONFORMITY  
DÉCLARATION DE CONFORMITÉ**

Wir erklären in alleiniger  
Verantwortung, dass das  
Produkt

We declare under our sole  
responsibility that the  
product

Nous déclarons sous notre  
seule responsabilité que le  
produit

**pH-/ISE-/  
Leitfähigkeits-  
Messgerät  
ProLab 4000**

**pH / ISE /  
conductivity  
measuring  
instrument  
ProLab 4000**

**Appareil de mesure  
pour pH/ISE/  
conductivité  
ProLab 4000**

auf das sich diese Erklärung  
bezieht, übereinstimmt mit  
den Angaben im Kapitel

to which this declaration  
relates is in conformity with  
the specifications in the  
chapter

auquel se réfère cette  
déclaration est conforme aux  
indications du chapitre

**Technische Daten  
pH-/ISE-/Leitfähigkeits-Messgerät ProLab 4000  
30. Oktober 2009**

**SI Analytics GmbH  
Hattenbergstr. 10  
D-55122 Mainz  
Deutschland, Germany, Allemagne**

30. Oktober, October 30, 30 octobre 2005  
AGQSF 0000-A108-01/091030



## ProLab 4000 - Contents

<b>1</b>	<b>Overview</b>	<b>11</b>
1.1	General features	11
1.2	Keypad	12
1.3	Display	14
1.4	Socket field	15
1.5	Automatic sensor recognition	16
1.5.1	ID sensors	17
1.5.2	Sensor data from ID sensors	18
1.6	Electronic access control	19
<b>2</b>	<b>Safety</b>	<b>21</b>
2.1	Authorized use	21
2.2	General safety instructions	22
<b>3</b>	<b>Commissioning</b>	<b>23</b>
3.1	Scope of delivery	23
3.2	Initial commissioning	24
3.3	Connecting the power pack	24
3.4	Switching on the ProLab 4000	25
3.5	Connecting the USB mouse	26
3.6	Connecting sensors	26
3.6.1	Connecting an ID sensor	27
3.6.2	Connecting a non ID sensor	28
3.7	Connecting optional accessories	28
3.7.1	RS232 interface (serial port)	29
3.7.2	USB-B interface ( <i>USB Device</i> )	30
3.7.3	USB-A interface ( <i>USB Host</i> )	31
<b>4</b>	<b>Operating principles</b>	<b>33</b>
4.1	Operating and display elements	33
4.2	File system	37
4.3	Entry of numerals, letters and characters	38
4.4	Navigation	40
4.4.1	Navigation in the measured value display	41
4.4.2	Navigation in menus	42
4.4.3	Navigation in dialog boxes	44
4.4.4	Navigation in the file selection dialog box	45

---

<b>5</b>	<b>Access to the meter</b>	<b>47</b>
5.1	Switch the meter on and off	47
5.2	Login as a user	47
5.3	Password for login	49
5.3.1	Changing the password	49
5.3.2	Assigning a password	49
5.3.3	Forgotten the password?	49
5.4	Lock	50
5.5	Access control and user rights	51
5.5.1	Access control	52
5.5.2	User management and assigning user rights	53
5.6	Lost your electronic key?	55
<b>6</b>	<b>System functions</b>	<b>56</b>
6.1	Overview: System settings	56
6.2	Selecting the language	58
6.3	Selecting the country	58
6.4	Setting the date and time	59
6.5	Selecting the channels for measured value display	60
6.6	Interfaces for data download	60
6.7	Temperature	61
6.7.1	Temperature unit	61
6.7.2	Temperature measurement	62
6.8	Automatic stability control	63
6.9	Color assignment	64
6.10	Reset	65
6.10.1	Resetting the sensor settings	65
6.10.2	Resetting the system settings	66
6.11	List of open windows	67
<b>7</b>	<b>pH</b>	<b>69</b>
7.1	General information	69
7.2	Measuring the pH value	70
7.2.1	Preparatory activities	70
7.2.2	Measuring	71
7.2.3	Measurement settings	73
7.3	Calibration	74
7.3.1	Carrying out a calibration procedure (example: <i>AutoCal DIN</i> )	79
7.3.2	Carrying out a calibration procedure (example: <i>VariCal</i> )	83
7.3.3	Calibration settings and calibration data	87
7.3.4	Calibration interval	88

<b>8</b>	<b>ORP voltage</b>	<b>89</b>
8.1	General information	89
8.2	Measuring the ORP	90
8.2.1	Preparatory activities	90
8.2.2	Measuring	91
8.2.3	Measuring the relative ORP	93
8.2.4	Measurement settings	96
<b>9</b>	<b>Ion concentration</b>	<b>97</b>
9.1	General information	97
9.2	Measuring the ion concentration	98
9.2.1	Preparatory activities	98
9.2.2	Measuring	99
9.2.3	Measurement settings	101
9.3	Calibration	103
9.3.1	Carrying out calibration	106
9.3.2	Calibration data	110
9.4	<i>Blank value correction</i>	111
9.5	<i>Reference measurement</i>	112
9.6	Measuring with increment procedure (methods)	113
9.6.1	Selecting the measuring method	113
9.6.2	<i>Standard addition</i>	114
9.6.3	<i>Double standard addition</i>	116
9.6.4	<i>Standard subtraction</i>	119
9.6.5	<i>Sample addition</i>	122
9.6.6	<i>Sample subtraction</i>	125
9.6.7	<i>Blank value addition</i> (Standard addition with blank value correction)	128
<b>10</b>	<b>Conductivity</b>	<b>131</b>
10.1	General information	131
10.2	Measuring the conductivity	131
10.2.1	Preparatory activities	131
10.2.2	Measuring	132
10.2.3	Measurement settings	134
10.2.4	Determining/setting the temperature compensation	136
10.2.5	Selecting the nonlinear temperature compensation <i>TC nLF</i>	139
10.2.6	Selecting the linear temperature compensation <i>TC Lin...</i>	139
10.2.7	Selecting and adjusting the nonlinear temperature compensation <i>TC nLin1</i>	140
10.2.8	Selecting and determining the nonlinear temperature compensation <i>TC nLin2</i>	142
10.2.9	Selecting and determining the nonlinear temperature compensation <i>TC nLin3</i>	144

10.2.10	Selecting and determining the nonlinear temperature compensation <i>TC nLin4</i> . . . . .	146
10.2.11	Switching off the temperature compensation (TC off) . . . . .	148
10.3	Determining the cell constant (calibration in control standard) . . . . .	149
10.3.1	Determining the cell constant (calibration) . . . . .	151
10.3.2	Calibration settings and calibration data. . . . .	152
<b>11</b>	<b>Memory . . . . .</b>	<b>153</b>
11.1	Measurement data. . . . .	153
11.1.1	Creating and selecting a file for manually stored measurement datasets . . . . .	154
11.1.2	Storing measurement datasets manually . . . . .	155
11.1.3	Automatically storing measurement datasets . . . . .	156
11.1.4	Displaying and filtering stored measurement datasets . . . . .	158
11.1.5	Erasing measurement datasets . . . . .	159
11.2	Calibration data . . . . .	160
11.2.1	Displaying stored calibration data. . . . .	160
11.2.2	Managing the calibration data. . . . .	161
11.3	Recorder data . . . . .	162
11.4	Configuration data . . . . .	162
<b>12</b>	<b>Recorder . . . . .</b>	<b>163</b>
12.1	Recording the measured value curve . . . . .	164
12.2	Recording the curve of the measured temperature value . . . . .	165
12.3	Storing recorder data. . . . .	166
12.4	Displaying stored recorder data. . . . .	167
12.5	Settings for the recorder . . . . .	168
12.5.1	Defining the recording interval . . . . .	169
12.5.2	Specifying the axes of the system of coordinates . . . . .	169
12.5.3	Defining and activating limit values. . . . .	171
12.5.4	Defining the colors for the recorder representation . . . . .	172
12.6	Changing the displayed axis intercept. . . . .	173
12.7	Displaying exact measurement data at a point (cursor) . . . . .	175
12.8	Deleting stored recorder data . . . . .	175
<b>13</b>	<b>Transmitting data . . . . .</b>	<b>177</b>
13.1	Printing current measurement data . . . . .	177
13.2	Transmitting data (to a PC or printer) . . . . .	177
13.2.1	RS232 interface . . . . .	177
13.2.2	USB-B interface ( <i>USB Device</i> ) . . . . .	178
13.2.3	USB-A interface ( <i>USB Host</i> ) . . . . .	179
13.2.4	Options for data transmission . . . . .	179

---

13.3	Data backup . . . . .	180
13.3.1	Data backup by the administrator . . . . .	180
13.3.2	Viewing backed up data . . . . .	181
<b>14</b>	<b>Configurations . . . . .</b>	<b>182</b>
14.1	Viewing a configuration . . . . .	183
14.2	Creating a new configuration . . . . .	184
14.3	Loading a configuration . . . . .	185
14.4	Deleting a configuration . . . . .	186
<b>15</b>	<b>Maintenance, cleaning, disposal . . . . .</b>	<b>187</b>
15.1	Maintenance . . . . .	187
15.2	Cleaning . . . . .	188
15.3	Disposal . . . . .	188
<b>16</b>	<b>What to do if... . . . . .</b>	<b>189</b>
16.1	pH and ORP measurement . . . . .	189
16.2	Ion selective measurement . . . . .	191
16.3	Conductivity measurement . . . . .	192
16.4	General errors . . . . .	193
<b>17</b>	<b>Technical Data . . . . .</b>	<b>195</b>
17.1	General data . . . . .	195
17.2	Measuring ranges, resolution, accuracy . . . . .	198
17.2.1	Temperature . . . . .	198
17.2.2	pH/ORP . . . . .	198
17.2.3	ISE . . . . .	199
17.2.4	Conductivity . . . . .	199
<b>18</b>	<b>Lists . . . . .</b>	<b>201</b>
	<b>Appendix . . . . .</b>	<b>211</b>
A.19	Firmware update . . . . .	211
A.20	Menus . . . . .	213
A.20.1	Main menu . . . . .	213
A.20.2	pH sensor menu . . . . .	215
A.20.3	U sensor menu . . . . .	216
A.20.4	dU sensor menu . . . . .	216
A.20.5	ISE sensor menu . . . . .	217
A.20.6	Cond sensor menu . . . . .	218



# 1 Overview

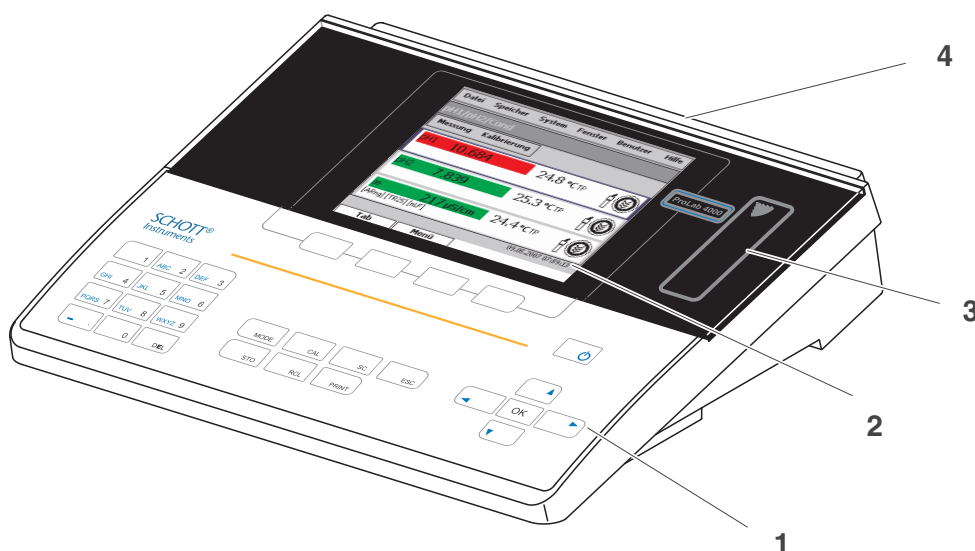
## 1.1 General features

The ProLab 4000 precision meter enables you to perform pH, ORP, conductivity and ion-selective measurements rapidly and reliably.

Das ProLab 4000 provides the maximum degree of ease of use, reliability and, above all, measuring certainty for all applications.

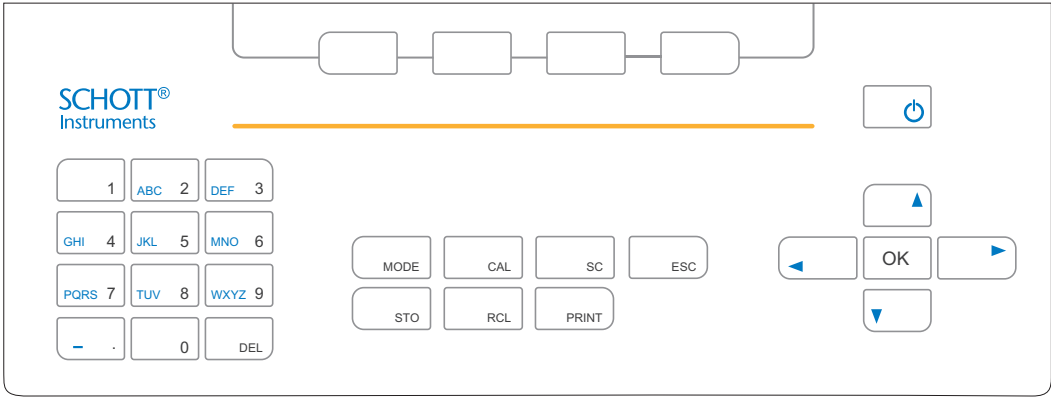
The proven calibration procedures, and stability control function (SC) and the sensor recognition function support your work with the meter.

In addition, the ProLab 4000 provides an electronic access control. Documented measurement data is thus automatically assigned to a user.



1	Keypad
2	Display
3	Reader field for electronic access control
4	Jack field

## 1.2 Keypad



**Keys with dedicated functions**

Keys with dedicated functions are labeled on the meter. In this operating manual, they are identified by the key labeling, bold letters and angle brackets <..> .






**Keys with changing functions (softkeys)**

Keys with changing functions are not labeled; the currently assigned function is shown on the display instead. In this operating manual, these keys are identified by the displayed softkey function, bold letters and angle brackets [..] .

The key symbol (e.g. <OK> or [OK]) generally means you should press a key in this operating manual.





**Key functions**

	<On/Off>	Switch the meter on/off
	<MODE>	Select measured parameter
	<CAL>	Call up calibration procedure
	<SC>	Switch on or off the stability control function manually.
	<▼>	Reduce values, Scroll Move in the menu
	<▲>	Increase values, Scroll Move in the menu
	<◀>	Reduce values, Scroll Move in the menu
	<▶>	Increase values, Scroll Move in the menu

	<b>&lt;OK&gt;</b>	Confirm entries
	<b>&lt;ESC&gt;</b>	Return to higher menu level / Cancel inputs
	<b>&lt;STO&gt;</b>	Store a measured value
	<b>&lt;RCL&gt;</b>	Open the menu for stored measured values
	<b>&lt;PRINT&gt;</b>	Print or output data to an interface (serial RS232, USB-A ( <i>USB Host</i> ) or USB-B ( <i>USB Device</i> ))

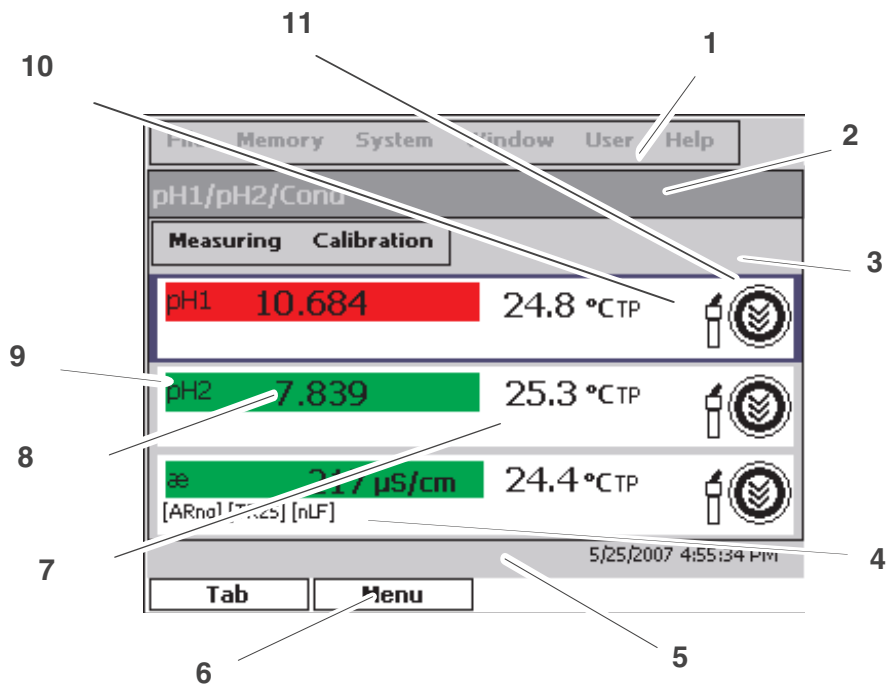
### Alphanumeric keypad

The keys of the alphanumeric keypad are used to enter numerals (<0...9>), letters (<A...Z>) and characters (<- .>). The keys of the alphanumeric keypad only have a function if the ProLab 4000 is waiting for a character to be entered, e.g. in input fields for the ID during manual storage.

	<b>&lt;0...9&gt;</b>	Press the key once. The numeral is displayed in the input field
	<b>&lt;A...Z&gt;</b>	Press the key several times if necessary until the required letter is displayed in the input field
	<b>&lt;- .&gt;</b>	Depending on the input field, the key is automatically interpreted as a minus sign or decimal point.  Numeral input field: Cursor is in front of the first digit: Minus. Cursor is behind a numeral: Decimal point
	<b>&lt;DEL&gt;</b>	Deletes the character left of the cursor

### 1.3 Display

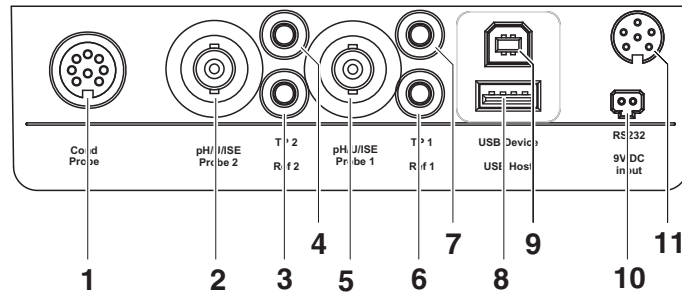
The graphic color display can display three measured parameters and the current temperature value for each measured parameter at the same time. The illumination enables to read the display even in the darkness.



**Elements:**

1	Menu line (main menu)
2	Sensor window (title bar)
3	Menu line (sensor menu)
4	Status line
5	Info line with date and time, info or action text
6	Key assignment with changing functions (softkeys)
7	Temperature display
8	Measured value (with unit)
9	Measured parameter
10	ID sensor symbol
11	CalClock

## 1.4 Socket field



### Connections:

1	Conductivity measuring cell ( <i>Cond Probe</i> )
2	pH/ISE/ORP electrode ( <i>pH/U/ISE Probe 2</i> )
3	Reference electrode ( <i>Ref 2</i> )
4	Temperature sensor ( <i>TP 2</i> )
5	pH/ISE/ORP electrode ( <i>pH/U/ISE Probe 1</i> )
6	Reference electrode ( <i>Ref 1</i> )
7	Temperature sensor ( <i>TP 1</i> )
8	USB Host interface, e.g. for <ul style="list-style-type: none"> <li>– the USB mouse,</li> <li>– a USB printer,</li> <li>– a USB hub,</li> <li>– a USB keyboard,</li> <li>– a USB storage,</li> <li>– a USB card reader or</li> <li>– other USB devices</li> </ul>
9	USB interface ( <i>USB Device</i> ), e.g. for a PC.
10	Power pack ( <i>9V/DC input</i> )
11	RS232 interface ( <i>RS232</i> )



### CAUTION

Only connect sensors to the meter that cannot return any voltages or currents that are not allowed (> SELV and > current circuit with current limiting).

Almost all sensors - in particular SI Analytics sensors - fulfill these conditions.

## 1.5 Automatic sensor recognition

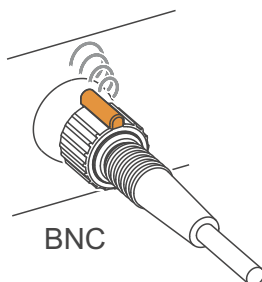
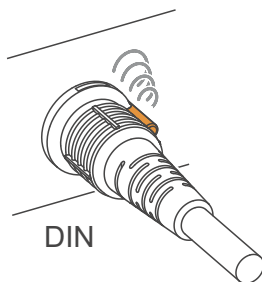
The automatic sensor recognition function enables

- to operate a sensor with different meters without recalibrating
- to operate different sensors with one meter without recalibrating
- to assign measurement data to a sensor
  - measurement datasets are always downloaded to the interface with the sensor type and sensor series number.
  - measurement datasets are always stored together with the sensor type and sensor series number.
- to assign calibration data to a sensor
  - calibration data is always downloaded to the interface with the sensor type and sensor series number.
- the automatic activation of the cell constants for conductivity sensors
- to hide menus that are not relevant for this sensor

To be able to use the automatic sensor recognition function a meter is required that supports the automatic sensor recognition (e.g. ProLab 4000), and a sensor (ID sensor) that is suitable for sensor recognition.

In every ID sensor, sensor data is stored that clearly identifies the sensor.

The sensor data is sent to the meter automatically via radio communication and used for sensor identification there.



### Note

With the ProLab 4000 you can also operate non ID sensors. Then, however, you cannot use the advantages of the sensor recognition function.

### 1.5.1 ID sensors

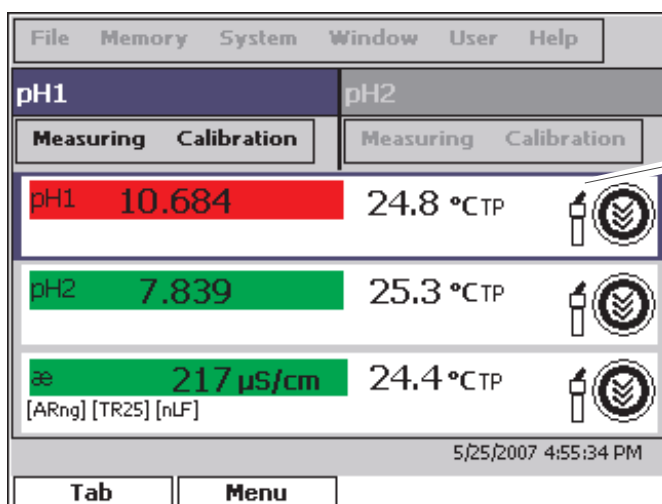
SI Analytics GmbH ID sensors support the automatic sensor recognition function. Their sensor designation has the addition "ID", e.g. Blue-Line A 161 1M-BNC-ID electrode.



#### Note

Information on available ID sensors is given on the Internet or directly by SI Analytics.

ID sensors connected to the ProLab 4000 meter can be recognized by the ID sensor symbol on the display.



ID sensor symbol

### 1.5.2 Sensor data from ID sensors

ID sensors transmit the following sensor data to the meter:

- **SENSOR ID**
  - Sensor type
  - Sensor series number
- **Calibration data**
  - Calibration date
  - User (having carried out the last calibration procedure)
  - Calibration characteristics
  - Calibration interval
  - Selected buffer set (pH electrodes only)
  - Last cell constant (conductivity measuring cell only)
- **Measurement settings (conductivity measuring cells only)**
  - Specified reference temperature
  - Adjusted temperature coefficient
  - Adjusted TDS factor

The calibration data is updated in the ID sensor after each calibration procedure. A message is displayed while data is updated in the sensor.

**Note**

While data is updated in the sensor, the sensor must not be disconnected because otherwise the calibration data will not be completely transmitted. The sensor will then have no valid calibration.

**Note**

If non-ID sensors are used, the calibration data from the meter is used and also stored in the meter.

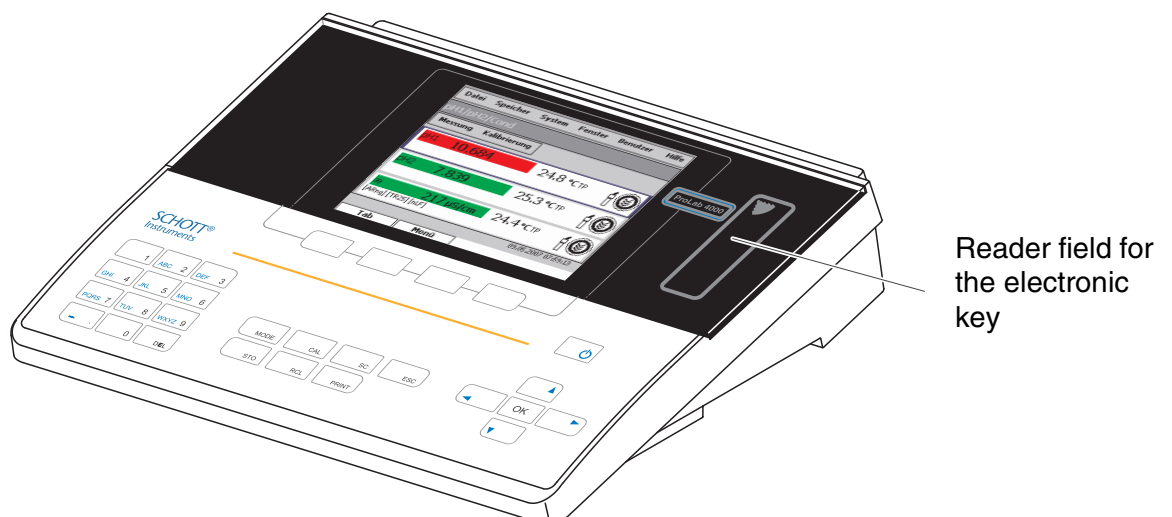
## 1.6 Electronic access control

The ProLab 4000 always documents measurement and calibration data together with a user name.

Thus all measurement data is assigned to the user, in compliance with GLP.

The user name is easily and safely transmitted to the ProLab 4000 via an electronic key. Each electronic key in the form of a keyring pendant contains a key number and a user name. The key number and user name are read by the meter via a contactless radio data connection.

The meter checks the access authorization for the user name. Measurements with an electronic key are only possible if the key number and user name is registered in the meter. The measuring data is then documented along with the registered user name.



If the user name of an electronic key is not registered in the meter, access to the meter with this electronic key is denied.

If access to the meter is anonymous (no password, no electronic key required), all data are documented with the user name, *Anonymous*. By labeling the measurement data with *Anonymous*, this data can be excluded from the GLP-compliant documentation.



## 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 measuring system. The operating manual must always be available within the vicinity of the meter.

### Target group

The meter was developed for work 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:



#### CAUTION

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

This meter is authorized exclusively for measurements of the pH, ORP, conductivity and ion-selective measurements in the laboratory. The technical specifications as given in chapter 17 TECHNICAL DATA (page 195) 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 **unauthorized**.

## 2.2 General safety instructions

This instrument is built and inspected according to the relevant guidelines and norms for electronic measuring instruments (see page 195). It left the factory in a safe and secure technical condition.

### Function and operational 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 17 TECHNICAL DATA (page 195).

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 meter reaches room temperature before putting the meter back into operation.

### Safe operation

If safe operation is no longer possible, the meter 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 meter.

### 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**

- ProLab 4000 laboratory meter
- Power pack
- 4 batteries 1.5 V Micro type AAA
- 1 electronic administrator key (as keyring pendant)
- 1 electronic user key (as keyring pendant)
- Cover
- USB cable (Z875)
- USB mouse
- CD-ROM with USB driver for the PC
- Operating manual

### 3.2 Initial commissioning

Perform the following activities:

- Insert the batteries (see page 187)
- Connect the power pack (see page 24).
- Switch on ProLab 4000 (see page 25).
- Connect the USB mouse (see page 26)
- Setting the language (see page 58)
- Set the date and time (see page 59)
- Set up the access authorization for user keys (see page 53)
- Connect the sensor (see page 27).

### 3.3 Connecting the power pack

The power pack supplies the meter with low voltage (9 V DC).

The batteries are only used to buffer the system time if the power supply is interrupted.



#### CAUTION

The line voltage at the operating site must lie within the input voltage range of the original power pack (see page 195).



#### CAUTION

Use original power packs only (see page 195).

1	Insert the plug into the socket of the meter.
2	Connect the original power pack to an easily accessible power outlet. The self-test, meter designation, software version and subsequently the <i>Standby</i> display appear.



### 3.4 Switching on the ProLab 4000

The ProLab 4000 indicates the *Standby* display.

- |   |   |
|---|---|
| 1 | Switch the meter on with <b>&lt;OK&gt;</b> .                            |
| 2 | The meter switches itself on. The <i>Login</i> dialog box is displayed. |



#### Note

The default password for the administrator is "00001".  
For your safety, change it as soon as possible (see page 49).

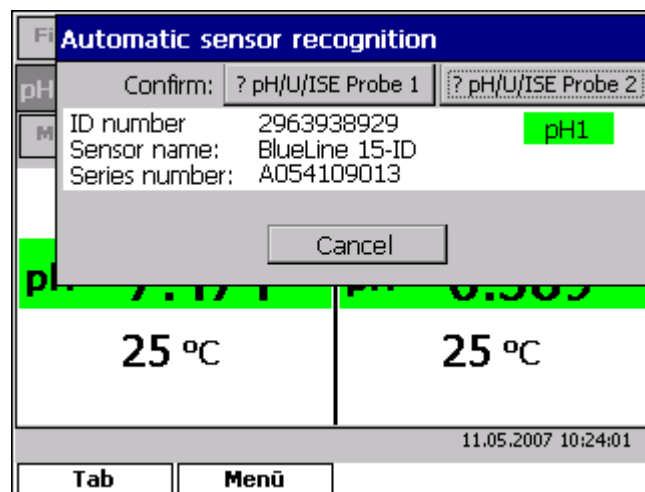
### 3.5 Connecting the USB mouse

You can connect the USB mouse included in the scope of delivery to the USB-A *USB Host* interface of the ProLab 4000. Thus the ProLab 4000 can be operated like a PC.

### 3.6 Connecting sensors

If an ID sensor is connected, the ProLab 4000 recognizes the sensor type, sensor name and series number of the sensor.

If the ID sensor cannot be automatically assigned to a channel, the *Automatic sensor recognition* window prompts the manual assignment.



#### Note

Ä wrong assignment of ID sensors to channels can be corrected by reassigning the sensors, e.g. after

- Switching off, then on the meter
- Disconnecting, then reconnecting all ID sensors.

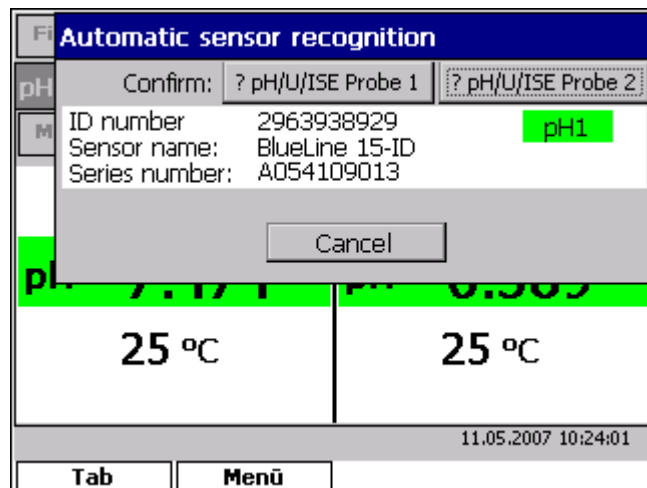
### 3.6.1 Connecting an ID sensor

#### ID sensor with temperature sensor

- 1 Connect the temperature sensor of the ID sensor to the socket.
- 2 Connect the ID sensor to the socket of the meter.  
The sensor is automatically assigned.  
The channel to which is was assigned shows the measurement data of the sensor.

#### ID sensor without temperature sensor

- 1 Connect the ID sensor to the socket of the meter.  
As soon as the meter has recognized the ID sensor, the *Automatic sensor recognition* window appears with the sensor name and series number.



- 2 Assign the sensor that was recognized to a channel with *pH/U/ISE Probe 1* or *pH/U/ISE Probe 2*.  
As soon as a sensor was assigned to a channel, the assignment is completed and the *Automatic sensor recognition* is closed again.



#### Note

The manual assignment of a sensor to a channel is stored in the meter. The next time the meter is switched on while ID sensors are connected, the last assignment of the sensor is displayed and can be confirmed with **<OK>**.

### 3.6.2 Connecting a non ID sensor

1	Connect the sensor and if necessary, temperature sensor to a socket. The relevant channel shows the measurement data of the sensor.
2	Prior to measuring: Calibrate the sensor.

### 3.7 Connecting optional accessories

The ProLab 4000 has several interfaces to connect accessories to. To connect a device, find the suitable interface in the following table. More information on how to operate an interface is provided with the description of the interface.

Accessory	Interface		
	RS232 (see page 29)	USB-B ( <i>USB Device</i> ) (see page 30)	USB-A ( <i>USB Host</i> ) (see page 31)
PC	x	x	
Printer	x		x
USB mouse			x
USB memory			x
USB card reader			x
USB keyboard			x
USB barcode reader			x
USB hub			x

### 3.7.1 RS232 interface (serial port)

PC and printer can be connected via the RS232 interface.

Data that is transmitted to the interface with **<PRINT>** can be printed out with a printer or received with a terminal program if a PC is connected.

#### Operation with RS232

Connect the interface of the ProLab 4000 to the devices using the Z390 (PC) or Z893 (external USB printer Z890) cable.

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

Baud rate	selectable between: 1200 ... 115200 The baud rate must agree with the baud rate set on the PC/printer.
Handshake	RTS/CTS
PC only:	
Parity	none
Data bits	8
Stop bits	1



#### Note

Pin assignment of the socket: See page 195.

### 3.7.2 USB-B interface (*USB Device*)

You can connect a PC to the meter via the USB-B interface (*USB Device*).

Data that is transmitted to the interface with **<PRINT>** can be printed out with a printer or received with a terminal program if a PC is connected.

The USB driver of the enclosed CD-ROM must be installed for the interface to be available for the PC.

#### Installation of the USB driver on the PC

System requirements of the PC for installation of the USB driver:

- PC with Pentium processor or higher with at least one free USB connection and CD-ROM drive
- Windows 2000, XP.

1	Insert the supplied installation CD in the CD drive of your PC.
2	Connect the meter to the USB input of the PC via the USB cable. Windows automatically installs the driver for the meter. Follow the Windows installation instructions as necessary. The meter is listed as a virtual COM interface among the connections in the Windows instrument manager.

#### Operation at USB-B (*USB Device*)

Connect the interface on the ProLab 4000 to the PC using a cable with a USB-A and a USB-B plug.

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

Baud rate	selectable between: 1200 ... 115200 The baud rate must agree with the baud rate set on the PC/printer.
Handshake	RTS/CTS
PC only:	
Parity	none
Data bits	8
Stop bits	1

### 3.7.3 USB-A interface (*USB Host*)

You can connect the following devices to the USB-A interface (*USB Host*) at the ProLab 4000:

<b>Accessory</b>	<b>Use</b>
USB mouse	Simple operation of the ProLab 4000 like a PC
USB printer	Simple output of data to the printer with the <b>&lt;PRINT&gt;</b> key
USB memory	Simple data backup on an external USB medium
USB card reader	Simple data backup on an external memory card
USB keyboard	Input of text with the keyboard
USB barcode reader	Input of data such as sample designations using a barcode. Data input using the barcode reader is always possible whenever it is possible to input data via the keyboard.
USB hub (USB 2.0)	Multiplication of the number of USB-A interfaces <i>USB Host</i> for simultaneous operation of several USB devices

#### **Operation at USB-A (*USB Host*)**

Connect the interface on the ProLab 4000 to the external device using a cable with a USB-A and a USB-B plug.  
The device is automatically recognized and is immediately operable.



## 4 Operating principles

This section contains basic information on the operation of the ProLab 4000.

### 4.1 Operating and display elements

**Mouse** The ProLab 4000 is designed for mouse operation. With a mouse click you can carry out all functions except for the entry of characters and numerals. This means the ProLab 4000 can be operated as easily as a software on the PC.

**Keys** Frequently required functions such as Store (<**STO**>), Calibrate (<**CAL**>) or Print (<**PRINT**>) are directly available using keys. In this operating manual, keys with dedicated functions are identified by the key labeling, bold letters and angle brackets, e.g. <**OK**>.



#### Note

When the meter is operated with the mouse, all key functions are available in a context menu (right mouse button).

**Window** The screen shows display windows and dialog boxes like a PC software. Only one window is active at a time. The active window has a colored title bar. Windows that are not active have a grayed out title bar. In the measured value display, for each channel there is a window with special menus for the displayed measured parameter.

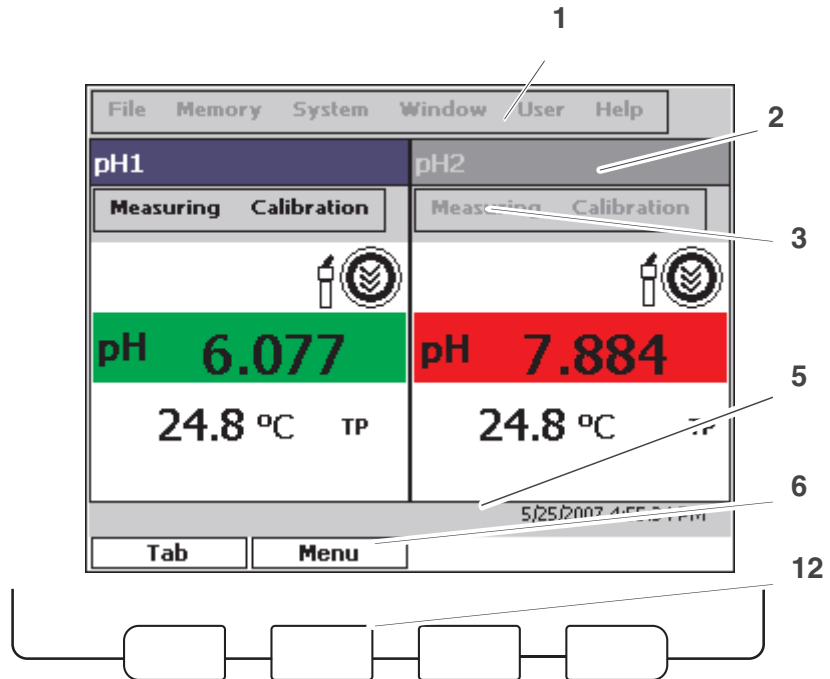
Windows contain further operating elements such as buttons, register cards, selection lists, option fields and input fields.

When operating the meter without the mouse, use the [**Tab**] softkey to activate the open window while scrolling, e.g. individual channels or the main menu.

**Buttons** Functions in dialog boxes are executed using buttons. In this operating manual, buttons are identified by angle brackets. Example: [*Continue*] or [*OK*].

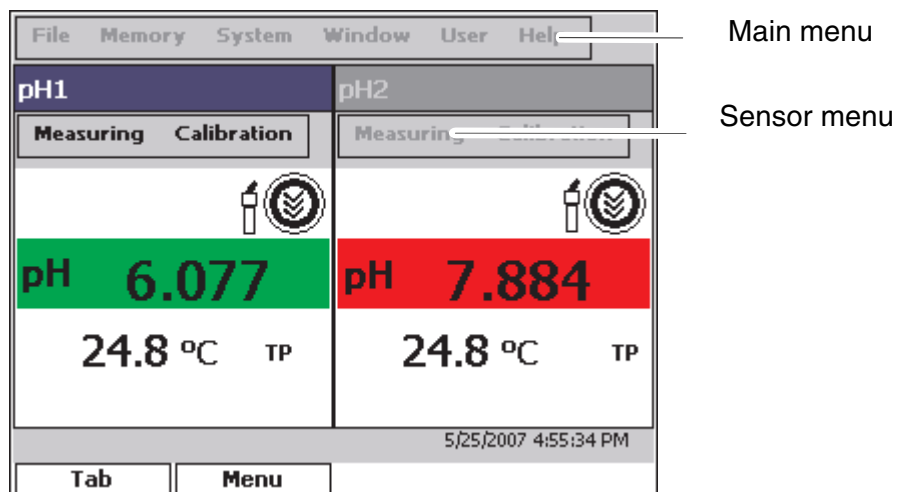
When operating without the mouse the buttons have to be selected first. Then the respective function can be executed with <**OK**>. The [*Cancel*] button can always be operated with the <**ESC**> key directly.

**Display** Depending on the operating situation, the color display shows measurement data, calibration steps, setting dialogs or stored data.



1	Main menu
2	Channel
3	Menu for a measured parameter
5	Info line
6	Softkey assignment
12	Softkeys

**Main menu (1)**



In the main menu, there are sensor independent functions and settings:

- Manage configurations (*File*) (see page 182)
- Store current measurement data, and display and edit stored measurement and calibration data (*Memory*) (see page 153)
- System settings such as language, date, time, color assignment, interface settings and general measurement settings (*System*) (see page 56)
- Select the measurement data to be displayed (*Window*)
- Manage user data (*User*) (see page 163)

<b>Channel (2)</b>	In the measured value display, for each connected sensor you can see a channel with special menus for the displayed measured parameter ( <i>Measuring, Calibration</i> ).
<b>Menu for a measured parameter (3)</b>	<p>Menus for a measured parameter comprise sensor dependent functions and settings:</p> <ul style="list-style-type: none"><li>● Calibration settings and calibration data (<i>Calibration</i>) (see section CALIBRATION in the chapter for the respective sensor)</li><li>● Temperature settings such as usage of the temperature sensor of another sensor, manual temperature setting (<i>Measuring</i>)</li><li>● The measured value display with recorder (see page 164)</li><li>● Resetting the sensor settings</li><li>● Special measurement settings (<i>Measuring</i>)</li></ul> <p>A detailed description of the functions is given with the description of the measured parameter.</p>
<b>Info line (4)</b>	The info line shows the date and time, information or instructions on the current situation.
<b>Softkey assignment and softkeys (5+6)</b>	<p>Softkeys provide additional, situation-related functions. In this operating manual, softkeys are indicated by the currently displayed function, bold letters and angle brackets, e.g. [<b>Tab</b>].</p> <p>The current functions are displayed in the four fields in the lower display (empty field = no function).</p>

## 4.2 File system

**Files** With the ProLab 4000 you can store data in files just like using a PC. Different data is stored in an extra file, such as

- manually stored measured values
- automatically stored measured values
- recorder data

A complete overview of the data that can be stored and the corresponding file formats is given in chapter 11 MEMORY (see page 153).

**File system** The ProLab 4000 creates an individual directory with the user name for each registered user.

In his/her directory, each user can:

- Create folders
- Store data
- Delete files
- View stored files

File dialogs such as *Save as* always suggest the directory of the registered user.



### Note

If an external USB memory is connected, the external memory appears as a folder in the directory of the user.

Only the administrator can move to a higher directory and in other user folders.

### 4.3 Entry of numerals, letters and characters

Numerals, letters, punctuation marks and special characters are entered on the alphanumeric keypad on the meter or an external keyboard.

Entering characters is required in operating situations such as the following:

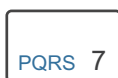
- Entry of the date and time
- Entry of an ID, e. g. if you want to store measurement data
- Entry of the user name and password
- User management

#### Character set

The following characters are available:

- Numerals 0 ... 9
- Letters A ... Z
- Punctuation marks . -

#### Operating principle



Characters can be entered as long as an input field is displayed.

The keys of the alphanumeric are assigned to the characters that are printed on them. Example: With the **<PQRS 7>** key you can enter the following characters: 7, P, Q, R, S.

The required character is selected by pressing the key several times (similar to a cell phone). The numeral appears on the first pressing if the key is assigned to several characters. One keypressing is sufficient to enter a numeral.

The key for punctuation marks (**<- .>**) is assigned to a decimal point of minus sign, depending on the context. If a number is in front of the punctuation mark, a decimal point is automatically displayed, in all other cases a minus (-).

A character is taken over in the input field if

- the character is highlighted longer than one second,
- the character is confirmed with **<OK>**,
- another alphanumeric key is pressed.

#### Operating example: Entering an ID

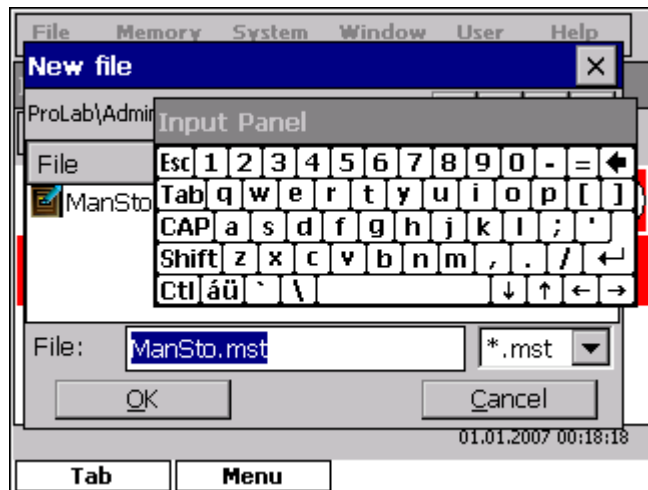
The input field for an ID appears if you press the **<STO>** key to store measurement data. A dialog with input fields for the ID and comment opens up. In the following example, a measurement dataset with the ID "Test" should be stored.

- |   |   |
|---|---|
| 1 | Press <b>&lt;TUV 8&gt;</b> several times until "T" appears in the input line. After approx. 1 second the character is taken over. |
|---|---|

2 | Complete and confirm the ID with <A...9>.

### Mouse operation:

With the mouse, you have in all entry fields the additional option of showing a keyboard with the right mouse button. You can then enter letters or numerals with the mouse.



### Correcting wrong entries

Move the cursor behind the character to be deleted with <◀><▶>. Then delete the character in front of the cursor with <DEL>.

### 4.4 Navigation

The dialog with the meter takes place through menus and dialog boxes as usual with any PC software. In each dialog box there are operating elements such as register cards, selection lists, buttons or input fields.



**Note**

The ProLab 4000 is designed to be operated with a mouse. A suitable mouse is included in the scope of delivery.

**General operating principles**

If you wish to operate the meter without using a mouse, find some general operating principles listed below.

Key / soft-key	Measured value display	Menu	Dialog box
[Tab]	Select main menu or channel	-	Select an element such as a register card or button
[Menu]	Open main menu or selected channel	-	-
<▲><▼> and <◀><▶>	-	Select a menu item	Select a subelement in a dialog box
<OK>	-	Execute a menu item, e.g. start an action or open a dialog box.	Execute the function of the selected button
<ESC>	-	Close the menu	Cancel current action without change

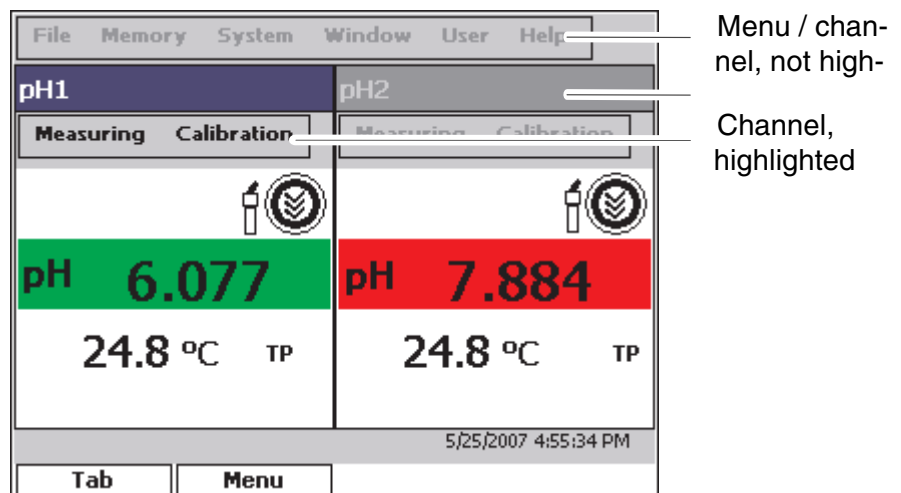
#### 4.4.1 Navigation in the measured value display

The display shows, for example, the measurement data of all activated channels, the main menu, the sensor menu and the softkey functions.

- Using **[Tab]**, activate channels or the main menu
- Using **[Menu]**, open the menu line.
- Using **<MODE>**, change the measured parameter for the selected channel (e. g. pH ><- mV).
- Using the functions keys on the meter such as Calibrate (**<CAL>**), Store (**<STO>**), Print (**<PRINT>**), Display stored measurement data (**<RCL>**), Manual stability control (**<SC>**) etc. you can execute further functions.

#### Operating example: Highlighting a channel

A channel is an indication on the display that corresponds to a physical connection at the meter. The number of the channel is displayed with the selected measured parameter, e.g. pH1, pH2.



- 1 In the measured value display, highlight the main menu or a channel with **[Tab]**.  
The highlighting moves on with each keypressing.

#### Mouse operation:

- 1 Select a channel or menu name with a mouse click.

### 4.4.2 Navigation in menus

A menu item contains submenus, executes a function or opens a dialog box.

The selection is made with the <▲><▼> and <◀><▶> keys or the mouse.

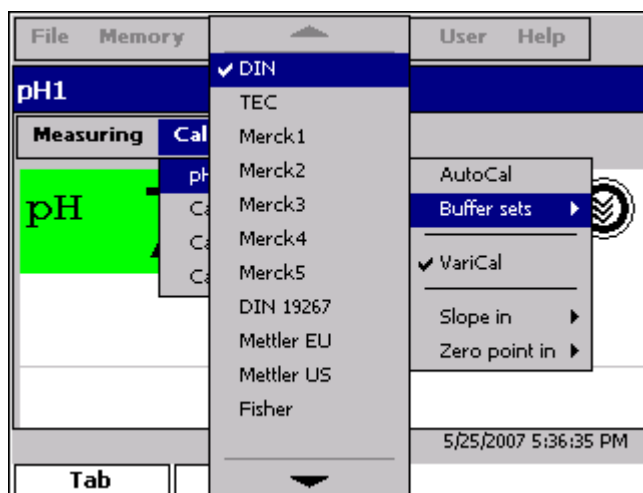
The current selection is highlighted.

- Menus  
Submenus are marked by an arrow to the right (▶). Menus are opened with <OK>.
- Functions  
Functions are indicated by the name of the function. They are immediately carried out by confirming with <OK>.
- Dialog boxes  
Settings are marked by dots (...).  
The relevant setting window is opened with <OK>.

#### Operating example: Navigation in the menu

Menus are available for general settings and functions and for each individual measured parameter.

1	In the measured value display, highlight the main menu or a channel with <b>[Tab]</b> . A highlighted channel is marked by a frame.
2	Open the menu with the current selection with <b>[Menu]</b> .
3	Highlight a menu item with <◀><▶> and <▲><▼>. The highlighted menu item is displayed inverse.
4	Confirm the highlighted menu item with <OK>.



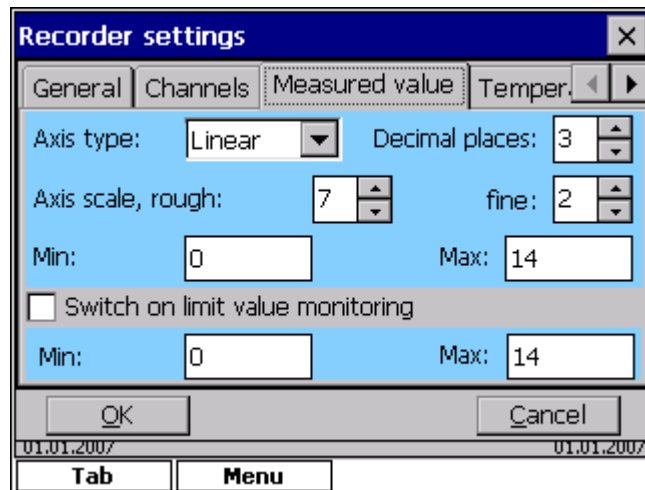
5	Highlight a menu item with <◀><▶> and <▲><▼>. The highlighted menu item is displayed inverse.
6	Confirm the highlighted menu item with <OK>. When a function is executed the main menu is closed and the function executed, or a dialog box opens up.

**Mouse operation:**

1	Select a menu name with a mouse click. The menu pops up.
2	Select a menu item and confirm with a mouse click. When a function is executed the main menu is closed and the function executed, or a dialog box opens up.

### 4.4.3 Navigation in dialog boxes

Dialog boxes contain further subelements such as register cards, selection lists and buttons. The elements are selected with the **[Tab]** softkey. Within a list or register card, they are selected with the **<▲><▼>** or **<◀><▶>** keys.



#### Operating example: Navigation and settings in dialog boxes

- |   |  |
|---|--|
| 1 | Using <b>[Tab]</b> , highlight individual elements in a dialog box. Highlighted elements such as register cards, option fields or buttons are marked by a dotted frame. Highlighted lists are displayed inverse. |
| 2 | If an element such as a register card or list that allows a further selection is highlighted:<br>Highlight a different selection in element with <b>&lt;◀&gt;&lt;▶&gt;</b> or <b>&lt;▲&gt;&lt;▼&gt;</b> .        |
| 3 | If an element such as a button that executes a function is highlighted:<br>Use <b>&lt;OK&gt;</b> to execute the function.  |

#### Mouse operation:

- |   |  |
|---|--|
| 1 | Select an element with a mouse click. The relevant function is executed. |
|---|--|

#### 4.4.4 Navigation in the file selection dialog box

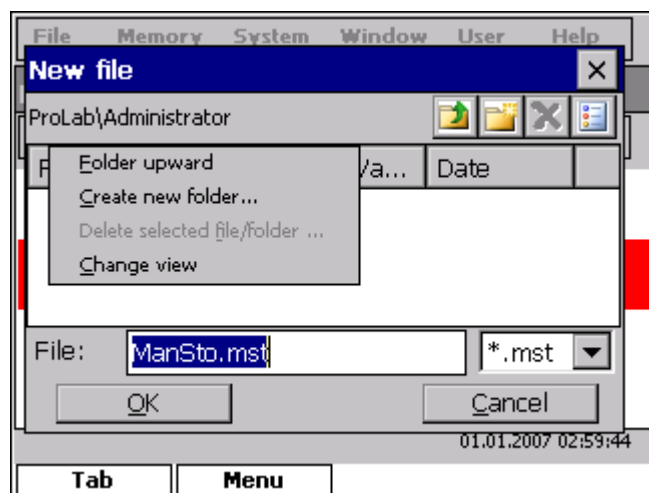
The file selection dialog is opened if a file is to be created, stored, selected or deleted.

All files are stored in the folder of the user. Each user can create or delete subfolders in his/her folder.

The file dialog box contains further subelements such as

- symbol buttons,
- a list with files and subfolders,
- an input field for the file name and
- buttons.

The elements are selected with the **[Tab]** softkey. Within a list or register card, they are selected with the <▲><▼> or <◀><▶> keys. The functions of the symbol buttons available with the keypad using the **[Menu]** softkey. A context menu opens up that contains all key functions.



#### Note

Functions in file dialog boxes that are activated with symbol buttons can be activated via the context menu with **[Menu]** if you operate without the mouse. Examples:



: move one folder up



: create new folder



: display/hide header

**Operating example:  
Navigation and settings  
in file selection dialogs**

1	Highlight an element in a file dialog box with <b>[Tab]</b> . Highlighted elements such as buttons are marked by a dotted frame. Highlighted input fields are displayed inverse.
2	If an element such as the file list in the current folder allows a further selection: Highlight a different selection in element with <b>&lt;◀&gt;&lt;▶&gt;</b> or <b>&lt;▲&gt;&lt;▼&gt;</b> .
3	If an element such as the input field for the file name allows an entry: Enter a name with <b>&lt;A...9&gt;</b> .
4	If an element such as a button that executes a function is highlighted: Use <b>&lt;OK&gt;</b> to execute the function.

**Mouse operation:**

1	Select an element with a mouse click. The assigned function is executed.
2	If an element such as the input field for the file name allows an entry: Enter a name with <b>&lt;A...9&gt;</b> .

## 5 Access to the meter

### 5.1 Switch the meter on and off

#### Switching on

- |   |   |
|---|---|
| 1 | Switch the meter on with <b>&lt;On/Off&gt;</b> .<br>The self-test, meter designation, software version and subsequently the <i>Login</i> dialog box appear. |
|---|---|

#### Switching off

- |   |   |
|---|---|
| 1 | Switch off the meter with <b>&lt;On/Off&gt;</b> . |
|---|---|

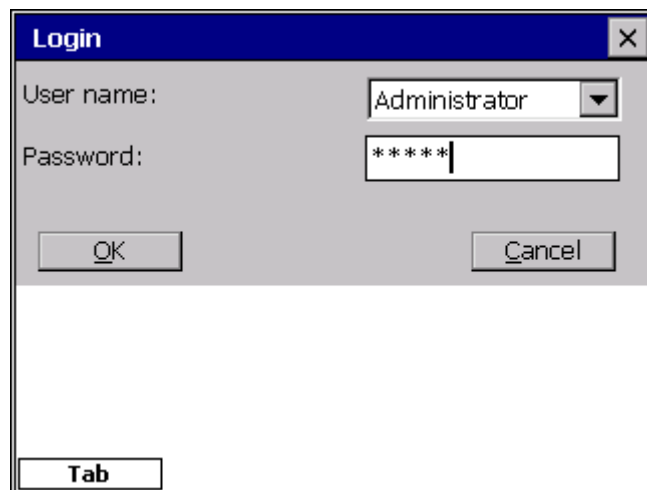
### 5.2 Login as a user

After switching on, the *Login* dialog box pops up. Depending on the adjusted type of access control, the dialog box contains:

- a list to select a user name and a field to enter a password or
- the prompt, *Place the electronic key on the reader field*.

In the delivery condition, access is possible with password.

#### Login with password



- |   |   |
|---|---|
| 1 | Select an item in the <i>User name</i> list.  |
| 2 | Enter the correct password for the user name and confirm with <b>&lt;OK&gt;</b> .<br>The login has taken place. |

**Note**

The default password for the administrator is "00001". For your safety, change it as soon as possible (see page 49). No password entry is required for anonymous access.

**Login with electronic key**

The *Login* dialog box displays the instruction:  
*Place the electronic key on the reader field.*

- |   |  |
|---|--|
| 1 | Place the electronic key on the read field and leave it there for approx. 2 seconds until the key has been recognized. The user name and key number is displayed. The login has taken place. |
|---|--|

**Login with electronic key and password**

The *Login* dialog box displays the instruction:  
*Place the electronic key on the reader field.*

- |   |   |
|---|---|
| 1 | Place the electronic key on the read field and leave it there for approx. 2 seconds until the key has been recognized. The user name and key number is displayed. |
| 2 | Enter the correct password and confirm with <b>&lt;OK&gt;</b> . The login has taken place.  |

**Note**

Depending on user rights, individual functions and settings may be grayed out and thus locked. More information on user rights: See page 51.

### 5.3 Password for login

If the use of a password for login to the meter was set by the administrator, each user has to enter his or her password during the login.

*The ProLab 4000 is delivered with the password "00001" for the user name, Administrator . Change this password as soon as possible.*

#### 5.3.1 Changing the password

All users can change their own password.  
A valid password consists of at least 5 characters.

1	Open the <i>User / Change password...</i> menu. The <i>Change password</i> window opens. The old password is in the <i>Old password</i> field.
2	Enter the new password in the <i>New password</i> field.
3	Enter the new password once again in the <i>Confirm password</i> field.
4	Confirm the new password with <i>[OK]</i> . The password is changed. The <i>Change password</i> window is closed.

#### 5.3.2 Assigning a password

During the first login with the new user name the *Change password* window appears. Here the password is set by the user. A valid password consists of at least 5 characters.

#### 5.3.3 Forgotten the password?

If the access control requires the entry of a password, access to the meter is not possible without the password.

#### Users

The administrator can delete the password for user profiles (see page 53).

## 5.4 Lock

During operation (e.g. if the automatic storing function is active), the activated lock prevents the inadvertent use of the meter with the name of the registered user.

The lock can only be released with the currently registered electronic key or the administrator key.



### Note

The lock can only be activated in the measuring mode of operation. With anonymous access, the *Activate lock* function is not available.

### Activating the lock

- |   |  |
|---|--|
| 1 | Activate the lock in the <i>System / Activate lock</i> menu.<br>The meter is locked against inadvertent use. |
|---|--|

### Releasing the lock

- |   |   |
|---|---|
| 1 | Press any key.<br>The login window pops up.   |
| 2 | Log in with the password, electronic key or electronic key and password.<br>The lock is released. |

### 5.5 Access control and user rights

You as the administrator define the type of access (access control) to the ProLab 4000. In addition, you define the rights to carry out functions and measurements for the users (user rights).

When the meter is delivered, only the enclosed electronic administrator key has an access authorization for the meter.

The administrator can set up access authorizations for electronic user keys (see below).

Anonymous access without password and electronic key (user name, *Anonymous*) is always possible. Measurement and calibration data is identified by the user name, *Anonymous*.

After the login as administrator, the user management functions are available in the *Access control* and *Administration* register cards of the *User / Administration...* menu.

**Access control**

In the *Access control* register card you define the general access settings that will apply to all users.

**User rights**

Each user is given user rights with the ProLab 4000. The user rights are limited by the user type and configuration:

User type	User rights
Administrator	<ul style="list-style-type: none"> <li>● Calibrate and measure</li> <li>● Create file for manual storage</li> <li>● Create user configuration</li> <li>● Define type of access to the meter</li> <li>● User administration</li> <li>● Delete all files</li> </ul>
Users	
without configuration	<ul style="list-style-type: none"> <li>● Calibrate and measure</li> <li>● Create file for manual storage</li> <li>● Create user configuration</li> <li>● Delete files in their own folder</li> </ul>
with configuration	<ul style="list-style-type: none"> <li>● Calibrate and measure (limited by settings in configuration file)</li> </ul>

User type	User rights
Anonymous	<ul style="list-style-type: none"> <li>● Calibrate and measure</li> <li>● Create file for manual storage</li> <li>● Create user configuration</li> <li>● Delete files in the folder, Anonymous</li> </ul>



### Note

Only one user can be the administrator. The administrator is adjusted in the delivery condition. The administrator can only create users of the type, user.

### 5.5.1 Access control

The administrator defines the type of access to the meter. The setting applies to all users and the administrator.

Type of access	Description
<i>Access with password</i>	The meter can only be unlocked by entering the password for a certain user.
<i>Access with electronic key</i>	Access with electronic key only. No additional password is required here.
<i>Access with el. key and password</i>	To be able to work with the meter, a password has to be entered in addition to access with the electronic key.

1	Open the <i>User</i> menu with <i>Administration...</i> The <i>User administration</i> dialog box pops up. The <i>General</i> register card is open.
2	Select the type of access and confirm with <i>[OK]</i> . The new setting is active when the ProLab 4000 is switched on the next time.






### 5.5.2 User management and assigning user rights

The ProLab 4000 has basic user management functions. The administrator can

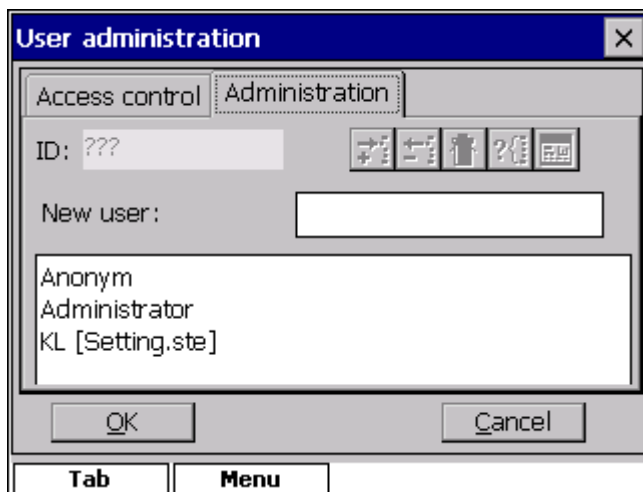
- add new users
- delete users
- delete the password assigned to a user
- store a configuration file for users.  
The configuration file contains measurement settings that cannot be changed by the user. Besides, the administrator considerably restricts the rights of the user.  
The user **cannot**
  - change or reset any defined measurement settings
  - delete any files
  - create or change any configuration
  - backup any data
- hide the anonymous access or any user. If a user or anonymous access is hidden, it is no longer available in the login dialog and cannot be selected.

The administrator also defines the user rights for any new user (see page 51).

The symbol buttons are used for user management with the mouse. The relevant functions are available as a context menu with the **[Menu]** softkey when operating with the meter keypad.

Symbol button	Function (designation in context menu)
	<i>Add user</i>
	<i>Delete user</i>
	<i>Delete old password</i>
	<i>Hide user/visible</i>
	<i>Add configuration...</i>

1	Open the <i>User</i> menu with <i>Administration...</i> The <i>User administration</i> dialog box pops up.
2	Open the <i>Administration</i> register card.



**Adding a new user**

- |   |  |
|---|--|
| 1 | Enter a new user name in the <i>New user</i> field.<br>or<br>Place an electronic user key on the reader field.<br>The key number and a user name already stored in the key are displayed.<br>If necessary, enter a new user name in the <i>New user</i> field. |
| 2 | In the context menu, select the menu item, <i>Add user</i> .<br>The new user is included in the list of registered users.<br>On access with the electronic key, the user name is at the same time stored in the electronic key.                                |
| 3 | Remove the electronic key from the reader field.   |

**Assigning a configuration to a user**

- |   |  |
|---|--|
| 4 | Highlight a user in the list of users.   |
| 5 | In the context menu, select the menu item, <i>Add configuration....</i><br>The <i>Open file</i> dialog box pops up.  |
| 6 | Select a configuration file and confirm with <i>[OK]</i> .<br>The configuration file is permanently assigned to the user and is also displayed in the list of users. |

**Erasing a registered user**

- |   |  |
|---|--|
| 7 | Highlight a user in the list of users.   |
| 8 | In the context menu, select the menu item, <i>Delete user</i> .<br>A safety query appears. After confirming the safety query the access authorization for the currently highlighted user is deleted. |

**Erasing the password  
for a registered user**

9	Highlight a user in the list of users.
10	In the context menu, select the menu item, <i>Delete old password</i> . A safety query appears. After confirming the safety query the password for the currently highlighted user is deleted.

**Hiding / displaying a  
user**

11	Highlight a user in the list of users.
12	In the context menu, select the menu item, <i>Hide user/visible</i> . If the user is hidden, the [ <i>Hidden</i> ] labeling is displayed in the list of users.

**Exiting the user  
management**

13	Confirm the settings with [ <i>OK</i> ]. The user settings are active.
----	---

**5.6 Lost your electronic key?**

Without an electronic key with access authorization, anonymous access is possible only.

**Electronic user key**

Keys for additional users can be obtained from SI Analytics GmbH. The access authorization for new keys is set up by the administrator (see page 53).

**Electronic administrator  
key**

If the electronic administrator key is lost, the access authorization for a new electronic administrator key can be set up in the factory only.

The addresses and telephone numbers of SI Analytics GmbH are given on the cover of this operating manual.

## 6 System functions

System functions are all functions that are independent of the probe.

### 6.1 Overview: System settings

The following sensor-independent meter features can be adjusted in the *System* menu and its submenus:

Menu item	Setting	Description
<i>System</i>		
– <i>Data output...</i>		
– <i>USB printer</i>	(✓)	
– <i>USB interface /Baud</i>	(✓) / 1200 ... 115200	Baud rate of the data interface
– <i>Serial interface /Baud</i>	(✓) / 1200 ... 115200	Baud rate of the data interface
– <i>Output format</i>	– <i>ASCII</i> – <i>CSV</i>	Output format for data transmission For details, see page 179
– <i>Autom. printout...</i>	<i>Printout interval</i>	Automatic output of the measurement data to the interfaces at the specified interval.
– <i>Reset</i>	-	Resets the system settings to the default values. For details, see page 66
<i>Measuring</i>		
– <i>Autom. stability control</i>	(✓)	You can activate or switch off the automatic stability control function (see page 63).
– <i>Temperature unit</i>	– <i>Celsius</i> – <i>Fahrenheit</i>	All temperatures are displayed with the selected unit.
– <i>Connect Ref1/Ref2</i>	(✓)	Use reference electrode of the other pH/ISE input

Menu item	Setting	Description
<i>System</i>		
– <i>Signal On</i>	(✓)	Switches on or off the acoustic signal. The signal sounds e.g. when a stable measured value has been recognized (stability control)
– <i>Country and language...</i>		
– <i>Country</i>	List with over 100 countries	With this setting you can select the country-specific notation for the date, time and numbers. The setting applies to all data that is stored or output to an interface.
– <i>Language</i>	– <i>Deutsch</i> – <i>English</i> – <i>Francais</i> – <i>Español</i>	Select the menu language
– <i>Date and time...</i>		
– <i>Date</i>		Setting the date
– <i>Time</i>		Setting the time
– <i>Color code...</i>	– <i>SC stable</i> – <i>SC not stable</i> – <i>Instruction display</i> – <i>Information display</i>	Settings in the <i>Color code</i> group field change the background color for display indications with certain states (stability criterion for stable measured values met / not met) and for indications in the info line.
– <i>Activate lock</i>	(✓)	After a user login with the electronic key, the key lock can be activated here. The meter is locked against operational actions until the electronic key is applied again.

## 6.2 Selecting the language

Menus can be displayed in different languages. The language is selected in the *System* main menu.

- 1 Open the *System / Country and language...* menu.  
The *Country and language* window opens.



- 2 Select a language in the *Language* list.  
The active language is highlighted.
- 3 Confirm the selection with *[OK]*.  
The language is changed.

## 6.3 Selecting the country

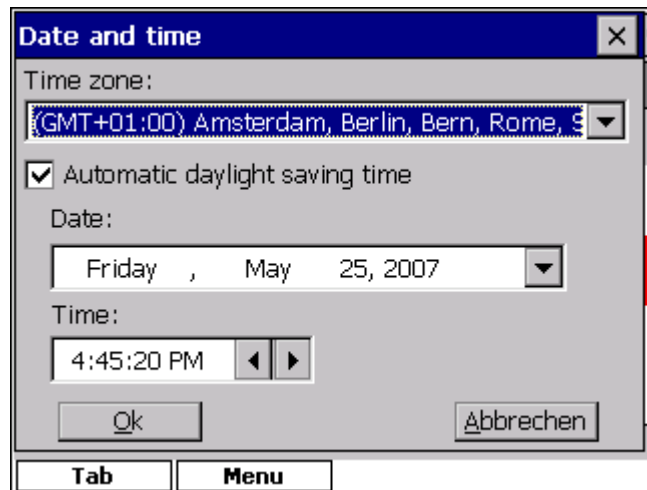
With this setting you can select the country-specific notation for the date, time and numbers. This data is stored and output to an interface in the country-specific notation.

- 1 Open the *System / Country and language...* menu.  
The *Country and language* window opens.
- 2 Select a country in the *Country* list.  
The active country is highlighted.
- 3 Confirm the selection with *[OK]*.  
The country is changed.

## 6.4 Setting the date and time

The data and time are displayed in the local format, according to the *Country* setting (see above). The date and time are set in the menu, *System / Date and time...*

- 1 Open the *System / Date and time...* menu.  
The *Date and time* window opens.



- 2 Select the time zone in the *Time zone* field.
- 3 If necessary, mark the *Automatic daylight saving time* field.
- 4 Select the date.
- 5 Enter the time.
- 6 Confirm the entries with *[OK]*.  
The date and time are taken over.

## 6.5 Selecting the channels for measured value display

In the *Window / Channels...* you can define which channels are visible in the measured value display.

Depending on the number of activated measurement data one, two or three sensor data are displayed at the same time.

Menu item	Description
<i>pH/U/ISE Probe 1</i>	Display or hide the sensor data of the pH/U/ISE 1 channel.
<i>pH/U/ISE Probe 2</i>	Display or hide the sensor data of the pH/U/ISE 2 channel.
<i>Cond Probe</i>	Display or hide the Cond sensor window.

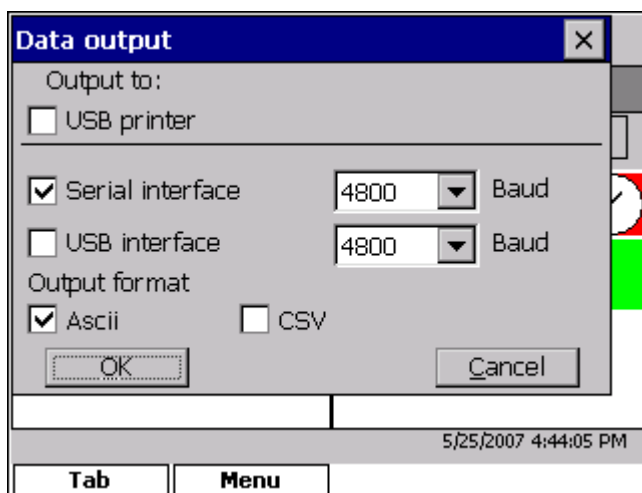
## 6.6 Interfaces for data download

The meter has three interfaces to which data can be downloaded:

- RS232: serial printer or PC
- USB-B (*USB Device*): PC
- USB-A (*USB Host*): USB printer

You can specify to which interfaces data will be downloaded at the same time.

- 1 Open the *System / Data output...* menu.  
The *Data output* window opens.



2	Mark the option fields, <i>USB printer</i> , <i>Serial interface</i> and <i>USB interface</i> . The interfaces are selected for data download.
3	If data should be downloaded to the <i>Serial interface</i> or <i>USB interface</i> interfaces: Set the baud rate in the respective <i>Baud</i> list field. The interface is ready for data download.

## 6.7 Temperature

The temperature affects the measurement results. You can select the unit of the temperature display. The temperature is determined automatically with an external temperature sensor or one that is integrated in the sensor. It is also possible to enter temperature values manually.

### 6.7.1 Temperature unit

Measured temperature values can be displayed in the unit, °C (degrees Celsius) or °F (degrees Fahrenheit).

1	Open the <i>System / Measuring / Temperature unit</i> menu and select the unit, <i>Celsius</i> or <i>Fahrenheit</i> . The selected temperature unit is active.
---	---

### 6.7.2 Temperature measurement

For reproducible measurements it is essential to determine the corresponding temperature value.

The measuring system receives the temperature value from:

- a temperature sensor integrated in the sensor,
- a temperature sensor integrated in another sensor,
- an external temperature sensor NTC30 or Pt1000, or
- manual input of the temperature value.

On the display, the used temperature sensor is labeled with *TP*, *pH1 TP*, *pH2 TP* or *Cond TP*.

#### Using an integrated temperature sensor

Sensors with an integrated temperature sensor always measure the measured parameter and temperature simultaneously. If the integrated temperature sensor is recognized, the measured temperature value and the *TP* status indicator appear on the display.

#### Using the temperature sensor of another sensor

If no temperature sensor is available for a pH/ISE channel, you can measure the temperature with the integrated temperature sensor of another sensor.

To do so proceed as follows:

1	Immerse two electrodes in the measuring sample.
2	Highlight a channel in the measured value display.
3	In the sensor menu, select the <i>Alternative TP</i> menu item, e.g. <i>Measuring / Alternative TP</i> . The temperature measurement is active. For checking purposes, the used temperature sensor is indicated on the display.

#### Using an external temperature sensor

If you want to measure the temperature using an external temperature probe, proceed as follows:

1	Connect a temperature sensor to the measuring module.
2	Immerse the temperature sensor in the test sample. The measured temperature value is shown on the display.

## 6.8 Automatic stability control

The *Autom. stability control* function continuously checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of measured values.

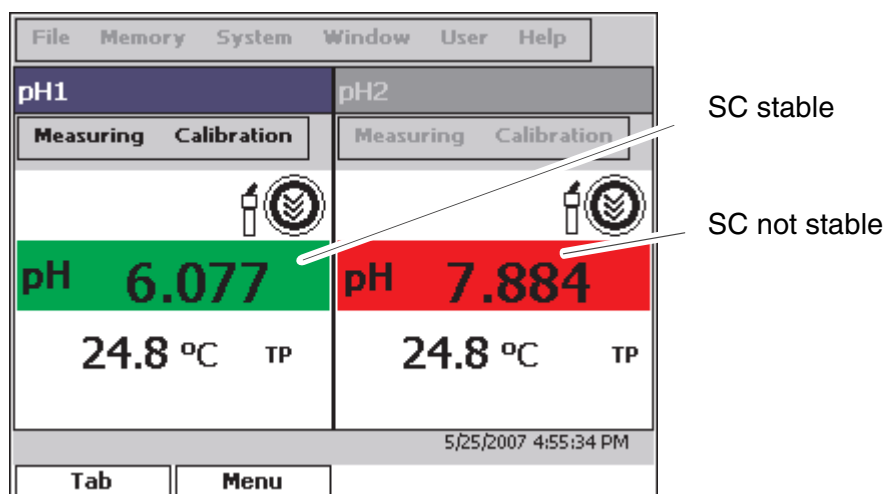
You can activate or switch off the *Autom. stability control* function (menu, *Autom. stability controlSystem*).

The *Autom. stability control* function is carried out:

- as soon as the measured value is outside the allowed stability range
- when you switch over between the measured parameters with **<MODE>**.

The stability of the measured value is indicated by the background color of the measured value. In the delivery condition, the SC stable / SC not stable conditions are assigned to the following colors:

Color	Meaning
red	SC not stable Stability criteria not met
green	SC stable Stability criteria met



**Note**

The stability criteria that apply to a measured parameter are given in the description of the measured parameter.

You can change the assignment of colors to conditions (see page 64).

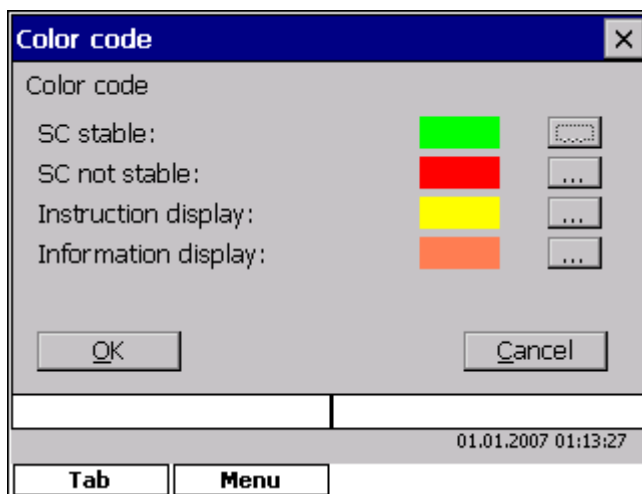
**6.9 Color assignment**

For easy differentiation, the following conditions are highlighted by a background color:

- Stability criterion met / not met
- Indications in the info line: Instruction / info display

You can adapt the colors yourself for these conditions.

- 1 Open the *System / Color code...* menu.  
The *Color code* window pops up.



- 2 Open the *Color palette* window with [...].
- 3 Select a color.
- 4 Confirm the color with [OK].  
The color is entered for the selected condition.
- 5 If necessary, change the background color for other conditions.
- 6 Confirm the color assignment with [OK].  
The new color assignment is accepted and immediately effective.

## 6.10 Reset

You can reset (initialize) all sensor settings and sensor-independent settings separately from each other.

### 6.10.1 Resetting the sensor settings



#### Note

The calibration data is reset to the default settings together with the measuring parameters. Recalibrate after performing a reset.

The sensor settings are reset in the sensor menu. In the measured value display, activate the relevant sensor window [**Tab**] and open the menu with [**Menu**].

**pH** The following settings for pH measurements are reset to the default settings with the *Reset pHMeasuring* function:

Setting	Default settings
<i>Calibration interval...</i>	7 d
<i>Slope in</i>	<i>mV/pH</i>
Measured parameter	pH
<i>pH resolution</i>	<i>High</i>
<i>Zero point</i>	0 mV
<i>Slope</i>	-59.16 mV/pH
Temperature, manual	25 °C

**Cond** The following settings for conductivity measurements are reset to the default settings with the *Reset CondCond-Setup* function:

Setting	Default settings
<i>Calibration interval...</i>	150 d
Measured parameter	$\chi$
<i>Cell constant</i>	0.475 cm <sup>-1</sup> ( <i>Calibrated cell constant</i> ) 0.475 cm <sup>-1</sup> ( <i>Adjustable cell constant...</i> )
<i>Temperature coefficient</i>	<i>TC nLF</i>
<i>Tref</i>	<i>Tref 25</i>

<b>Setting</b>	<b>Default settings</b>
Temperature coefficient (TC) of the linear temperature compensation	2.000 %/K
<i>TDS factor</i>	1,00

### 6.10.2 Resetting the system settings

The following system settings are reset to the default settings with the *System / Reset* function:

<b>Setting</b>	<b>Default settings</b>
<i>Language</i>	<i>English</i>
<i>Temperature unit</i>	<i>Celsius</i>
<i>Signal On</i>	✓
<i>Baud rate (Baud)</i>	4800
<i>Output format</i>	<i>ASCII</i>

## 6.11 List of open windows

The *Window* menu item in the main menu provides an overview of the open windows of the ProLab 4000. Open recorder windows and the measured value display of the indicated sensors appear in the list of open windows.

- |   |  |
|---|--|
| 1 | Open the <i>Window</i> menu.   |
| 2 | Select a window from the list.<br>The window is activated and displayed in the foreground. |



### Note

Recorder windows that are open and displaced can be maximized and restored with the *Maximize recorder* function.

### Recorder window

- |   |  |
|---|--|
| 1 | Open the <i>Window / Maximize recorder</i> menu.<br>Recorder windows that are open and displaced are maximized.<br>The first recorder window is displayed. |
|---|--|



## 7 pH

### 7.1 General information

#### Temperature measurement

For reproducible pH measurements, it is essential to measure the temperature of the test sample.

You have the following options to measure the temperature:

- Automatic temperature measurement with
  - Temperature sensor (NTC30 or Pt1000) integrated in electrode (if available).
  - the integrated temperature sensor of another electrode that is connected and immersed in the sample at the same time.
  - an external temperature sensor (NTC30 or Pt1000).
- Manual determination and input of the temperature.

The display of the temperature indicates the active temperature measuring mode:

Temperature sensor	Resolution of the temp. display	Mode
yes	0.1 °C	Automatic with temperature sensor
-	1 °C	Manual

## 7.2 Measuring the pH value

### 7.2.1 Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Adjust the temperature of the solutions and measure the current temperature if the measurement is made without a temperature sensor.
2	Connect a pH electrode to the meter.
3	Highlight the channel of the pH electrode in the measured value display.
4	If necessary, select the pH display with <b>&lt;MODE&gt;</b> .
5	With manual temperature input: <ul style="list-style-type: none"> <li>– Call up the input window for the manual temperature input with <i>Measuring / Setting of man. temp...</i></li> <li>– Measure the temperature of the test sample using a thermometer.</li> <li>– Enter the measured temperature value and confirm it with <i>[OK]</i>.</li> </ul>
6	Calibrate the meter with the electrode.



#### Note

An incorrect calibration of pH electrodes leads to incorrect measured values. Calibrate regularly. The meter has to be calibrated before measuring.

#### Temperature sensor

You can measure with or without a temperature sensor. The *TP* display indicator appears when a temperature sensor is connected.

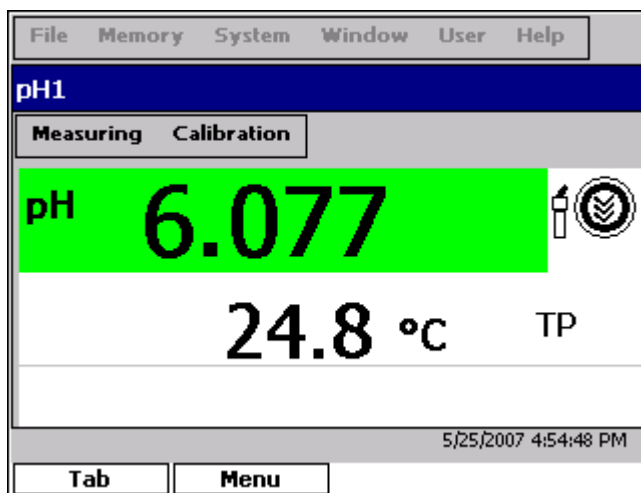


#### Note

If using a pH electrode without temperature sensor, you can also use the temperature sensor of another connected electrode or conductivity measuring cell (see page 62). In this case, the indication from which channel the temperature value is taken appears next to the temperature value.

## 7.2.2 Measuring

1	Perform the preparatory activities (see page 69).
2	Immerse the pH electrode in the test sample.
3	If necessary, select the pH parameter with <b>&lt;MODE&gt;</b> .



### Stability control

The Stability control function checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of measured values. The background color is red until the measured value is stable. When the measured value is stable, the background color switches to green.

Regardless of the setting for *Autom. stability control* (see page 63) in the *System* menu, you can start the *Stability control* function manually at any time.

1	Highlight the channel of the electrode in the measured value display.
2	If necessary, switch to the pH parameter with <b>&lt;MODE&gt;</b> .
3	Freeze the measured value with <b>&lt;SC&gt;</b> . In the status line, [SC] is displayed.
4	With <b>&lt;OK&gt;</b> activate the <i>Stability control</i> function. As long as the measured value does not meet the stability criterion, the background color is red. As soon as the measured value is stable, the background color is green. The current measurement data is downloaded to the interface. The measured values of all channels meeting the criterion for stability control are marked by SC.

**Note**

You can terminate prematurely the *Stability control* function with **<OK>** manually at any time. If the *Stability control* function is terminated prematurely, the current measurement data is not downloaded to the interface.

- |   |   |
|---|---|
| 5 | Using <b>&lt;SC&gt;</b> or <b>&lt;MODE&gt;</b> , release the frozen measured value. The [SC] status display disappears. |
|---|---|

**Criteria**

With identical measurement conditions, the following applies:

Measured parameter	Reproducibility	Response time
pH value	Better than 0.01	> 15 seconds

### 7.2.3 Measurement settings

All settings for pH measurements are in the *Measuring* menu.

Menu item	Setting	Description
<i>Measuring</i>		
— <i>pH resolution</i>	<i>High</i> (✓) <i>Medium</i> <i>Low</i>	Resolution of the pH display: <i>High</i> = 0.001 <i>Medium</i> = 0.01 <i>Low</i> = 0.1
— <i>Alternative TP</i>	(✓)	(✓) = alternative temperature sensor is used ( ) = no alternative temperature sensor is used
— <i>Setting of man. temp...</i>	-35 ... +150 °C	Entry of the manually determined temperature. For measurements without temperature sensor only.
— <i>Reset pH</i>		Resets all sensor settings to the delivery condition (see page 65).
— <i>Recorder...</i>		Start recorder (see page 163).

### 7.3 Calibration

#### Why calibrate?

pH electrodes age. This changes the zero point (asymmetry) and slope of the pH electrode. As a result, an inexact measured value is displayed. Calibration determines the current values of the zero point and slope of the electrode and stores them.

Thus, you should calibrate at regular intervals.

#### When do you have to calibrate?

- After connecting a non-ID electrode
- After the CalClock has expired

#### Buffer sets for calibration

You can use the buffer sets quoted in the table for an automatic calibration. The pH values are valid for the specified temperature values. The temperature dependence of the pH values is taken into account during the calibration.

No.	Buffer set *	pH values	at
1	<i>DIN</i> DIN buffers according to DIN 19266 and NIST Traceable Buffers	1,679 4,006 6,865 9,180 12,454	25 °C
2	<i>TEC</i>	2,000 4,010 7,000 10,011	25 °C
3	<i>Merck1</i> * (Technical buffers)	4,000 7,000 9,000	20°C
4	<i>Merck2</i> *	1,000 6,000 8,000 13,000	20°C
5	<i>Merck3</i> *	4,660 6,880 9,220	20°C
6	<i>Merck4</i> *	2,000 4,000 7,000 10,000	20°C
7	<i>Merck5</i> *	4,010 7,000 10,000	25 °C

No.	Buffer set *	pH values	at
8	<i>DIN 19267</i> *	1,090 4,650 6,790 9,230	25 °C
9	<i>Mettler EU</i>	1,679 4,003 7,002 10,013	25 °C
10	<i>Mettler US</i> *	1,995 4,005 7,002 9,208	25 °C
11	<i>Fisher</i> *	2,007 4,002 7,004 10,002	25 °C
12	<i>Fluka</i> *	4,006 6,984 8,957	25 °C
13	<i>Radiometer</i> *	1,678 4,005 7,000 9,180	25 °C
14	<i>Baker</i> *	4,006 6,991 10,008	25 °C
15	<i>Metrohm</i> *	3,996 7,003 8,999	25 °C
16	<i>Beckmann</i> *	4,005 7,005 10,013	25 °C
17	<i>Hamilton DC</i> *	4,005 7,002 10,013	25 °C
18	<i>Precisa (Hamilton Duracal)</i> *	3,996 7,003 8,999	25 °C

No.	Buffer set *	pH values	at
19	<i>Reagecon TEC</i> *	2,000 4,010 7,000 10,000	25 °C
20	<i>Reagecon 20</i> *	2,000 4,000 7,000 10,000 13,000	20°C
21	<i>Reagecon 25</i> *	2,000 4,000 7,000 10,000 13,000	25 °C
22	<i>Riedel-de Haen</i> *	2,000 4,000 7,000 10,000	20°C

\* Brand names or trade names are trademarks of their respective owners protected by law (see page 207).



#### Note

The buffers are selected in the *Calibration* sensor menu (see page 73).

### Calibration points

Calibration can be performed using one to five buffer solutions in any order (single-point to five-point calibration). The measuring instrument determines the following values and calculates the calibration line as follows:

	Displayed calibration data
<b>1-point</b>	<ul style="list-style-type: none"> <li>● Zero point</li> <li>● Slope = Nernst slope (-59.16 mV/pH at 25 °C)</li> </ul>
<b>2-point</b>	<ul style="list-style-type: none"> <li>● Zero point</li> <li>● Slope</li> </ul>
<b>3-point to 5-point</b>	<ul style="list-style-type: none"> <li>● Zero point</li> <li>● Slope</li> </ul> <p>The calibration line is calculated by linear regression.</p>

**Note**

You can display the slope in the unit, *mV/pH* or % (see page 73).

**Stability control**

The calibration procedure automatically activates the stability control function. The current measurement with stability control can be terminated at any time (accepting the current value).

**Calibration record**

When finishing a calibration, the new calibration values are first displayed as an informative message. Then you can decide whether you want to take over these values of the new calibration or whether you want to continue measuring with the old calibration data. After accepting the new calibration values the calibration record is displayed.

**Display of calibration data and download to interface**

You can display the data of the last calibration (see page 158). Subsequently, you can transmit the displayed calibration data to the interface, e. g. to a printer or PC, with the **<PRINT>** key.

**Note**

The calibration record is automatically transmitted to the interface after calibrating.

**Sample record:**





```
Print date26.04.07 16 was selected:13
ProLab 4000 (06249876)
Current user: 1234567890

CALIBRATION pH
Calibration date20.04.07 10:14:03
A 161 1M-BNC-ID (A062498765)
User: Administrator

Calibration interval 7 days
AutoCal DIN 2-point TAuto SC
Buffer 1          6.86
Buffer 2          9.18
Voltage 1         7.2 mV      26.3 °C
Voltage 2        -171 mV     26.3 °C
Slope            -59.2 mV/pH
Zero point       -0.5 mV
Sensor          +++
```

**Calibration evaluation**

After calibrating, the meter automatically evaluates the calibration. The zero point and slope are evaluated separately. The worse evaluation of both is taken into account. The evaluation appears on the display and in the calibration record.

Display	Calibration record	Zero point [mV]	Slope [mV/pH]
	+++	-18 ... +18	-60.5 ... -57.5
	++	-22 ... +22	-57.5 ... -56
	+	-26 ... +26	-61 ... -60.5 or -56 ... -55
	-	-30 ... +30	-62 ... -61 or -55 ... -50
Clean the electrode according to the sensor operating manual			
<i>Error</i>	<i>Error</i>	< -30 or > 30	... -62 or ... -50
Eliminate the error according to chapter 16 WHAT TO DO IF... (page 189)			

**Preparatory activities**

Perform the following preparatory activities when you want to calibrate:

1	Connect a pH electrode to the meter.
2	Highlight the channel of the electrode in the measured value display.
3	If necessary, select the pH display with <b>&lt;MODE&gt;</b> .
4	Keep the buffer solutions ready. Adjust the temperature of the buffer solutions, or measure the current temperature, if you measure without a temperature sensor.

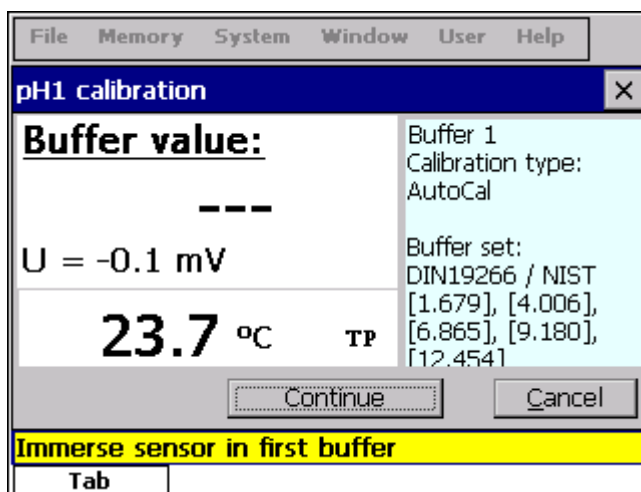
### 7.3.1 Carrying out a calibration procedure (example: *AutoCal DIN*)

Make sure the *Calibration / pH calibration type / Buffer sets* setting is selected correctly and the *AutoCal* calibration type is marked (see page 73).

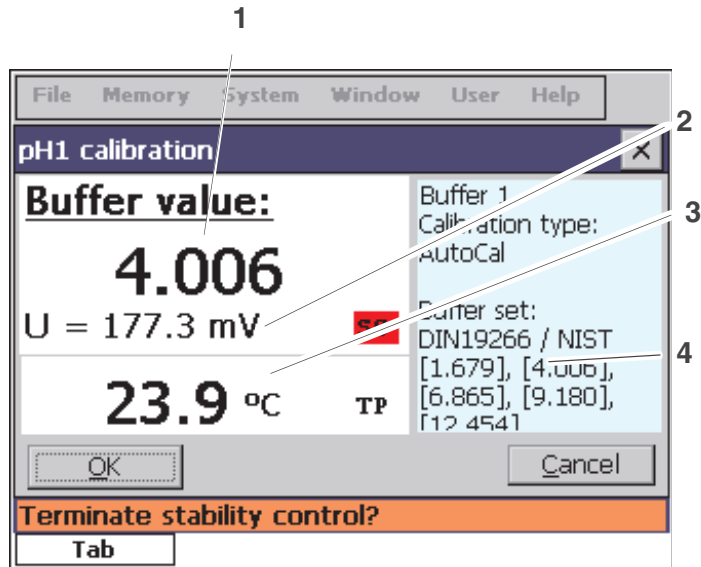
Use any one to five buffer solutions of the selected buffer set.

The *DIN* calibration is described below. With other buffer sets, other nominal buffer values are displayed. Apart from that, the procedure is identical.

- 1 Perform the preparatory activities (see page 78).
- 2 Start the calibration with **<CAL>**.  
The *pHX calibration* window opens.

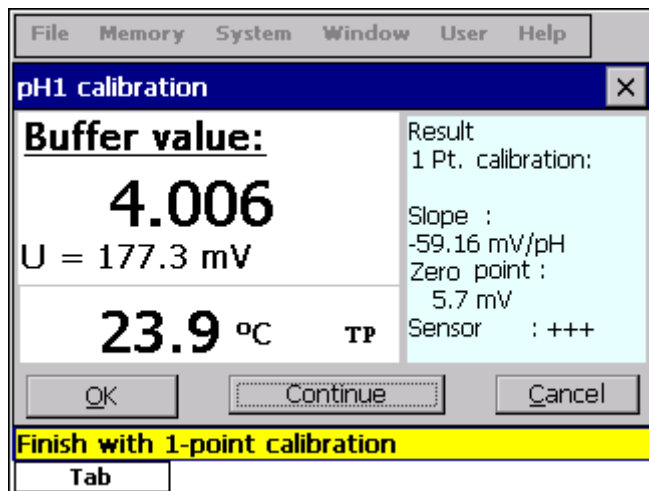


- 3 If necessary, check whether the displayed buffer set agrees with the used buffer set.
- 4 When measuring without temperature sensor:
  - Measure the temperature of the standard solution using a thermometer.
  - Open the setting window for the temperature value with **[Man. temp.]**.
  - Enter the temperature and confirm with **[OK]**.
- 5 Thoroughly rinse the electrode with distilled water.
- 6 Immerse the electrode in buffer solution 1.
- 7 Start the measurement with **[Continue]**.  
The measured value is checked for stability (Stability control).



- 1 Recognized nominal buffer value (referring to 25 °C)
- 2 Current electrode voltage
- 3 Current temperature value
- 4 Selected buffer set

8 Wait for the measurement with stability control to end.  
 or  
 Terminate the stability control with [OK].  
 The *pHX calibration* window for the according to buffer solution pops up and the *Finish with 1-point calibration* infotext is displayed.



- |   |   |
|---|---|
| 9 | <p>Using <i>[OK]</i>, confirm the <i>Finish with 1-point calibration</i> infotext and take over the new calibration values.<br/>The calibration record is displayed and output to the interface.<br/>The calibration procedure is finished.</p> <p>or</p> <p>Continue the calibration with <i>[Continue]</i>.</p> <p>or</p> <p>Cancel the calibration procedure without taking over the calibration values with <i>[Cancel]</i>, or <b>&lt;ESC&gt;</b>.</p> |
|---|---|

**Note**

For **single-point calibration**, the meter uses the Nernst slope (-59.16 mV/pH at 25 °C) and determines the zero point of the electrode.

**Continuing with two-point calibration**  
(*Buffer: DIN*)

- |    |   |
|----|---|
| 10 | <p>When measuring without temperature sensor:</p> <ul style="list-style-type: none"> <li>● Measure the temperature of the standard solution using a thermometer.</li> <li>● Open the setting window for the temperature value with <b>[Man. temp.]</b>.</li> <li>● Enter the temperature and confirm with <i>[OK]</i>.</li> </ul>   |
| 11 | Thoroughly rinse the electrode with distilled water.  |
| 12 | Immerse the electrode in buffer solution 2.   |
| 13 | <p>Start the measurement with <i>[Continue]</i>.<br/>The measured value is checked for stability (Stability control).</p>   |
| 14 | <p>Wait for the measurement with stability control to end.<br/>or<br/>Terminate the stability control with <i>[OK]</i>.<br/>The <i>pHX calibration</i> window for the according to buffer solution pops up and the <i>Finish with 2-point calibration</i> infotext is displayed.</p>  |
| 15 | <p>Using <i>[OK]</i>, confirm the <i>Finish with 2-point calibration</i> infotext and take over the new calibration values.<br/>The calibration record is displayed and output to the interface.<br/>The calibration procedure is finished.</p> <p>or</p> <p>Continue the calibration with <i>[Continue]</i>.</p> <p>or</p> <p>Cancel the calibration procedure without taking over the calibration values with <i>[Cancel]</i>, or <b>&lt;ESC&gt;</b>.</p> |



**Continuing with three-point to five-point calibration (Buffer ) DIN)**

**Note**

A calibration line is determined for the **two-point calibration**.

16	When measuring without temperature sensor: <ul style="list-style-type: none"> <li>● Measure the temperature of the standard solution using a thermometer.</li> <li>● Open the setting window for the temperature value with <b>[Man. temp.]</b>.</li> <li>● Enter the temperature and confirm with <b>[OK]</b>.</li> </ul>
17	Thoroughly rinse the electrode with distilled water.
18	Immerse the electrode in buffer solution 3.
19	Start measurement of the next buffer with <b>[Continue]</b> . The measured value is checked for stability (Stability control).
20	Wait for the measurement with stability control to end. or Terminate the stability control with <b>[OK]</b> . The <i>pHX calibration</i> window for the according to buffer solution pops up and the <i>Finish with 3-point calibration</i> infotext is displayed.
21	Using <b>[OK]</b> , confirm the <i>Finish with 3-point calibration</i> infotext and take over the new calibration values. The calibration record is displayed and output to the interface. The calibration procedure is finished. or Continue the calibration with <b>[Continue]</b> . or Cancel the calibration procedure without taking over the calibration values with <b>[Cancel]</b> , or <b>&lt;ESC&gt;</b> .



**Note**

The calibration is automatically finished after all buffers of a buffer set were used.



**Note**

The calibration line is determined by linear regression.

### 7.3.2 Carrying out a calibration procedure (example: *VariCal*)

Make sure the *Calibration / pH calibration type / VariCal* calibration type is marked (see page 73).

#### Single-point calibration

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

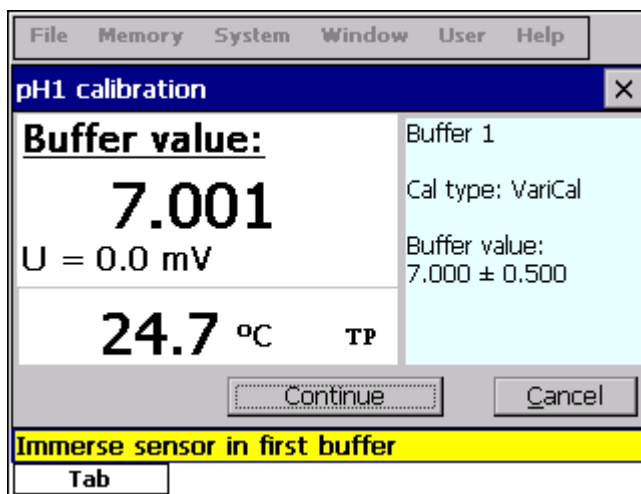
#### Two-point calibration

Use two buffer solutions for this procedure:

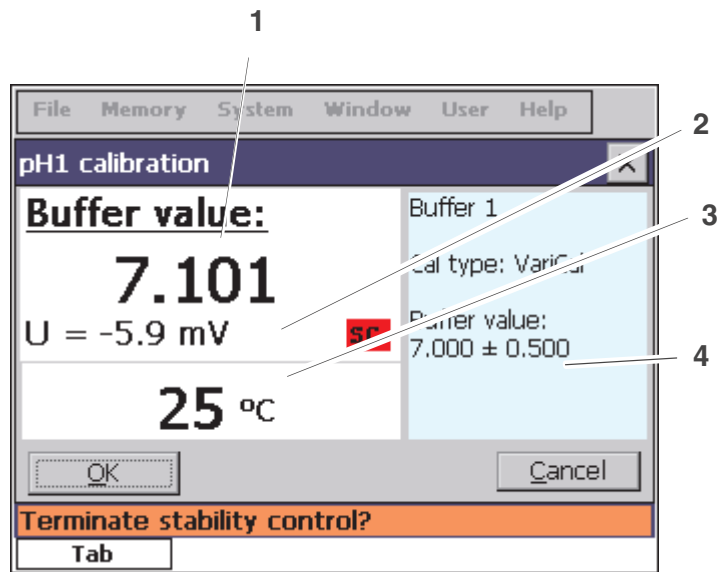
- first buffer solution: pH  $7.000 \pm 0.500$
- any other buffer solution

To carry out the calibration procedure, the *pH calibration type VariCal* must be set in the sensor menu (see page 87).

1	Perform the preparatory activities (see page 78).
2	Start the calibration with <b>&lt;CAL&gt;</b> . The <i>pHX calibration</i> window opens.

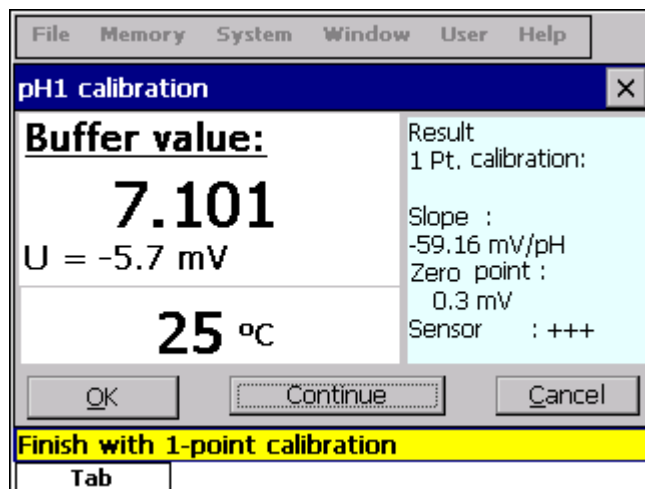


3	When measuring without temperature sensor: <ul style="list-style-type: none"> <li>● Measure the temperature of the standard solution using a thermometer.</li> <li>● Open the setting window for the temperature value with <b>[Man. temp.]</b>.</li> <li>● Enter the temperature and confirm with <b>[OK]</b>.</li> </ul>
4	Thoroughly rinse the electrode with distilled water.
5	Immerse the electrode in buffer solution 1 (pH $7.000 \pm 0.500$ ).
6	Start the measurement with <b>[Continue]</b> . The measured value is checked for stability (Stability control).



- 1 Recognized nominal buffer value (referring to 25 °C)
- 2 Current electrode voltage
- 3 Current temperature value
- 4 Selected buffer set

7 Wait for the measurement with stability control to end.  
 or  
 Terminate the stability control with [OK].  
 The *pHX calibration* window for the according to buffer solution pops up and the *Finish with 1-point calibration* infotext is displayed.



- |   |   |
|---|---|
| 8 | <p>Using <i>[OK]</i>, confirm the <i>Finish with 1-point calibration</i> infotext and take over the new calibration values.<br/>The calibration record is displayed and output to the interface.<br/>The calibration procedure is finished.</p> <p>or</p> <p>Continue the calibration with <i>[Continue]</i>.</p> <p>or</p> <p>Cancel the calibration procedure without taking over the calibration values with <i>[Cancel]</i>, or <b>&lt;ESC&gt;</b>.</p> |
|---|---|

**Note**

For **single-point calibration**, the meter uses the Nernst slope (-59.16 mV/pH at 25 °C) and determines the zero point of the electrode.

### Continuing with two-point calibration

- |    |   |
|----|---|
| 9  | <p>When measuring without temperature sensor:</p> <ul style="list-style-type: none"> <li>● Measure the temperature of the standard solution using a thermometer.</li> <li>● Open the setting window for the temperature value with <b>[Man. temp.]</b>.</li> <li>● Enter the temperature and confirm with <i>[OK]</i>.</li> </ul>   |
| 10 | Thoroughly rinse the electrode with distilled water.  |
| 11 | Immerse the electrode in buffer solution 2.   |
| 12 | <p>Start the measurement with <i>[Continue]</i>.<br/>The measured value is checked for stability (Stability control).</p>   |
| 13 | <p>Wait for the measurement with stability control to end.</p> <p>or</p> <p>Terminate the stability control with <i>[OK]</i>.<br/>The <i>pHX calibration</i> window for the according to buffer solution pops up and the <i>Finish with 2-point calibration</i> infotext is displayed.</p>  |
| 14 | <p>Using <i>[OK]</i>, confirm the <i>Finish with 2-point calibration</i> infotext and take over the new calibration values.<br/>The calibration record is displayed and output to the interface.<br/>The calibration procedure is finished.</p> <p>or</p> <p>Continue the calibration with <i>[Continue]</i>.</p> <p>or</p> <p>Cancel the calibration procedure without taking over the calibration values with <i>[Cancel]</i>, or <b>&lt;ESC&gt;</b>.</p> |

**Note**

A calibration line is determined for the **two-point calibration**.

### 7.3.3 Calibration settings and calibration data

In the *Calibration* menu, you can

- set the calibration interval,
- define the calibration type and
- view the calibration data.

Menu item	Setting	Description
<i>Calibration</i>		
— pH calibration type		
— AutoCal	(✓)	Calibration with commercial buffer sets. The buffer set is selected with the next menu item ( <i>Buffer sets</i> )
— Buffer sets	DIN (✓) TEC ...	Buffer sets to be used for pH calibration. For details, see page 74.
— VariCal	(✓)	Calibration with any buffer solutions
— Slope in	mV/pH (✓) %	Unit of the slope. The % display refers to the Nernst slope of -59.16 mV/pH ([determined slope/Nernst slope] x 100).
— Zero point in	mV (✓) pH	Unit for the zero point.
— Calibration interval...	1 ... 999	<i>Calibration interval...</i> for the pH electrode (in days). The meter reminds you to calibrate regularly by the red frame around the CalClock in the measuring window.
— Calibration history...		Displays the calibration history of the last calibrations.

### 7.3.4 Calibration interval

The calibration interval and calibration evaluation are indicated on the display as the CalClock.

#### CalClock



The remaining time of the calibration interval is indicated by the segmented ring around the calibration evaluation. This segmented ring reminds you to calibrate regularly.

The CalClock appears on a red square after the specified calibration interval has expired. It is still possible to measure.



#### Note

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

#### Setting the calibration interval

The calibration interval is set to 7 days in the factory. You can change the interval (1 ... 999 days):

1	Highlight the channel of the electrode in the measured value display.
2	If necessary, select the pH display with <b>&lt;MODE&gt;</b> .
3	Open the input window for the calibration intervals with <i>Calibration / Calibration interval...</i>
4	Enter the calibration interval with <b>&lt;0...9&gt;</b> .
5	Confirm the setting with <b>&lt;OK&gt;</b> .

## 8 ORP voltage

### 8.1 General information

You can measure the following variables:

- ORP [mV]
- Relative ORP [mV]

#### Temperature measurement

The temperature value is measured and documented with all measurements.

You have the following options to measure the temperature:

- Automatic temperature measurement with
  - Temperature sensor (NTC30 or Pt1000) integrated in electrode (if available).
  - the integrated temperature sensor of another electrode that is connected and immersed in the sample at the same time.
  - an external temperature sensor (NTC30 or Pt1000).
- Manual determination and input of the temperature.

The display of the temperature indicates the active temperature measuring mode:

Temperature sensor	Resolution of the temp. display	Mode
yes	0.1 °C	Automatic with temperature sensor
-	1 °C	Manual

## 8.2 Measuring the ORP

### 8.2.1 Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Adjust the temperature of the solutions and measure the current temperature if the measurement is made without a temperature sensor.
2	Connect the ORP electrode to the meter.
3	Highlight the channel of the electrode in the measured value display.
4	If necessary, select the U or dU display with <b>&lt;MODE&gt;</b> .
5	Adjust the temperature of the solutions and measure the current temperature if the measurement is made without a temperature sensor.
6	With manual temperature input: Call up the manual input of the temperature value with <i>Measuring / Setting of man. temp....</i>
7	Enter the measured temperature value and confirm it with <b>[OK]</b> .
8	Check the meter with the electrode.



#### Note

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

#### Temperature sensor

You can measure with or without a temperature sensor. The *TP* display indicator appears when a temperature sensor is connected.



#### Note

If using an ORP electrode without temperature sensor, you can also use the temperature sensor of another electrode (see page 62). In this case, the indication from which channel the temperature value is taken appears next to the temperature value.

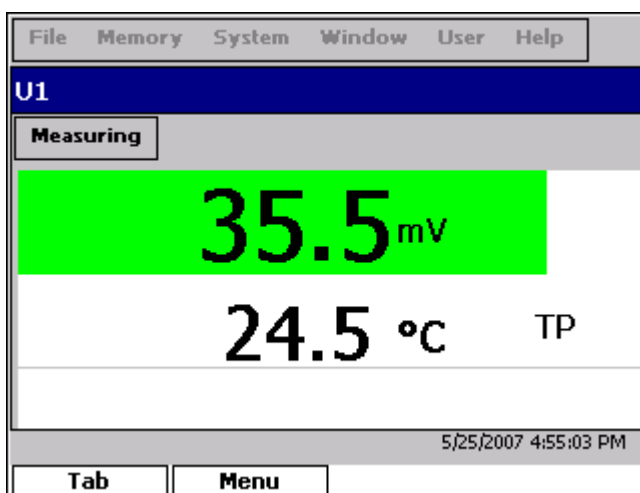
## 8.2.2 Measuring



### Note

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

1	Perform the preparatory activities (see page 69).
2	Highlight the channel of the electrode in the measured value display.
3	If necessary, select the U display with <b>&lt;MODE&gt;</b> .
4	Immerse the ORP electrode in the test sample.



### Stability control

The *Stability control* function checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of measured values. The background color is red until the measured value is stable.

Regardless of the setting for *Autom. stability control* (see page 63) in the *System* menu, you can start the *Stability control* function manually at any time.

1	Highlight the channel of the ORP electrode.
2	If necessary, select the U or dU parameter with <b>&lt;MODE&gt;</b> .
3	Freeze the measured value with <b>&lt;SC&gt;</b> . The display switches to the display of the selected channel as necessary. In the status line, [SC] is displayed.

- 4 With **<OK>** activate the *Stability control* function. The background color is red as long as the measured value does not meet the stability criterion. As soon as the measured value is stable, the background color is green. The current measurement data is downloaded to the interface. The measured values of all channels meeting the criterion for stability control are marked by SC.



**Note**

When you measure the electromotive force, please note that it may take some time until the measured value is stable.



**Note**

You can terminate prematurely the *Stability control* function with **<OK>** manually at any time. If the *Stability control* function is terminated prematurely, the current measurement data is not downloaded to the interface.

- 5 Using **<SC>** or **<MODE>**, release the frozen measured value. The [SC] status display disappears.

**Criteria**

With identical measurement conditions, the following applies:

Measured parameter	Reproducibility	Response time
ORP voltage	better than 0.3 mV	> 15 seconds

### 8.2.3 Measuring the relative ORP

**Note**

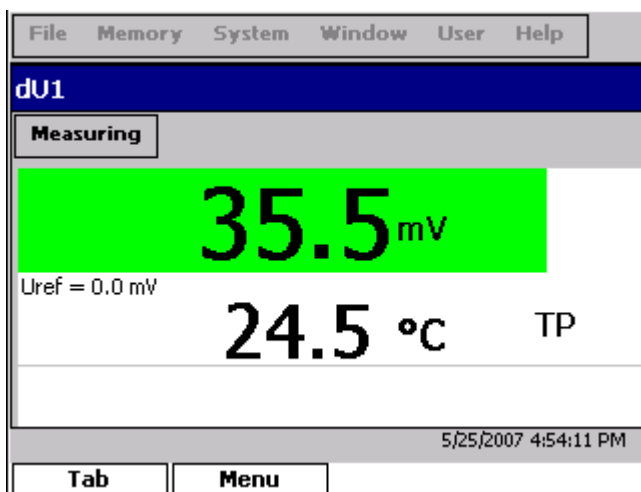
The relative ORP can be determined with pH and ORP electrodes.

To measure the difference of the ORPs of two solutions it is best to use two ORP electrodes. Define one of the ORP electrodes as the reference in the menu. The difference of the two voltages is displayed.

1	Perform the preparatory activities (see page 69).
2	Prepare the reference solution for the determination of the reference point.
3	Immerse one electrode in the reference solution. Immerse one electrode in the test sample.
4	Highlight the channel of the electrode that is in the test sample in the measured value display.
5	If necessary, select the U display with <b>&lt;MODE&gt;</b> .
6	Display the difference voltage with <i>Measuring / Referenz / anderer U-Kanal</i> .

As an alternative you can also determine the difference of the ORPs of two solutions with one ORP electrode only. To do so, first define the ORP of one solution as the zero point.

1	Perform the preparatory activities (see page 69).
2	Prepare the reference solution for the determination of the reference point.
3	Immerse the electrode in the reference solution.
4	Highlight the channel of the electrode in the measured value display.
5	If necessary, select the U display with <b>&lt;MODE&gt;</b> .
6	Display the voltage of the current zero point with <b>&lt;CAL&gt;</b> or <i>Measuring / Referenz / Determine reference...</i>
7	Measure the reference solution with <b>&lt;OK&gt;</b> . The measured voltage is defined as the zero point. or Terminate the display of the zero point with <b>&lt;ESC&gt;</b> .
8	Rinse the electrode and immerse it into the test sample.



### Stability control

The *Stability control* function checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of measured values. The background color is red until the measured value is stable.

Regardless of the setting for *Autom. stability control* (see page 63) in the *System* menu, you can start the *Stability control* function manually at any time.

1	In the measured value display, mark the channel of the ORP or pH electrode.
2	If necessary, select the U or dU parameter with <b>&lt;MODE&gt;</b> .
3	Freeze the measured value with <b>&lt;SC&gt;</b> . The display switches to the display of the selected channel as necessary. In the status line, [SC] is displayed.
4	With <b>&lt;OK&gt;</b> activate the <i>Stability control</i> function. The background color is red as long as the measured value does not meet the stability criterion. As soon as the measured value is stable, the background color is green. The current measurement data is downloaded to the interface. The measured values of all channels meeting the criterion for stability control are marked by SC.

**Note**

When you measure the electromotive force, please note that it may take some time until the measured value is stable.

**Note**

You can terminate prematurely the *Stability control* function with **<OK>** manually at any time. If the *Stability control* function is terminated prematurely, the current measurement data is not downloaded to the interface.

5	Using <b>&lt;SC&gt;</b> or <b>&lt;MODE&gt;</b> , release the frozen measured value. The [SC] status display disappears.
---	--

**Criteria**

With identical measurement conditions, the following applies:

Measured parameter	Reproducibility	Response time
ORP voltage	better than 0.3 mV	> 15 seconds

### 8.2.4 Measurement settings

The following settings are possible for ORP measurements in the *Measuring* menu:

Menu item	Setting	Description
<i>Measuring</i>		
— <i>High resolution</i>	(✓)	Resolution of the mV display: (✓) = 0.1 mV ( ) = 1 mV
— <i>Alternative TP</i>	(✓)	(✓) = Temperature sensor of another channel is used
— <i>Setting of man. temp...</i>	-35 ... +150 °C	Entry of the manually determined temperature value. For measurements without temperature sensor only.
— <i>Determine reference...</i>		Only if the relative ORP (dU) is selected as the measured parameter
— <i>Recorder...</i>		Start recorder (see page 163).

## 9 Ion concentration

### 9.1 General information



#### Note

Incorrect calibration of ion sensitive electrodes will result in incorrect measured values. Calibrate regularly before measuring.

#### Temperature measurement with ion selective measurements

The temperature value is measured and documented with all measurements.

You have the following options to measure the temperature:

- Automatic temperature measurement with
  - the temperature sensor integrated in the electrode (NTC30 or Pt1000) .
  - the integrated temperature sensor of another electrode that is connected and immersed in the sample at the same time.
  - an external temperature sensor (NTC30 or Pt1000).
- Manual determination and input of the temperature.

The display of the temperature indicates the active temperature measuring mode:

Temperature sensor	Resolution of the temp. display	Mode
yes	0.1 °C	Automatic with temperature sensor
-	1 °C	Manual

## 9.2 Measuring the ion concentration

### 9.2.1 Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect an ion sensitive electrode to the meter.
2	Highlight the channel of the electrode in the measured value display.
3	If necessary, select the ISE display with <b>&lt;MODE&gt;</b> .
4	Open the <i>Measuring / ISE settings / Ion type</i> menu and select the ion type to be measured.
5	With manual temperature input: <ul style="list-style-type: none"> <li>– Measure the temperature of the test sample using a thermometer.</li> <li>– Open the <i>Measuring / Setting of man. temp...</i> menu. The <i>Manual temperature</i> window opens.</li> <li>– Enter the measured temperature value and confirm it with <b>[OK]</b>.</li> </ul>
6	Calibrate the meter with the electrode (see page 103). or For measurement with a method, start a method. The calibration is included in the course of the measuring method (see page 113 ff.).



#### Note

While no valid calibration is available, e.g. in the delivery condition, *Error* appears in the measured value display.

### Temperature sensor

You can measure with or without a temperature sensor. The *TP* display indicator appears when a temperature sensor is connected.

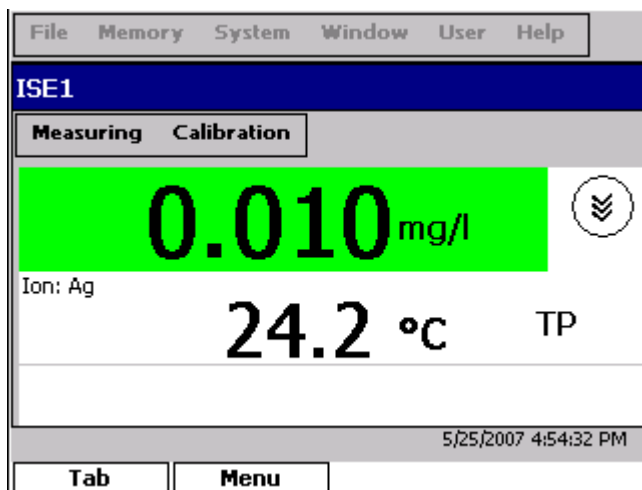


#### Note

If using an ion sensitive electrode without temperature sensor, you can also use the temperature sensor of another electrode (see page 62). In this case, the indication from which channel the temperature value is taken appears next to the temperature value.

### 9.2.2 Measuring

- 1 Perform the preparatory activities according to page 97.
- 2 Immerse the electrode in the test sample.



#### Temperature for calibrating and measuring

For precise ion selective measurements, the temperature difference between measurement and calibration should not be greater than 2 K. Therefore, adjust the temperature of the standard and measuring solutions accordingly. If the temperature difference is greater the *[TempErr]* warning appears in the measured value display.

#### Stability control

The Stability control function continuously checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of measured values. The background color is red until the measured value is stable.

Regardless of the setting for automatic *Autom. stability control* (see page 63) in the *System* menu, you can start the *Stability control* function manually at any time.

- 1 Highlight the channel of the electrode in the measured value display.
- 2 If necessary, switch to the ISE display with **<MODE>**.
- 3 Freeze the measured value with **<SC>**. In the status line, [SC] is displayed.

- 4 With **<OK>** activate the *Stability control* function. While the measured value does not meet the stability criterion, the background color is red. As soon as a stable measured value is recognized, the current measurement data is downloaded to the interface. The measured values of all channels meeting the criterion for stability control are marked by SC.

**Note**

You can terminate prematurely the *Stability control* function with **<OK>** manually at any time. If the *Stability control* function is terminated prematurely, the current measurement data is not downloaded to the interface.

- 5 Using **<SC>** or **<MODE>**, release the frozen measured value. The [SC] status display disappears.

**Criteria**

The criteria of the stability control affect the reproducibility of the measured values.

If possible, always use the highest reproducibility criteria. If the stability criteria cannot be achieved with your test sample and electrode, you can switch over to lower reproducibility criteria. The following criteria can be adjusted:

- *High*: highest reproducibility
- *Medium*: medium reproducibility
- *Low*: lowest reproducibility

**Note**

Increasing reproducibility also causes the response time to increase until a measured value is evaluated as stable.

### 9.2.3 Measurement settings

All settings for ion selective measurements are done in the *Measuring* menu.

Menu item	Setting	Description
<i>Measuring</i>		
- <i>ISE settings</i>		
- <i>Units</i>	<ul style="list-style-type: none"> <li>- <i>mg/l</i></li> <li>- <i>mol/l</i></li> <li>- <i>mg/kg</i></li> <li>- <i>ppm</i></li> <li>- <i>%</i></li> </ul>	Selection with which unit the measurement result and calibration standards should be displayed.
- <i>Ion type</i>	<i>Ag, Br, Ca, Cd, Cl, CN, CO2, Cu, F, I, K, Na, NH3, NH4, NO3, Pb, S, ION</i>	<p>Selection of the ion type to be measured</p> <p>With the <i>ION</i> setting it is possible to measure ions that are not mentioned in the list. Depending on the selected unit, (see <i>ISE settings/Units</i>) a further entry may be necessary (molar mass of the ion or density of the solution).</p>
- <i>Blank value correction</i>		
- <i>Reference measurement</i>		
- <i>Input reference value...</i>		
- <i>Stability control</i>	<ul style="list-style-type: none"> <li>- <i>High (✓)</i></li> <li>- <i>Medium</i></li> <li>- <i>Low</i></li> </ul>	Selection of criteria for the stability control (see page 100).
- <i>ISE methods</i>	<ul style="list-style-type: none"> <li>- <i>Standard addition...</i></li> <li>- <i>Double standard addition</i></li> <li>- <i>Standard subtraction...</i></li> <li>- <i>Sample addition...</i></li> <li>- <i>Sample subtraction...</i></li> <li>- <i>Blank value addition...</i></li> </ul>	Selection of the available measuring methods.

Menu item	Setting	Description
<i>Measuring</i>		
<i>Alternative TP</i>	(✓)	(✓) : alternative temperature sensor is used ( ) : no alternative temperature sensor is used
<i>Setting of man. temp...</i>	-35 ... +150 °C	Entry of the manually determined temperature. For measurements without temperature sensor only.

### 9.3 Calibration

#### Why calibrate?

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

Thus, you should calibrate before each measurement and at regular intervals.

#### When to calibrate?

- Before any measurement if possible
- After connecting another ion selective (combination) electrode

#### Standard solutions

Use two to nine different standard solutions. The standard solutions have to be selected in either increasing or decreasing order.

Standard solution (Std 1 - 9)	Values
Unit [mg/l]	0.001 ... 500000
Unit [mol/l]	0.010 ... 5000 $\mu$ mol/l 10.00 ... 5000 mmol/l
Unit [mg/kg]	0.001 ... 500000
Unit [ppm]	0.001 ... 500000
Unit [%]	0.0001 ... 50000

In addition to the list with defined values for the standard solutions, you can enter any concentration for a standard.



#### Note

The measurement precision is also dependent on the selected standard solutions. Therefore, the selected standard solutions should cover the expected value range of the subsequent concentration measurement.

#### Temperature for calibrating and measuring

For precise ion selective measurements, the temperature difference between measurement and calibration should not be greater than 2 K. Therefore, adjust the temperature of the standard and measuring solutions accordingly. If the temperature difference is greater the *[TempErr]* warning appears in the measured value display.

**ISE Cal** This is the conventional **two-point to nine-point calibration procedure** that uses 2 to 9 freely selectable standard solutions. The concentration expected in the measurement determines the concentration of the calibration standards.

**Stability control** During calibration, the stability control is automatically activated. The current measurement with stability control can be terminated at any time (accepting the current value).

**Calibration record** The new calibration values are displayed when a calibration procedure is finished. Then you can decide whether you want to take over these values of the new calibration or whether you want to continue measuring with the old calibration data. After accepting the new calibration values the calibration record is displayed.

**Display of calibration data and download to interface** You can display the data of the last calibration (see page 160). Subsequently, you can transmit the displayed calibration data to the interface, e. g. to a printer or PC, with the **<PRINT>** key.

**Note**

The calibration record is automatically transmitted to the interface after calibrating.

**Sample record:**


```
Print date 26.04.07 16:13
ProLab 4000 (06249876)
Current user: 1234567890

CALIBRATIONISE
Calibration date      20.04.07 10:14:03
User: Administrator

Standard 1:          0.010 mg/l
Standard 2:          0.020 mg/l
Voltage 1:           0.0 mV 24.0 °C
Voltage 2:           9.0 mV 24.0 °C
Ion type:            Ag
Slope:               29.9 mV
Sensor               +++
```

**Calibration evaluation**

After calibrating, the meter automatically evaluates the calibration.

Display	Calibration record	Magnitude of the slope [mV]	
		Ions with valency 1	Ions with valency 2
	+++	50.0 ... 70.0	25.0 ... 35.0
<i>Error</i> Eliminate the error according to chapter 16 WHAT TO DO IF... (page 189)	<i>Error</i>	< 50 or > 70	< 25 or > 35

### 9.3.1 Carrying out calibration

Use two to nine standard solutions in ascending or descending order.



**Note**

When calibrating within the framework of a method measurement, it is always a two-point calibration.

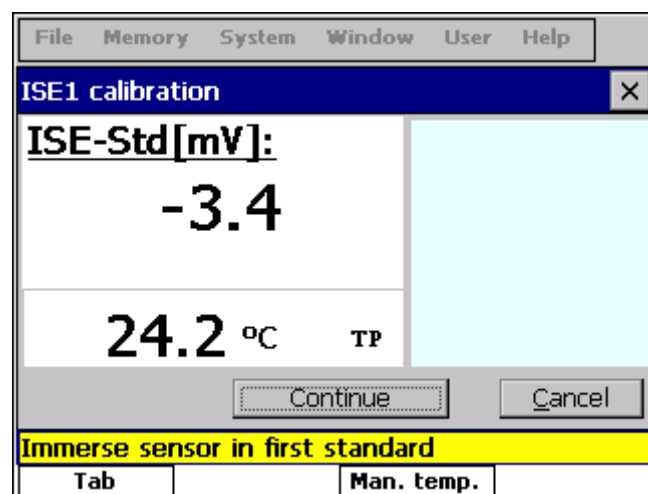
**Preparatory activities**

Perform the following preparatory activities when you want to calibrate:

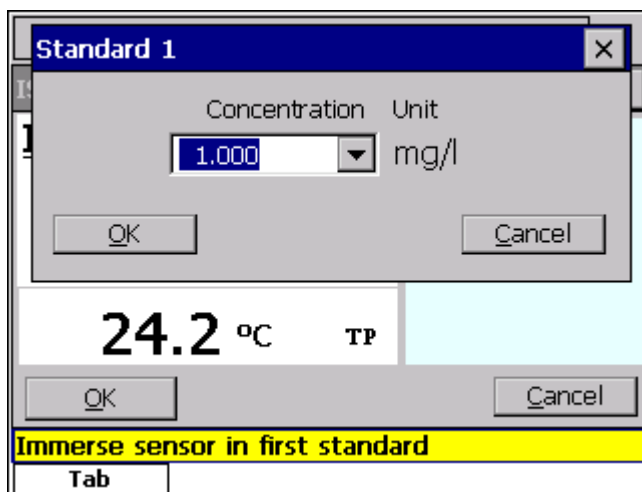
1	Connect an ion sensitive electrode to the meter.
2	Highlight the channel of the electrode in the measured value display.
3	If necessary, select the ISE display with <b>&lt;MODE&gt;</b> .
4	If necessary, open the <i>Measuring / ISE settings / Ion type</i> menu and select the ion type to be measured.
5	Keep the standard solutions ready.
6	If necessary, measure the temperature of the standard solutions with a thermometer.
7	If necessary, change the unit of the measurement result and calibration standards in the menu, <i>Measuring/Units</i> .

**Calibration**

1	Perform the preparatory activities (see page 106).
2	Start the calibration with <b>&lt;CAL&gt;</b> . The <i>ISEX calibration</i> window opens.



- |   |  |
|---|--|
| 3 | When measuring without temperature sensor: <ul style="list-style-type: none"> <li>● Measure the temperature of the standard solution using a thermometer.</li> <li>● Open the setting window for the temperature value with <b>[Man. temp.]</b>.</li> <li>● Enter the temperature and confirm with <b>[OK]</b>.</li> </ul> |
| 4 | Thoroughly rinse the electrode with distilled water.   |
| 5 | Immerse the electrode in standard solution 1.  |
| 6 | Open the <i>ISE standard input</i> window with <b>[Continue]</b> .   |



- |   |  |
|---|--|
| 7 | Select a value from the <i>Concentration</i> list.<br>or<br>Enter a value with <b>&lt;0...9&gt;</b> .<br>or<br>Cancel the calibration with <b>[Cancel]</b> . |
|---|--|

**Note**

To enter a concentration in exponential representation such as 1.00 E2 mg/l:

Enter the mantissa with **<0...9>** (here: 1.00).

Enter the exponential sign (E) with **<- .><- .>**.

Enter the exponent with **<0...9>** (here: 2).

- |   |   |
|---|---|
| 8 | Start the measurement with <b>[OK]</b> .<br>The measured value is checked for stability ( <i>Stability control</i> ). |
|---|---|

- 9 | Wait for the measurement with stability control to end.  
or  
Take over the calibration value with *[OK]*.  
The *ISE standard input* window for the entry of the concentration of the second standard solution pops up.

### Continuing with two-point calibration

- 10 | Select a value from the *ISE-Std* list.  
or  
Enter a value and, if necessary, an exponent with **<0...9>**.  
or  
Cancel the calibration with *[Cancel]*.



#### Note

To enter a concentration in exponential representation such as 1.00 E2 mg/l:

Enter the mantissa with **<0...9>** (here: 1.00).

Enter the exponential sign (E) with **<- .><- .>**.

Enter the exponent with **<0...9>** (here: 2).

- 11 | When measuring without temperature sensor:
- Measure the temperature of the standard solution using a thermometer.
  - Open the setting window for the temperature value with **[Man. temp.]**.
  - Enter the temperature and confirm with *[OK]*.
- 12 | Thoroughly rinse the electrode with distilled water.
- 13 | Immerse the electrode in standard solution 2.
- 14 | Start the measurement with *[OK]*.  
The measured value is checked for stability (*Stability control*).
- 15 | Wait for the measurement with stability control to end.  
or  
Take over the calibration value with *[OK]*.  
The *ISEX calibration* window for the next standard solution pops up and the *Finish with 2-point calibration* infotext is displayed.

- 16 Using [OK], confirm the *Finish with 2-point calibration* infotext and take over the new calibration values.  
The calibration record is displayed and output to the interface.  
The calibration procedure is finished.  
or  
Continue the calibration with [Continue].  
or  
Cancel the calibration procedure without taking over the calibration values with <ESC>.

**Note**

A calibration line is determined for the **two-point calibration**.

**Continuing with three-point to nine-point calibration**

Repeat the steps 9 to 16 in the same way with the third and further standard solutions as necessary. The new calibration values are displayed after the last calibration step is finished.

**Note**

Based on the calibration data, the calibration line is determined in sections. A straight line of the calibration is determined according to the Nernst equation between the highest and second highest calibration standard.

Between the lowest and second lowest calibration standard, a calibration line is determined according to the Nernst equation modified by Nikolski. The Nikolski equation reproduces the real course of the characteristic curve of the electrode for the low concentration range.

### 9.3.2 Calibration data

In the *Calibration* menu, you can view the calibration data of ISE calibrations.

Menu item	Description
<i>Calibration</i>	
— <i>Calibration record...</i>	Displays the calibration record of the last calibration.
— <i>Calibration history...</i>	Displays the calibration history of the last calibrations.

### 9.4 Blank value correction

If the ion concentration in the sample is so small that it is not in the linear range of the electrode, you can increase the ion concentration in the linear range with the blank value correction by the addition of a blank value solution.

The displayed measured value is the difference between the actual measured value and the determined blank value.

#### Calibration

1	In the <i>Measuring / ISE Setup</i> menu, select and confirm the menu item, <i>Blank value correction</i> . The <i>Blank value correction</i> function is active (✓).
2	Carry out a 2 to 5-point calibration according to the user guide (see page 106). As soon as a stable value is achieved for the standard calibration solution, the slope (mV) and evaluation (Error, +++) of the electrode after calibration is displayed. The infotext, <i>Accept calibration and terminate</i> is displayed.
3	Using <i>[OK]</i> , confirm the infotext <i>Accept calibration and terminate</i> . The calibration record is displayed and output to the interface. The calibration procedure is finished.
4	Close the calibration record with <i>[OK]</i> . The prompt for the measurement of the blank value appears.

#### Measuring

5	Thoroughly rinse the electrode with deionized water.
6	Immerse the electrode in the blank value solution.
7	Start the measurement with <i>[Continue]</i> . The measured value is checked for stability (Stability control).
8	Wait for the measurement with stability control to end. or Take over the measured value with <i>[OK]</i> . The calibration record is displayed and output to the interface. The calibration procedure is finished.
9	Close the calibration record with <i>[OK]</i> .

## 9.5 Reference measurement

A reference measurement enables you to assign any concentration value to the calibration curve of your electrode for a specific ion concentration (reference concentration).

Prerequisite: A valid calibration must be available.

### Determining the reference value and activating reference measurement

1	Only if no valid calibration is available (no sensor symbol on the measured value display): Perform a calibration (see page 103).
2	Prepare the solution with reference concentration.
3	Open the <i>Measuring / Input reference value...ISE settings</i> menu. The window for the entry of the reference value pops up.
4	Enter the reference value and confirm with <i>[OK]</i> . The <i>[ISERef]</i> symbol is displayed in the status line. The measurement with reference value is active.

### Switching off the reference measurement

1	In the <i>Measuring / ISE settings</i> menu, select and confirm the menu item, <i>Reference measurement</i> . The <i>Reference measurement</i> function is switched off. The <i>[ISERef]</i> symbol disappears from the status line.
---	--

### Activating reference measurement with existing reference value

If a reference value was determined but the reference measurement was switched off, the reference value does not have to be determined again if you want to measure with the reference. The meter has stored the last reference value with the respective concentration.

1	In the <i>Measuring / ISE settings</i> menu, select and confirm the menu item, <i>Reference measurement</i> . The <i>Reference measurement</i> function is activated. The <i>[ISERef]</i> symbol is displayed in the status line.
---	---

## 9.6 Measuring with increment procedure (methods)

### 9.6.1 Selecting the measuring method

The following methods are supported:

- *Standard addition*
- *Double standard addition*
- *Standard subtraction*
- *Sample addition*
- *Standard subtraction*
- *Blank value addition* (Standard addition with blank value correction)

1	Perform the preparatory activities (see page 103).
2	Highlight the channel of the electrode in the measured value display.
3	If necessary, select the ISE display with <b>&lt;MODE&gt;</b> .
4	Thoroughly rinse the electrode with distilled water.
5	Adjust the temperature of the calibration standard solutions.
6	Select a unit in the menu, <i>Measuring / ISE settings / Units</i> .
7	Select a method in the menu, <i>Measuring / ISE methods</i> . The selected method is started (see page 114 ff).

### 9.6.2 Standard addition

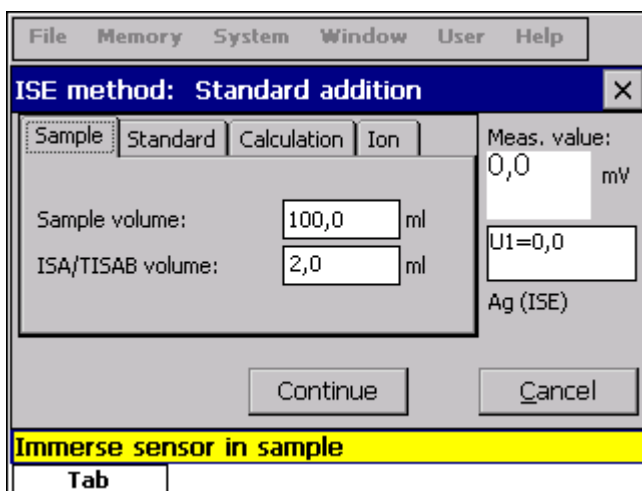
In the *Standard addition* procedure, a known amount of standard solution is added to the sample.

The ion concentration in the sample is calculated from the change in potential.

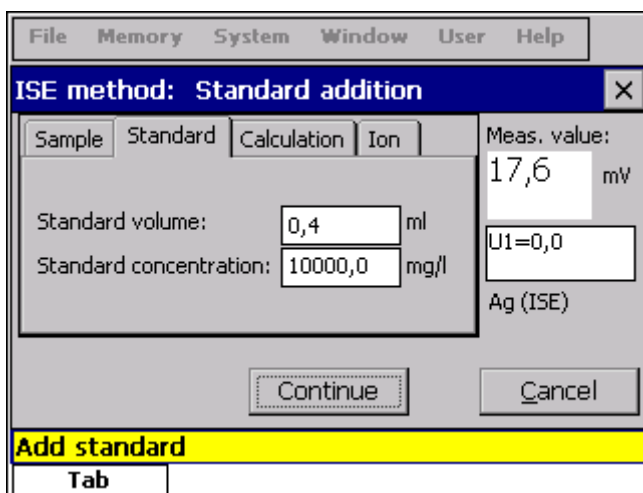
#### Calibration

- |   |  |
|---|--|
| 1 | Check the currently displayed ion.<br>If the ion to be measured is displayed incorrectly:<br>Select the ion type in the menu, <i>Measuring / ISE methods / Ion type</i> .  |
| 2 | In the <i>Measuring / ISE methods</i> menu, select the method, <i>Standard addition</i> .<br>The <i>ISE standard input</i> window for the first calibration standard appears.  |
| 3 | Carry out a two-point calibration according to the user guidance (see page 106).<br>As soon as a stable value is achieved for the second standard calibration solution, the slope (mV) and evaluation (Error, +++) of the electrode after calibration is displayed.<br>The infotext, <i>Accept calibration and terminate</i> is displayed. |
| 4 | Using <i>[OK]</i> , confirm the infotext <i>Accept calibration and terminate</i> .<br>The calibration record is displayed and output to the interface.<br>The calibration procedure is finished.   |
| 5 | Close the calibration record with <i>[OK]</i> .<br>The <i>ISE method: The Standard addition</i> window pops up. The <i>Sample</i> register is displayed.   |

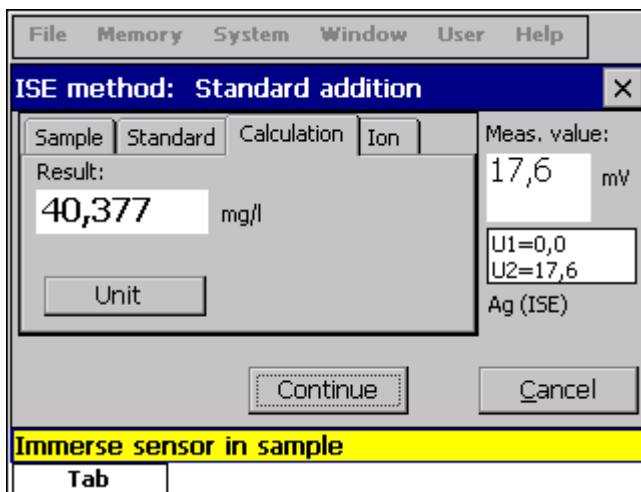
#### Measuring



6	In the <i>Sample</i> register, enter the values for the sample volume ( <i>Sample volume</i> ) and the volume of the ISA/TISAB solution ( <i>ISA/TISAB volume</i> ) as necessary.
7	Thoroughly rinse the electrode with deionized water.
8	Immerse the electrode in the sample.
9	Start the measurement with <i>[Continue]</i> . The measured value is checked for stability (Stability control).
10	Wait for the measurement with stability control to end. or Take over the calibration value with <i>[OK]</i> . The <i>Standard</i> register with the calculated measured value pops up.



11	In the <i>Standard</i> register, enter the values for <i>Standard volume</i> and <i>Standard concentration</i> if necessary.
12	Add the standard solution to the sample.
13	Start the measurement with <i>[Continue]</i> . The measured value is checked for stability (Stability control).
14	Wait for the measurement with stability control to end. or Take over the calibration value with <i>[OK]</i> . The <i>Calculation</i> register with the calculated measured value pops up.



15	Change the displayed unit of the measured value with <i>[Unit]</i> if necessary.
16	If required, display the record of the current measurement with <i>[Record]</i> .
17	Start measuring further samples with <i>[Continue]</i> . Repeat the steps 5 - 15 for all samples. or Terminate the measuring method with <i>[Cancel]</i> and confirm the safety query with <i>[OK]</i> . Measurement with the selected method is completed.

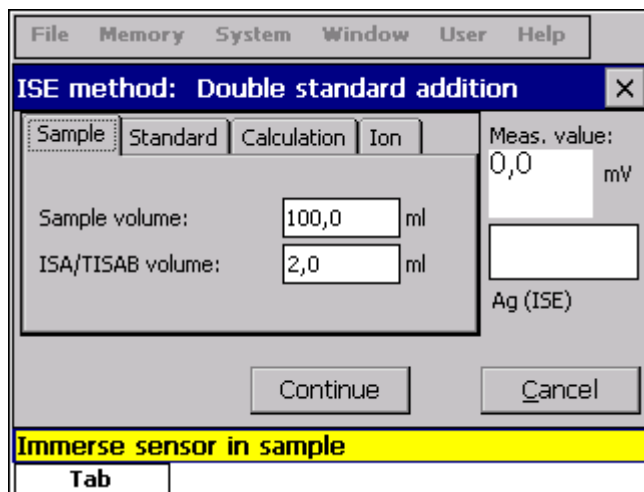
### 9.6.3 Double standard addition

In the *Double standard addition* procedure, a known amount of standard solution is added to the sample in two steps. First, one percent of the sample volume is added, then 2 percent of the sample volume is added.

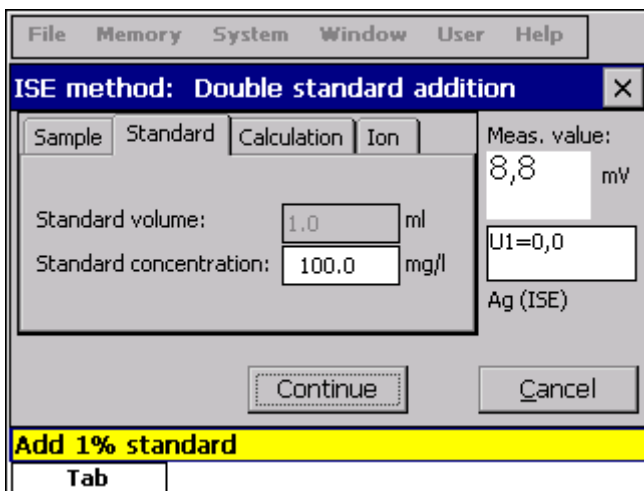
The ion concentration in the sample is calculated from the change in potential between the first and second addition of standard solution.

#### Measuring

1	Check the currently displayed ion. If the ion to be measured is displayed incorrectly: Select the ion type in the menu, <i>Measuring / ISE methods / Ion type</i> .
2	In the <i>Measuring / ISE methods</i> menu, select the method, <i>Double standard addition</i> . The <i>ISE method: The Double standard addition</i> window pops up. The <i>Sample</i> register is open.

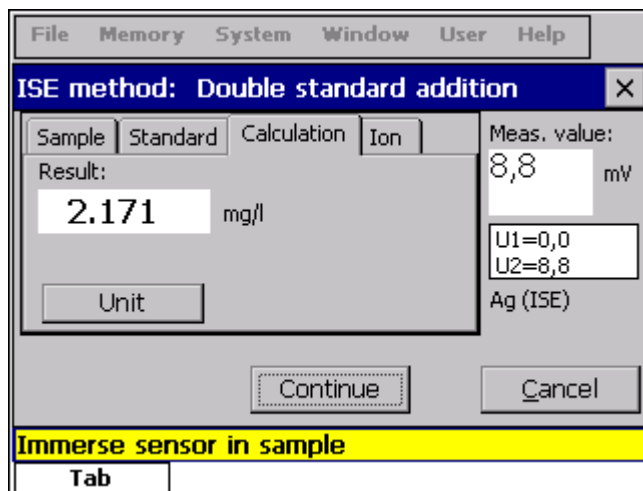


- 3 In the *Sample* register, enter the values for the sample volume (*Sample volume*) and the volume of the ISA/TISAB solution (*ISA/TISAB volume*) as necessary.
- 4 Thoroughly rinse the electrode with deionized water.
- 5 Immerse the electrode in the sample.
- 6 Start the measurement with [*Continue*]. After end of the measurement, the *Standard* pops up.



- 7 In the *Standard* register, enter the value for *Standard concentration* if necessary.
- 8 Add standard solution to the sample (1 percent by volume of the sample solution).
- 9 Start the measurement with [*Continue*]. The measured value is checked for stability (Stability control).

10	Wait for the measurement with stability control to end. or Take over the measured value with <i>[OK]</i> . The <i>Standard</i> register opens up.
11	Add standard solution to the sample (2 percent by volume of the sample solution).
12	Start the measurement with <i>[Continue]</i> . The measured value is checked for stability (Stability control).
13	Wait for the measurement with stability control to end. or Take over the measured value with <i>[OK]</i> . The <i>Calculation</i> register with the calculated measured value pops up.



14	Change the displayed unit of the measured value with <i>[Unit]</i> if necessary.
15	If required, display the record of the current measurement with <i>[Record]</i> .
16	Start measuring further samples with <i>[Continue]</i> . Repeat the steps 2 - 14 for all samples. or Terminate the measuring method with <i>[Cancel]</i> and confirm the safety query with <i>[OK]</i> . Measurement with the selected method is completed.

### 9.6.4 Standard subtraction

In the "Standard Subtraction" procedure, a known amount of standard solution is added to the sample (as complexing agent or precipitating agent) and, thus, the ion concentration lowered.

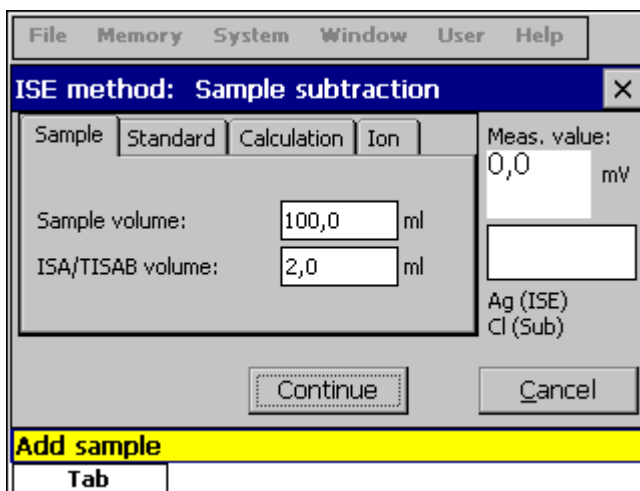
The ion concentration in the sample is calculated from the change in potential.

- |   |   |
|---|---|
| 1 | Check the currently displayed ion.<br>If the ion to be measured is displayed incorrectly:<br>Select the ion type in the menu, <i>Measuring / ISE methods / Ion type</i> . |
| 2 | In the <i>Measuring / ISE methods</i> menu, select the method, <i>Standard subtraction</i> .  |

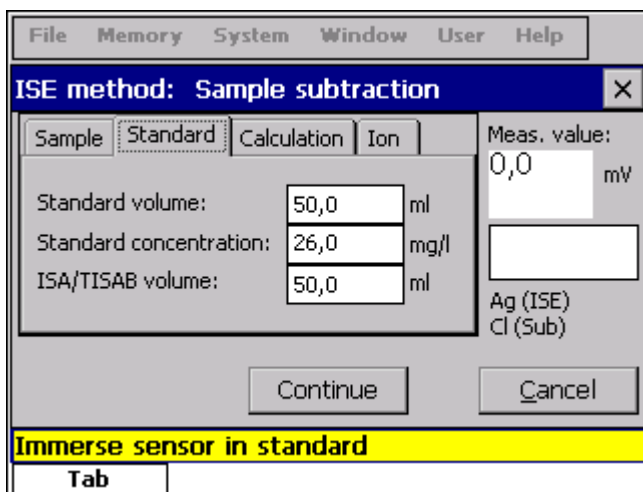
### Calibration

- |   |  |
|---|--|
| 3 | Carry out a two-point calibration according to the user guidance (see page 106).<br>As soon as a stable value is achieved for the second standard calibration solution, the slope (mV) and evaluation (Error, +++) of the electrode after calibration is displayed.<br>The infotext, <i>Accept calibration and terminate</i> is displayed. |
| 4 | Using [OK], confirm the infotext <i>Accept calibration and terminate</i> .<br>The calibration record is displayed and output to the interface.<br>The calibration procedure is finished.   |
| 5 | Close the calibration record with [OK].<br>The <i>ISE method: The Standard subtraction</i> window pops up.<br>The <i>Sample</i> register is displayed.   |

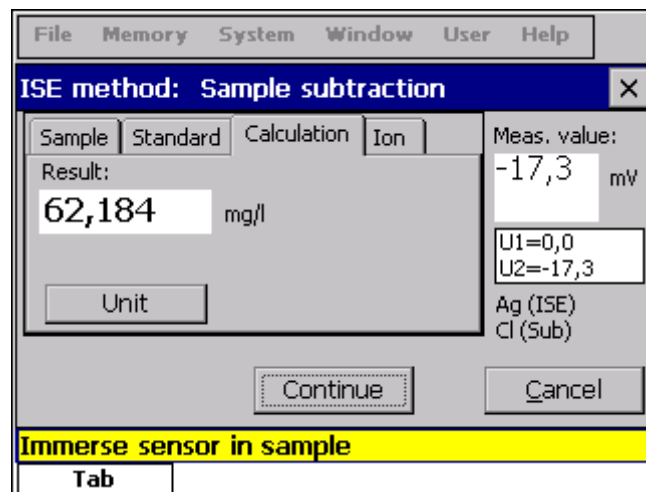
### Measuring



6	In the <i>Sample</i> register, enter the values for the sample volume ( <i>Sample volume</i> ) and the volume of the ISA/TISAB solution ( <i>ISA/TISAB volume</i> ) as necessary.
7	Check the currently displayed ions. If the ion of the standard (e.g. Cl (Sub)) is displayed incorrectly: Change the ion type of the standard solution [e.g. Cl (Sub)] in the <i>ION</i> register.
8	Thoroughly rinse the electrode with deionized water.
9	Immerse the electrode in the sample.
10	Start the measurement with [ <i>Continue</i> ]. The measured value is checked for stability (Stability control).
11	Wait for the measurement with stability control to end. or Take over the measured value with [ <i>OK</i> ]. The <i>Standard</i> register opens up.



12	In the <i>Standard</i> register, enter the values for <i>Standard volume</i> and <i>Standard concentration</i> if necessary.
13	Add the standard solution to the sample.
14	Start the measurement with [ <i>Continue</i> ]. The measured value is checked for stability (Stability control).
15	Wait for the measurement with stability control to end. or Take over the measured value with [ <i>OK</i> ]. The <i>Calculation</i> register with the calculated measured value pops up.



16	Change the displayed unit of the measured value with <i>[Unit]</i> if necessary.
17	If required, display the record of the current measurement with <i>[Record]</i> .
18	<p>Start measuring further samples with <i>[Continue]</i>.  Repeat the steps 5 - 16 for all samples.  or  Terminate the measuring method with <i>[Cancel]</i> and confirm the safety query with <i>[OK]</i>.  Measurement with the selected method is completed.</p>

### 9.6.5 Sample addition

In the *Sample addition* procedure, a known amount of test sample is added to the standard solution.

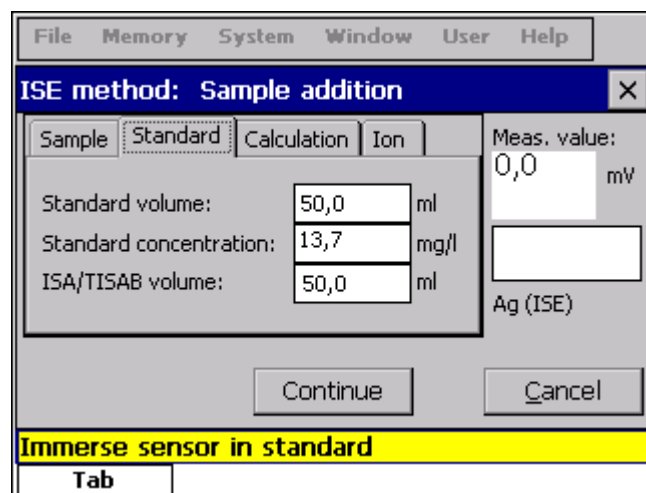
The ion concentration in the sample is calculated from the change in potential.

- |   |   |
|---|---|
| 1 | Check the currently displayed ion.<br>If the ion to be measured is displayed incorrectly:<br>Select the ion type in the menu, <i>Measuring / ISE methods / Ion type</i> . |
| 2 | In the <i>Measuring / ISE methods</i> menu, select the method, <i>Sample addition</i> .   |

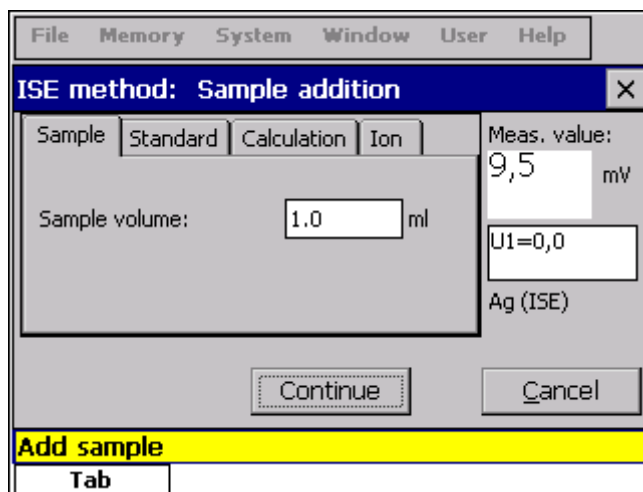
### Calibration

- |   |  |
|---|--|
| 3 | Carry out a two-point calibration according to the user guidance (see page 106).<br>As soon as a stable value is achieved for the second standard calibration solution, the slope (mV) and evaluation (Error, +++) of the electrode after calibration is displayed.<br>The infotext, <i>Accept calibration and terminate</i> is displayed. |
| 4 | Using <i>[OK]</i> , confirm the infotext <i>Accept calibration and terminate</i> .<br>The calibration record is displayed and output to the interface.<br>The calibration procedure is finished.   |
| 5 | Close the calibration record with <i>[OK]</i> .<br>The <i>ISE method</i> : The <i>Sample addition</i> window pops up. The <i>Standard</i> register is displayed.   |

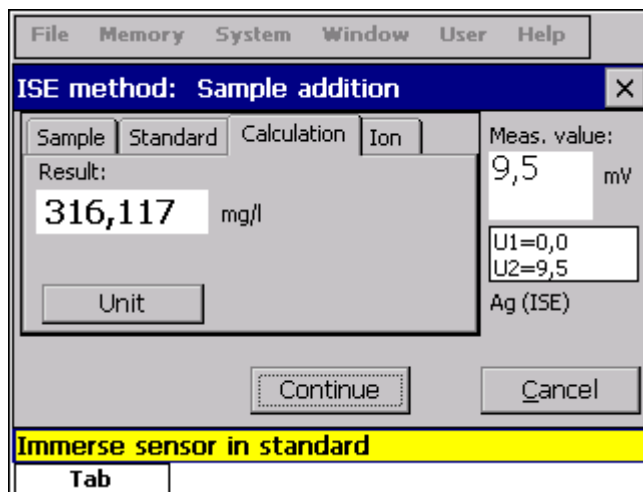
### Measuring



6	In the <i>Standard</i> register, enter the values for <i>Standard volume-Standard concentration</i> and <i>ISA/TISAB volume</i> if necessary.
7	Thoroughly rinse the electrode with deionized water.
8	Immerse the electrode in the standard.
9	Start the measurement with [ <i>Continue</i> ]. The measured value is checked for stability (Stability control).
10	Wait for the measurement with stability control to end. or Take over the measured value with [ <i>OK</i> ]. The <i>Sample</i> register opens up.



11	Add the sample to the standard solution.
12	In the <i>Sample</i> register, enter the values for the sample volume ( <i>Sample volume</i> ) if necessary.
13	Start the measurement with [ <i>Continue</i> ]. The measured value is checked for stability (Stability control).
14	Wait for the measurement with stability control to end. or Take over the measured value with [ <i>OK</i> ]. The <i>Calculation</i> register with the calculated measured value pops up.



- |    |  |
|----|--|
| 15 | Change the displayed unit of the measured value with <i>[Unit]</i> if necessary.   |
| 16 | If required, display the record of the current measurement with <i>[Record]</i> .  |
| 17 | <p>Start measuring further samples with <i>[Continue]</i>.<br/> Repeat the steps 5 - 15 for all samples.<br/> or<br/> Terminate the measuring method with <i>[Cancel]</i> and confirm the safety query with <i>[OK]</i>.<br/> Measurement with the selected method is completed.</p> |

### 9.6.6 Sample subtraction

In the *Sample subtraction* procedure, a known amount of test sample is added to the standard solution.

The ion concentration in the sample is calculated from the change in potential.

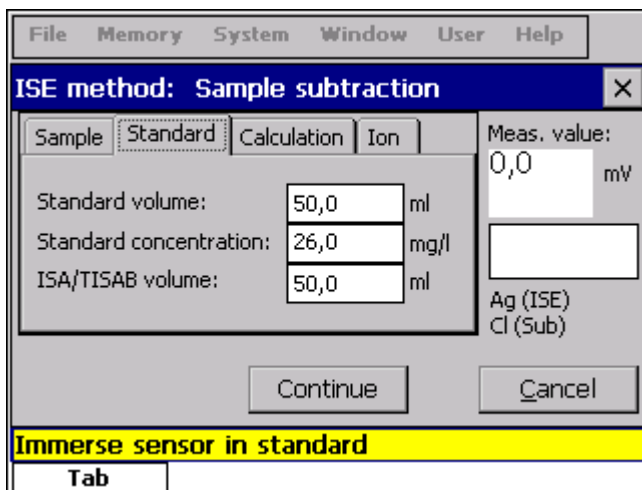
The sample subtraction is one method for the indirect determination of ions. It is used for the determination of ions for which no direct determination is possible.

- 1 Check the currently displayed ion.  
If the ion to be measured is displayed incorrectly:  
Select the ion type in the menu, *Measuring / ISE methods / Ion type*.
- 2 In the *Measuring / ISE methods* menu, select the method, *Sample subtraction*.

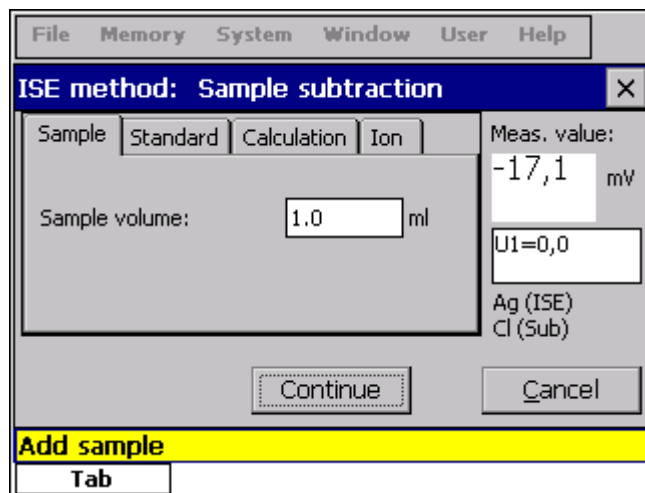
### Calibration

- 3 Carry out a two-point calibration according to the user guidance (see page 106).  
As soon as a stable value is achieved for the second standard calibration solution, the slope (mV) and evaluation (Error, +++) of the electrode after calibration is displayed.  
The infotext, *Accept calibration and terminate* is displayed.
- 4 Using [OK], confirm the infotext *Accept calibration and terminate*.  
The calibration record is displayed and output to the interface.  
The calibration procedure is finished.
- 5 Close the calibration record with [OK].  
The *ISE method*: The *Sample subtraction* window pops up.  
The *Standard* register is displayed.

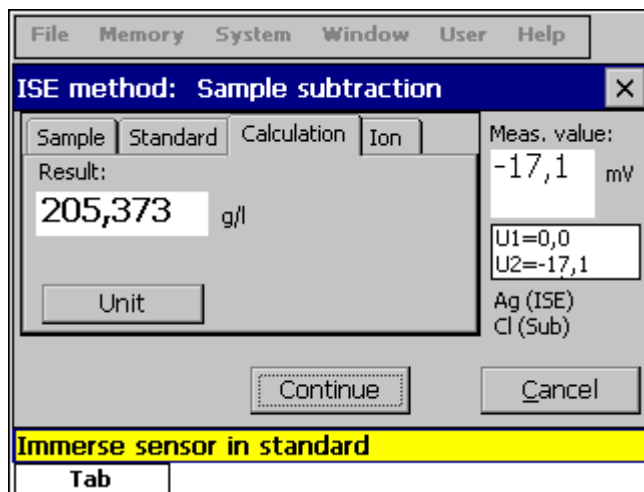
### Measuring



6	In the <i>Standard</i> register, enter the values for <i>Standard volume-Standard concentration</i> and <i>ISA/TISAB volume</i> if necessary.
7	Check the currently displayed ions. If the ion of the standard (e.g. Cl (Sub)) is displayed incorrectly: Change the ion type of the standard solution [e.g. Cl (Sub)] in the <i>ION</i> register.
8	Thoroughly rinse the electrode with deionized water.
9	Immerse the electrode in the sample.
10	Start the measurement with <i>[Continue]</i> . The measured value is checked for stability (Stability control).
11	Wait for the measurement with stability control to end. or Take over the measured value with <i>[OK]</i> . The <i>Sample</i> register opens up.



12	Add the sample to the standard solution.
13	In the <i>Sample</i> register, enter the value for the sample volume ( <i>Sample volume</i> ) if necessary.
14	Start the measurement with <i>[Continue]</i> . The measured value is checked for stability (Stability control).
15	Wait for the measurement with stability control to end. or Take over the measured value with <i>[OK]</i> . The <i>Calculation</i> register with the calculated measured value pops up.



- |    |  |
|----|--|
| 16 | Change the displayed unit of the measured value with <i>[Unit]</i> if necessary.   |
| 17 | If required, display the record of the current measurement with <i>[Record]</i> .  |
| 18 | <p>Start measuring further samples with <i>[Continue]</i>. Repeat the steps 5 - 16 for all samples.</p> <p>or</p> <p>Terminate the measuring method with <i>[Cancel]</i> and confirm the safety query with <i>[OK]</i>. Measurement with the selected method is completed.</p> |

### 9.6.7 *Blank value addition* (Standard addition with blank value correction)

In the "Standard addition with blank value correction" procedure, a known amount of standard solution is added to the sample in two steps. With the first addition, the ion concentration is raised to the linear range of the electrode characteristic curve.

The second addition is equivalent to the standard addition.

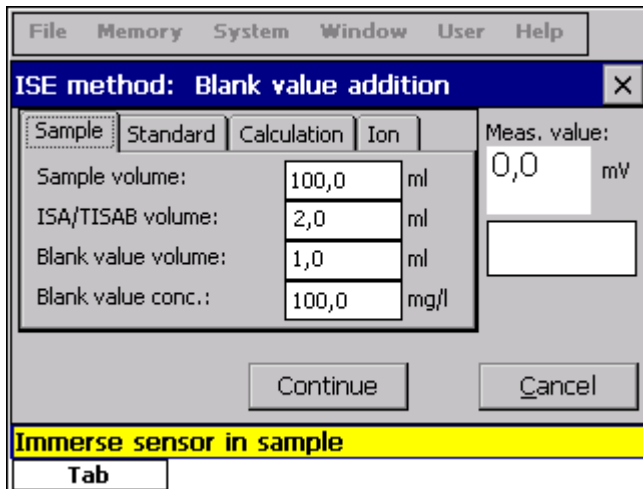
The ion concentration in the sample is calculated from the change in potential.

1	Check the currently displayed ion. If the ion to be measured is displayed incorrectly: Select the ion type in the menu, <i>Measuring / ISE methods / Ion type</i> .
2	In the <i>Measuring / ISE methods</i> menu, select the method, <i>Blank value addition</i> .

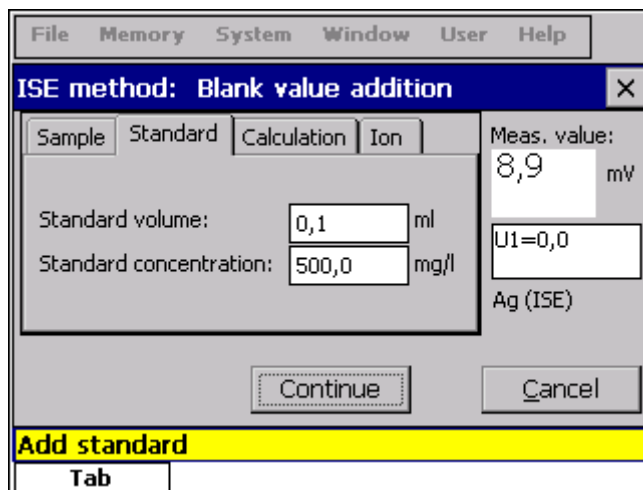
#### Calibration

3	Carry out a two-point calibration according to the user guidance (see page 106). As soon as a stable value is achieved for the second standard calibration solution, the slope (mV) and evaluation (Error, +++) of the electrode after calibration is displayed. The infotext, <i>Accept calibration and terminate</i> is displayed.
4	Using <i>[OK]</i> , confirm the infotext <i>Accept calibration and terminate</i> . The calibration record is displayed and output to the interface. The calibration procedure is finished.
5	Close the calibration record with <i>[OK]</i> . The <i>ISE method</i> : The <i>Blank value addition</i> window pops up. The <i>Sample</i> register is displayed.

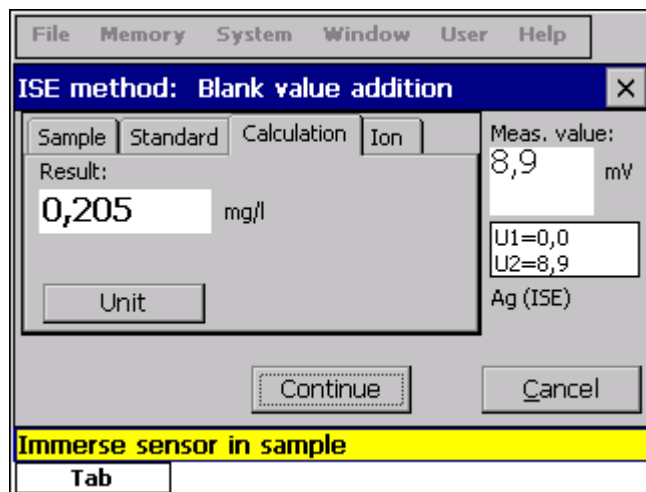
Measuring



- 6 In the *Sample* register, enter the following values:
  - the volume of the sample (*Sample volume*)
  - the volume of the ISA/TISAB solution (*ISA/TISAB volume*)
  - the volume of the blank value solution (*Blank value volume*)
  - the concentration of the blank value solution (*Blank value conc.*).
- 7 Thoroughly rinse the electrode with deionized water.
- 8 Immerse the electrode in the sample that was supplemented with blank value solution.
- 9 Start the measurement with [*Continue*].  
The measured value is checked for stability (Stability control).
- 10 Wait for the measurement with stability control to end.  
or  
Take over the measured value with [*OK*].  
The *Standard* register opens up.



11	In the <i>Standard</i> register, enter the values for <i>Standard volume</i> and <i>Standard concentration</i> if necessary.
12	Add the standard solution to the sample.
13	Start the measurement with <i>[Continue]</i> . The measured value is checked for stability (Stability control).
14	Wait for the measurement with stability control to end. or Take over the measured value with <i>[OK]</i> . The <i>Calculation</i> register with the calculated measured value pops up.



15	Change the displayed unit of the measured value with <i>[Unit]</i> if necessary.
16	If required, display the record of the current measurement with <i>[Record]</i> .
17	Start measuring further samples with <i>[Continue]</i> . Repeat the steps 5 - 15 for all samples. or Terminate the measuring method with <i>[Cancel]</i> and confirm the safety query with <i>[OK]</i> . Measurement with the selected method is completed.

## 10 Conductivity

### 10.1 General information

You can measure the following variables:

- Conductivity
- Specific resistance
- Salinity
- Total dissolved solids (TDS)

The meter provides the following functions:

- AutoRange (automatic selection of the measuring range). If a measuring range is exceeded, AutoRange causes the meter to automatically change to the next higher measuring range and back again. Therefore, the instrument always measures in the measuring range with the highest possible resolution.
- Stability control to check the stability of the measurement signal. This ensures the reproducibility of the measuring signal. The background color is red until the measured value is stable. When the measured value is stable, the background color switches to green.

#### Temperature measurement

The LF413T(-ID) and LF313T(-ID) conductivity measuring cells have an integrated temperature sensor.

### 10.2 Measuring the conductivity

#### 10.2.1 Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect a conductivity measuring cell to the meter.
2	Highlight the channel of the conductivity measuring cell in the measured value display.
3	If necessary, select the measured parameter with <b>&lt;MODE&gt;</b> .
4	Check whether the setting of the <i>Cell constant</i> is suitable for the connected conductivity measuring cell. If necessary, correct the setting.

**Note**

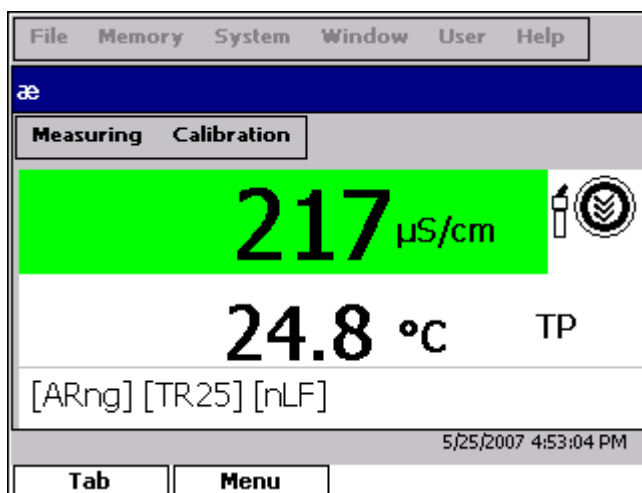
The selection of the measuring cell and setting of the cell constant is made in the conductivity measuring menu (see page 134). The cell constant to be set must either be taken from the operating manual of the measuring cell or is printed on the measuring cell.

With ID conductivity measuring cells, the last used cell constant and other settings are stored in the sensor (see page 18).

**10.2.2 Measuring**

You can carry out conductivity measurements as follows:

- |   |   |
|---|---|
| 1 | Perform the preparatory activities according to page 131.   |
| 2 | Immerse the conductivity measuring cell in the test sample. |

**Selecting the displayed measured variable**

You can switch between the following displays with **<MODE>**:

- Conductivity [ $\mu\text{S}/\text{cm}$ ] / [ $\text{mS}/\text{cm}$ ]
- Resistivity [ $\text{k}\Omega\cdot\text{cm}$ ] / [ $\text{M}\Omega\cdot\text{cm}$ ]
- Salinity SaL [ ]
- Total dissolved solids TDS [ $\text{mg}/\text{l}$ ]

The factor to calculate the total dissolved solids is set to 1.00 in the factory. You can adjust this factor to meet your requirements in the range of 0.40 to 1.00. The factor is set in the menu, *Measuring / TDS factor setting....*

**Stability control**

The Stability control function checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of measured values. The background color is red until the measured value is stable.

Regardless of the setting for *Autom. stability control* (see page 63) in the *System* menu, you can start the *Stability control* function manually at any time.

1	Highlight the channel of the conductivity measuring cell in the measured value display.
2	If necessary, select the measured parameter with <b>&lt;MODE&gt;</b> .
3	Freeze the measured value with <b>&lt;SC&gt;</b> . The display switches to the display of the selected channel as necessary. In the status line, [SC] is displayed.
4	With <b>&lt;OK&gt;</b> activate the <i>Stability control</i> function. As long as the measured value does not meet the stability criterion, the background color is red. As soon as the measured value is stable, the background color is green. The current measurement data is downloaded to the interface. The measured values of all channels meeting the criterion for stability control are marked by SC.

**Note**

You can terminate prematurely the *Stability control* function with **<OK>** manually at any time. If the *Stability control* function is terminated prematurely, the current measurement data is not downloaded to the interface.

5	Using <b>&lt;SC&gt;</b> or <b>&lt;MODE&gt;</b> , release the frozen measured value. The [SC] status display disappears.
---	---

**Criteria**

The meter checks the stability of the measured value on the basis of the temperature measurement. For identical measurement conditions, the following applies:

Measured parameter	Reproducibility	Response time
Temperature	better than 0.02 °C	> 10 seconds

### 10.2.3 Measurement settings

The following measurement settings are possible for conductivity measuring cells:

Menu item	Setting	Description
<i>Measuring</i>		
- <i>Cell constant</i>		
- <i>Calibrated cell constant</i>		Measuring cells whose cell constant is determined by calibration in KCL control standard (calibration ranges see page 149). The currently valid cell constant is displayed in the status line.
- <i>Adjustable cell constant...</i>		Any measuring cells with freely adjustable cell constants in the range 0.250 to 25.000 cm <sup>-1</sup> .
- <i>Adjustable LF 313T...</i>		Measuring cell LF313T(-ID), nominal cell constant 0.100 cm <sup>-1</sup> . The cell constant can be adjusted in the range 0.090 to 0.110 cm <sup>-1</sup> .
- <i>LF 213T</i>		Measuring cell with a nominal cell constant of 0.010 cm <sup>-1</sup> . The cell constant is permanently set.
- <i>Temperature coefficient</i>		
- <i>TC nLF</i>		Nonlinear temperature compensation
- <i>TC Lin...</i>	<i>0.000 ... 3.000 %/K</i>	Coefficient of the linear temperature compensation.
- <i>TC off</i>		No temperature compensation.
- <i>TC nLin1.....TC nLin4...</i>		Measurement with entered or determined temperature coefficient.

Menu item	Setting	Description
<i>Measuring</i>		
– <i>Reference temperature</i>	– <i>Tref 25</i> – <i>Tref 20</i>	Reference temperature
– <i>TDS factor setting...</i>	<i>0.40 ... 1.00</i>	TDS factor This setting only applies to the measured parameter, TDS. If a TDS factor is used, it is displayed in the Status line.
– <i>Alternative TP</i>	(✓)	(✓) = alternative temperature sensor is used
– <i>Setting of man. temp...</i>	<i>-35 ... +150 °C</i>	Entry of the manually determined temperature. For measurements without temperature sensor only.
– <i>Reset Cond</i>		Resets all sensor settings to the delivery condition (see page 65).
– <i>Recorder</i>		Start recorder (see page 163).

**10.2.4 Determining/setting the temperature compensation**

The conductivity of aqueous solutions is mainly caused by the temperature and the concentration of dissolved substances.

**Reference temperature**

To compare measured values that were determined at different temperatures they have to be converted to a reference temperature. Thus, a conductivity specification includes a reference temperature specification as a matter of principle.

**Temperature compensation**

The temperature compensation is used to calculate the conductivity at the reference temperature from a conductivity value that was measured at any temperature.

To do so, the temperature dependency (linear or nonlinear) of the conductivity for the solution must be known.

The characteristics of the test sample indicate which procedure is suitable for temperature compensation.

Characteristics of the test samples	Procedure for temperature compensation
<ul style="list-style-type: none"> <li>● diluted</li> <li>● wide temperature range</li> </ul>	nonlinear ( <i>TC nLF</i> )
<ul style="list-style-type: none"> <li>● diluted</li> <li>● small temperature range</li> </ul>	linear ( <i>TC lin</i> )
<ul style="list-style-type: none"> <li>● concentrated</li> <li>● wide temperature range</li> </ul>	nonlinear ( <i>TC nLin1...2</i> )
<ul style="list-style-type: none"> <li>● wide concentration range</li> <li>● wide temperature range</li> </ul>	nonlinear ( <i>TC nLin3, TC nLin4</i> )

For diluted test samples, linear and nonlinear temperature dependencies are stored in the meter.

For other test samples the ProLab 4000 provides the option of determining the temperature dependency and, if necessary, the concentration dependency of the conductivity as well.

### Temperature compensation for diluted solutions

For the measurement of aqueous solutions

- in a low concentration range (diluted solution)
- in a small temperature range ( $|T - T_{ref}| < 10 \text{ K}$ )
- with a fixed reference temperature at  $20 \text{ }^\circ\text{C}$  or  $25 \text{ }^\circ\text{C}$ ,

the procedures of linear (TC lin) and nonlinear (TC nLF) temperature compensation are suitable.

The calculation of the temperature compensation is based on the pre-set reference temperature,  $20 \text{ }^\circ\text{C}$  or  $25 \text{ }^\circ\text{C}$ . It appears on the display as *[TR20]* or *[TR25]*.



### Application tips

#### Note

The reference temperature and temperature compensation are set in the *Measuring* menu (see page 134).

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

Test sample	Temperature compensation	Display indicator
Natural water (ground water, surface water, drinking water)	<i>nLF</i> according to EN 27 888	<i>nLF</i>
Ultrapure water	<i>nLF</i> according to EN 27 888	<i>nLF</i>
Seawater (salinity)	Automatic <i>nLF</i> according to IOT	<i>Sal, nLF</i>
Other diluted solutions with known temperature dependency	Linear temperature compensation; Temperature coefficient can be set in the range $0.001 \dots 3.000 \text{ } \%/K$	<i>lin</i>
Solutions with unknown temperature dependency	No temperature compensation	

### Temperature compensation for concentrated solutions

For the measurement of aqueous solutions

- in a wide concentration range
- in a wide temperature range ( $\Delta T > 10 \text{ K}$ )
- with freely adjustable reference temperature,

procedures with an individually determined nonlinear temperature compensation are suitable (designation: *TC nLin1 ... 4*).

The temperature compensation procedures have different ways of determining the temperature and concentration dependency.

Procedure	Determining the temperature dependency (and concentration dependency)
<i>TC nLin1</i>	Temperature coefficients (e.g. from further reading) can be selected and entered manually.
<i>TC nLin2</i>	<ul style="list-style-type: none"> <li>● with <u>one</u> standard of known concentration</li> <li>● at different temperatures</li> </ul>
<i>TC nLin3</i>	<ul style="list-style-type: none"> <li>● with <u>several</u> standards of known concentration</li> <li>● at different temperatures</li> </ul>
<i>TC nLin4</i>	<ul style="list-style-type: none"> <li>● with <u>several</u> standards of unknown concentration (prepared with equidistant dilution)</li> <li>● at different temperatures</li> </ul>

### 10.2.5 Selecting the nonlinear temperature compensation *TC nLF*

1	Highlight the channel of the conductivity measuring cell in the measured value display.
2	If necessary, select the measured parameter with <b>&lt;MODE&gt;</b> .
3	Select the nonlinear temperature compensation with <i>Measuring / Temperature coefficient / TC nLF</i> . In the status line, [nLF] is displayed.

### 10.2.6 Selecting the linear temperature compensation *TC Lin...*

The temperature coefficient for the linear temperature compensation is adjustable in the range of coefficients from 0.001 ... 3.000 %/K.

The linear temperature compensation is carried out according to the following equation:

$$X_{Tref} = X_T / (1 + [TC/100] \cdot [T - Tref])$$

$X_T$	= Conductivity at temperature T	[S/cm]
$X_{Tref}$	= Conductivity at reference temperature Tref	[S/cm]
TC	= Temperature coefficient	[%/K]
T	= Temperature	[°C]
Tref	= Reference temperature	[°C]

1	Highlight the channel of the conductivity measuring cell in the measured value display.
2	If necessary, select the measured parameter with <b>&lt;MODE&gt;</b> .
3	Open the input window for the temperature coefficient of the linear temperature compensation with <i>Measuring / Temperature coefficient / TC Lin...</i>
4	Enter the temperature coefficient and confirm with <b>&lt;OK&gt;</b> . [Lin] is displayed in the status line of the measuring channel.

### 10.2.7 Selecting and adjusting the nonlinear temperature compensation *TC nLin1*

The nonlinear temperature compensation is carried out according to the following equation:

$$X_{Tref} = X_T / (1 + TC_1 \cdot [T - Tref] + TC_2 \cdot [T - Tref]^2)$$

$X_T$	= Conductivity at temperature T	[S/cm]
$X_{Tref}$	= Conductivity at reference temperature Tref	[S/cm]
$TC_1$	= Temperature coefficient 1	[1/°C]
$TC_2$	= Temperature coefficient 2	[1/°C <sup>2</sup> ]
T	= Temperature	[°C]
Tref	= Reference temperature	[°C]

The equation includes two temperature coefficients,  $TC_1$  and  $TC_2$ . In the ProLab 4000 meter, the temperature coefficients  $TC_1$  and  $TC_2$  are stored for the following test samples:

	HCl	NaOH	NaCl	KCl
<b>Concentration c [mol/l]</b>	1,0	0,67	0,85	0,67
<b>Temperature range [°C]</b>	0 ... 55	0 ... 40	0 ... 40	0 ... 40
<b>Tref [°C]</b>	25	25	25	25

Suitable temperature coefficients  $TC_1$  and  $TC_2$  for solutions that are not mentioned here can be taken from tables found in further reading and then entered in the meter.

1	Highlight the channel of the conductivity measuring cell in the measured value display.
2	If necessary, select the measured parameter with <b>&lt;MODE&gt;</b> .
3	Open the input window for the temperature coefficients with <i>Calibration / TC calibration / TC nLin1...</i>

TC calibration [nLin1]

Coefficients: adjustable

Formula:  $\alpha_{ref} = \alpha_{meas} / (1 + TC1*(T-Tref) + TC2*(T-Tref)^2)$

TC[1]: 1.000 E 0

TC[2]: 1.000 E 0

OK Cancel

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Tab Menu

TC calibration [nLin1]

Coefficients: HCl

Formula:  $\alpha_{ref} = \alpha_{meas} / (1 + TC1*(T-Tref) + TC2*(T-Tref)^2)$

TC[1]: 1.485 E -2

TC[2]: -4.448 E -5

OK Cancel

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Tab Menu

- |   |  |
|---|--|
| 4 | <p>Select a test sample with permanently stored coefficients (<i>NaCl</i>, <i>KCl</i>, <i>NaOH</i>, <i>HCl</i>) or the freely adjustable coefficients (<i>adjustable</i>).</p> <p>The stored temperature coefficients are displayed during the selection of the test sample.</p> |
| 5 | <p>With freely selectable temperature coefficients only:</p> <p>Enter each temperature coefficient with an exponent (unit: 1/°C or 1/°C<sup>2</sup>).</p>  |
| 6 | <p>Confirm the entries with <b>&lt;OK&gt;</b> .</p> <p>[nLin1] is displayed in the status line of the measuring channel.</p>   |

### 10.2.8 Selecting and determining the nonlinear temperature compensation *TC nLin2*

1	Highlight the channel of the conductivity measuring cell in the measured value display.
2	If necessary, select the measured parameter with <MODE>.
3	Immerse the measuring cell in the test sample.
4	Open the input window for the measurement of the temperature dependency with <i>Calibration / TC calibration / TC nLin2</i> .

TC calibration [nLin2]

Start temp.: 15 °C    End temp.: 40 °C  
 Temp. interval: 5 °C    Ref. temp.: 25 °C

Enter calibration parameter

Continue    Cancel

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Tab    Menu

5	<p>Enter the start temperature, end temperature, temperature interval and reference temperature and confirm with [<i>Continue</i>].</p> <p>The display shows:</p> <ul style="list-style-type: none"> <li>● the current conductivity value</li> <li>● the current temperature</li> <li>● information on the nominal temperature of the next measuring point and the temperature difference between the current temperature and the nominal temperature</li> </ul>
---	--

**Note**

The measuring method can only be started if *Ref. temp.*, *Start temp.* and *Temp. interval* are selected so that the reference temperature corresponds to the nominal temperature of a measuring point:  $Ref. temp. = Start temp. + x * Temp. interval$

- 6 Warm or cool the test sample to the start temperature *Start temp.*  
 As soon as the temperature of the measuring point is achieved and a stable value is recognized, the measurement is automatically started and the dataset stored.  
 After the measurement, a piece of information about the next measuring point with the relevant nominal temperature is displayed and the temperature difference between the current temperature and the nominal temperature.

**TC calibration [nLin2]**

Start temp.: 15 °C      End temp.: 40 °C  
 Temp. interval: 5 °C      Ref. temp.: 25 °C

0.0 µS/cm      25 °C

T > T start (15,0°C)

Terminate      Cancel

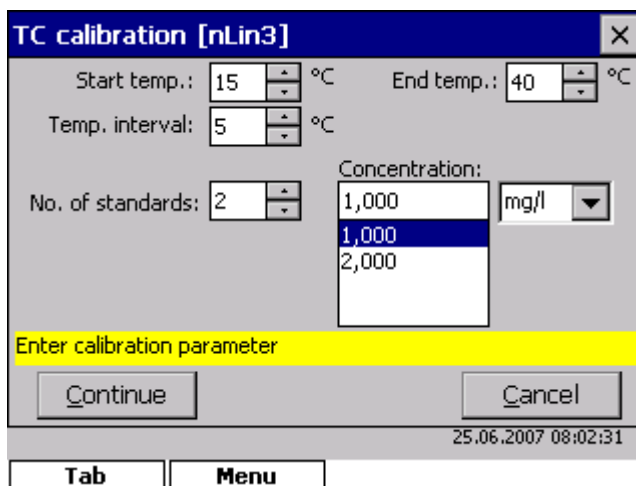
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Tab      Menu

- 7 Slowly warm or cool the test sample until the end temperature *End temp.* is achieved.  
 Each time the nominal temperature for a measuring point is reached a dataset is stored.  
 The corresponding calibration record with the determined temperature coefficients is displayed at the end of the calibration.  
 If the calibration is successful, the determined temperature dependency for the *TC nLin2* method is stored and used for further measurements with this method.
- 8 Confirm the record with [*Continue*].  
 [nLin2] is displayed in the status line of the measuring channel.

### 10.2.9 Selecting and determining the nonlinear temperature compensation *TC nLin3*

- |   |   |
|---|---|
| 1 | Highlight the channel of the conductivity measuring cell in the measured value display.                                       |
| 2 | If necessary, select the measured parameter with <MODE>.  |
| 3 | Immerse the measuring cell in the test sample.  |
| 4 | Open the input window for the measurement of the temperature dependency with <i>Calibration / TC calibration / TC nLin3</i> . |



- |   |   |
|---|---|
| 5 | Enter the start temperature ( <i>Start temp.</i> ), end temperature ( <i>End temp.</i> ) and temperature interval ( <i>Temp. interval</i> ). Enter the number of standards and the corresponding concentrations. The concentration unit entered here is displayed as the unit of the measured value display after the calibration is completed.     |
| 6 | Confirm with [ <i>Continue</i> ]. The display shows: <ul style="list-style-type: none"> <li>● the current conductivity value</li> <li>● the current temperature</li> <li>● information on the nominal temperature of the next measuring point and the temperature difference between the current temperature and the nominal temperature</li> </ul> |



**Note**

The measuring method can only be started if *Ref. temp.*, *Start temp.* and *Temp. interval* are selected so that the reference temperature corresponds to the nominal temperature of a measuring point:  $Ref. temp. = Start temp. + x * Temp. interval$

- 7 Warm or cool the measuring solution (standard 1) to the start temperature *Start temp.*.  
As soon as the temperature of the measuring point is achieved and a stable value is recognized, the measurement is automatically started and the dataset stored.  
After the measurement, a piece of information about the next measuring point with the relevant nominal temperature is displayed and the temperature difference between the current temperature and the nominal temperature.

**TC calibration [nLin3]**

Start temp.: 15 °C      End temp.: 40 °C

Temp. interval: 5 °C

No. of standards: 2

Concentration: 1,000 mg/l

0.0 µS/cm      25 °C

T > T start (15,0°C)

Terminate      Cancel

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Tab      Menu

- 8 Slowly warm or cool the measuring solution (standard 1) until the end temperature *End temp.* is achieved.  
Each time the nominal temperature for a measuring point is reached a dataset is stored.  
At the end of the series of measurements for the solution (standard 1), the corresponding measuring record is displayed.
- 9 Confirm the record with [*Continue*].
- 10 Repeat the steps 5 to 8 for all further solutions (standard 2 to x).  
The corresponding calibration record with the determined temperature coefficients is displayed at the end of the calibration.  
If the calibration is successful, the determined temperature dependency for the *TC nLin3* method is stored and used for further measurements with this method.
- 11 Confirm the record with [*Continue*].  
[nLin3] is displayed in the status line of the measuring channel.

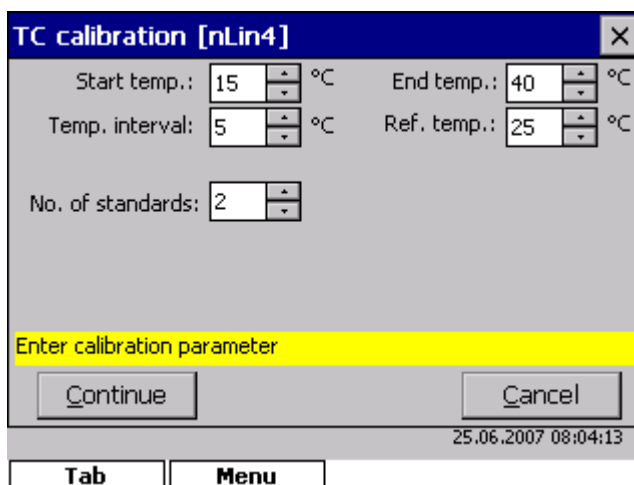
### 10.2.10 Selecting and determining the nonlinear temperature compensation *TC nLin4*

#### Preparatory activities

The nonlinear temperature compensation *TC nLin4* is determined from several standards of unknown concentration. You prepare the required standards yourself through equidistant dilution of the standard with the highest concentration e.g.:

	Standard with the highest concentration	Deionized water
	Volume share in %	Volume share in %
<b>Standard 1</b>	100	0
<b>Standard 2</b>	95	5
<b>Standard 3</b>	90	10
<b>Standard 4</b>	85	15
<b>Standard 5</b>	80	20

- 1 Highlight the channel of the conductivity measuring cell in the measured value display.
- 2 If necessary, select the measured parameter with **<MODE>**.
- 3 Immerse the measuring cell in the test sample.
- 4 Open the input window for the measurement of the temperature dependency with *Calibration / TC calibration / TC nLin3*.



- 5 Enter the start temperature, end temperature and temperature interval.  
Enter the number of standards and confirm with *[Continue]*.  
The display shows:
- the current conductivity value
  - the current temperature
  - information on the nominal temperature of the next measuring point and the temperature difference between the current temperature and the nominal temperature

**Note**

The measuring method can only be started if *Ref. temp.*, *Start temp.* and *Temp. interval* are selected so that the reference temperature corresponds to the nominal temperature of a measuring point:  $Ref. temp. = Start temp. + x * Temp. interval$

- 6 Warm or cool the measuring solution (standard 1) to the start temperature *Start temp.*.  
As soon as the temperature of the measuring point is achieved and a stable value is recognized, the measurement is automatically started and the dataset stored.  
After the measurement, a piece of information about the next measuring point with the relevant nominal temperature is displayed and the temperature difference between the current temperature and the nominal temperature.

**TC calibration [nLin4]**

Start temp.: 15 °C      End temp.: 40 °C  
 Temp. interval: 5 °C      Ref. temp.: 25 °C  
 No. of standards: 2

0.0 µS/cm      25 °C

T > T start (15,0°C)

Terminate      Cancel

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Tab      Menu

7	Slowly warm or cool the test sample (standard 1) until the end temperature <i>End temp.</i> is achieved. Each time the nominal temperature for a measuring point is reached a dataset is stored. At the end of the series of measurements for the solution (standard 1), the corresponding measuring record is displayed.
8	Confirm the record with [ <i>Continue</i> ].
9	Repeat the steps 5 to 8 for all further solutions (standard 2 to x). The corresponding calibration record with the determined temperature coefficients is displayed at the end of the calibration. If the calibration is successful, the determined temperature dependency for the <i>TC nLin3</i> method is stored and used for further measurements with this method.
10	Confirm the record with [ <i>Continue</i> ]. [nLin4] is displayed in the status line of the measuring channel.

#### 10.2.11 Switching off the temperature compensation (TC off)

1	Highlight the channel of the conductivity measuring cell in the measured value display.
2	If necessary, select the measured parameter with <MODE>.
3	Switch off the usage of a temperature compensation with <i>Measuring / Temperature coefficient / TC off</i> . The temperature compensation is no longer displayed in the status line.

### 10.3 Determining the cell constant (calibration in control standard)

#### Why determine the cell constant?

Due to aging, the cell constant slightly changes. As a result, an inexact measured value is displayed. Calibration determines and stores the current value of the cell constant.

Thus, you should calibrate at regular intervals. The calibration data of non-ID sensors is stored in the meter. For ID sensors, the calibration data is stored in the sensor.

You can determine the cell constant of the conductivity measuring cell in the ranges  $0.450 \dots 0.500 \text{ cm}^{-1}$ ,  $0.585 \dots 0.715 \text{ cm}^{-1}$  or  $0.800 \dots 1.200 \text{ cm}^{-1}$  by calibrating in the 0.01 mol/l KCl control standard or set it manually in the range  $0.250 \dots 2.500 \text{ cm}^{-1}$  or  $0.090 \dots 0.110 \text{ cm}^{-1}$ . Besides, the fixed cell constant  $0.010 \text{ cm}^{-1}$  can be selected.

In the delivery condition, the calibrated cell constant of the meters is set to  $0.475 \text{ cm}^{-1}$  (conductivity measuring cell LF413T(-ID)).

#### CalClock

The expiry of the CalClock reminds you to clean the measuring cell. It is still possible to measure.

The CalClock is set to 180 days in the factory. You can change the interval (see page 134).

#### Stability control

During calibration, the stability control is automatically activated.

#### Display of calibration data and download to interface

You can display the data of the last calibration (see page 160 and page 152). Subsequently, you can transmit the displayed calibration data to the interface, e. g. to a PC, with the **<PRINT>** key.



#### Note

The calibration record is automatically transmitted to the interface after calibrating.

**Sample record:**

```

Print date 26.04.07 16:13
ProLab 4000 (06249876)
Current user: 1234567890

CALIBRATION Cond
Calibration date      20.04.07 10:14:03
LF413-ID (A062498765)
User: Administrator

Calibration interval: 150 days
Standard:             0,01 mol/l KCl
Cond./Tref 25:       1413 µS/cm
Cal. temp:           25,4 °C
Cell constant:       0.475 1/cm      25.0 °C
Sensor               +++
    
```




**Note**

If non-ID sensors are used, the sensor type and series number are not output in the calibration record.

**Calibration evaluation**

After the calibration, the meter automatically evaluates the current status of the calibration. The evaluation appears on the display and in the calibration record.

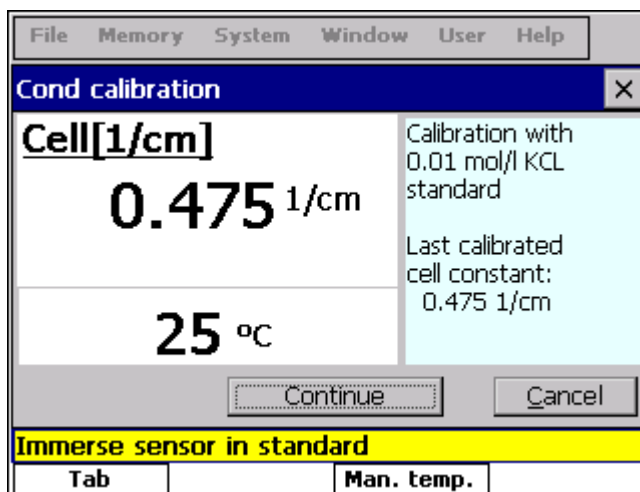
Display	Calibration record	Cell constant [cm <sup>-1</sup> ]
	+++	within the ranges 0.450 ... 0.500 cm <sup>-1</sup> 0.585 ... 0.715 cm <sup>-1</sup> or 0.800 ... 1.200 cm <sup>-1</sup>
<i>Error</i>	<i>Error</i>	outside the ranges 0.450 ... 0.500 cm <sup>-1</sup> or 0.800 ... 1.200 cm <sup>-1</sup>

Eliminate the error according to chapter 16 WHAT TO DO IF... (page 189)

### 10.3.1 Determining the cell constant (calibration)

Proceed as follows to determine the cell constant:

1	Connect a conductivity measuring cell to the meter.
2	Select the channel of the measuring cell in the measured value display.
3	If necessary, select the parameter, conductivity with <b>&lt;MODE&gt;</b> .
4	Start the calibration with <b>&lt;CAL&gt;</b> . The calibration display appears.



5	Immerse the conductivity measuring cell in the control standard solution, 0.01 mol/l KCl.
6	Start the measurement with <b>[OK]</b> . The measured value is checked for stability ( <i>Stability control</i> ).
7	Wait for the end of the measurement with <i>Stability control</i> or accept the calibration value with <b>[OK]</b> . The cell constant determined is displayed.
8	Accept the new calibration values with <b>[OK]</b> . The calibration record is displayed and output to the interface. The calibration procedure is finished. or To switch to the measured value display <u>without</u> accepting the new calibration values, press <b>&lt;ESC&gt;</b> .

### 10.3.2 Calibration settings and calibration data

In the *Calibration* menu you can set the calibration interval and view the calibration data.

Menu item	Setting	Description
<i>Calibration</i>		
— <i>Calibration interval...</i>	1 ... 999	Calibration interval for the measuring cell (in days). The meter reminds you to calibrate regularly by the red frame around the CalClock in the measuring window.
— <i>Calibration record...</i>		Displays the calibration record of the last calibration.
— <i>Calibration history...</i>		Displays the calibration history of the last calibrations.

## 11 Memory

With the ProLab 4000 software you can store and recall all important measurement and configuration data.

Each data type has an individual storage format.

- Measurement datasets of the manual memory "\*.mst" (see page 154)
- Measurement datasets of the automatic memory "\*.ast" (see page 156)
- Recorder "\*.rdt" (see page 163)
- Configurations "\*.ste" (see page 182)
- Calibration histories "\*.cal" (see page 160)

### 11.1 Measurement data

You can save measurement data in the following ways:

- Manual
  - with **<STO>**:  
stores all current measured values
- Automatically
  - after each measurement with manual stability control.
  - within the specified interval of the automatic memory (see page 156)

When creating an automatic memory, the system each time prompts you to create a file. The file is stored in the directory of the user. An external USB medium appears in the directory of the user and can be selected as the location for the automatic memory.

For measurement data to be stored manually, you can create or select a file prior to storing.

If no file is selected prior to storing, the ProLab 4000 automatically stores the measurement data in the files last selected by the current user. If this user has never selected a file, one is created automatically.

### 11.1.1 Creating and selecting a file for manually stored measurement datasets

#### Creating a file for manually stored measurement datasets

You can create the file in which to store your manually stored measurement datasets.

Files for manually stored measurement datasets have the file extension, ".mst".

1	Open the menu, <i>Memory / Manual memory / New....</i> The <i>Open file</i> dialog box pops up.
2	Enter a new file name and confirm with <i>[OK]</i> . The file is created. Data from manual storing will be stored in it.

#### Selecting the file for measurement dataset to be stored manually

You can open an existing file for stored measurement datasets in order to append new measurement datasets.

Files for manually stored measurement datasets have the file extension, ".mst".



#### Note

If a user has not yet created a file, the data is stored in the file, "Man-Sto.mst".

1	Open the menu, <i>Memory / Manual memory / Select....</i> The <i>Open file</i> dialog box pops up.
2	Select a file and confirm with <i>[OK]</i> . Manually stored data is written in the file. New datasets are appended to the existing dataset.

### 11.1.2 Storing measurement datasets manually

Measurement datasets are stored in a file selected before (see page 154). Allocating an Identification (*ID*) to the data record makes it easier to find it again.

- 1 Using <STO>, display the current measurement dataset.

Administrator	
ProLab 4000[65656666] -> ManSto	
No.:1	Date: 5/25/2007 3:41:59 PM
ID: TEST 1	V
pH1 [BlueLine 14-ID/A054804070][+++]	
9,099	23,1 °C
pH2 [BlueLine 14-ID/A054804070][+++]	
7,784	25,2 °C
Cond [C=0,475 1/cm]	
217 uS/cm	24,6 °C [nLF][TR25]
OK	Cancel
Tab	Menu

- 2 If necessary, enter an ID (*ID*) for the measurement.
- 3 If necessary, enter additional text in the comment field (V).



#### Note

The entry in the ID field automatically appears for the next storing procedure.

- 4 Use [OK] to save the selected data.  
The window is closed.

### 11.1.3 Automatically storing measurement datasets

The file in which measurement datasets should be automatically stored is selected by yourself. You can create a new file or select an existing file to be overwritten.

Files for automatically stored measurement datasets have the file extension, "\*.ast".

1	Open the menu, <i>Memory / Automatic memory / New...</i> The <i>New file</i> dialog is open.
2	Enter a new file name and confirm with <i>[OK]</i> . The <i>Automatic memory</i> window opens.
3	If necessary, select a different interval in the <i>Save interval</i> list.



#### Note

The selection in the *Save interval* field automatically appears for the next storing.

One hour is preset as the storing duration.

4	Enter the final date for automatic storing (date and time) and confirm with <i>[OK]</i> . The window for the input of the ID ( <i>ID</i> ) and comment ( <i>V</i> ) pops up.
5	If necessary, enter an ID ( <i>ID</i> ) for the measurement and a text in the comment field ( <i>V</i> ).



#### Note

The entry in the ID field automatically appears for the next storing procedure.

6	Start the automatic storing with <i>[OK]</i> . The <i>Automatic memory</i> window pops up. Other functions cannot be executed while the automatic storing is active.
---	--

**Note**

The progress of the automatic memory is indicated by a progress bar. The *Automatic memory* window can be minimized with the mouse in order to see the measured value display.

- 7 | Wait for the automatic storing to be finished.  
or  
Finish the automatic storing manually with *[Terminate]*.

### 11.1.4 Displaying and filtering stored measurement datasets

- 1 Open the currently selected manual memory with **<RCL>**.  
or  
Open the menu, *Memory / Manual memory* or *Automatic memory / Display...*  
The *Open file* dialog box pops up.
- 2 Select a file and confirm with **[OK]**.  
A data record of the selected file is displayed.

**Administrator**

ProLab 4000[65656666] -> ManSto

No.: 3      Date: 5/25/2007 3:42:38 PM

ID: TEST 1

pH1 [BlueLine 14-ID/A054804070][+++]  
9,099      23,1 °C

pH2 [BlueLine 14-ID/A054804070][+++]  
7,784      25,2 °C

Cond [C=0,475 1/cm]  
217 uS/cm      24,6 °C [nLF][TR25]

Print    Filter     3    Terminate

Tab    Menu

- 3 Using **[Filter]**, open the *Data filter* window for the setting of filter criteria if necessary.  
A combination of the following criteria is possible as the filter:
  - *Memory no.*
  - *Identification*
  - *Date of storing*

**Data filter**

Memory no.:    from 1    to 1

Identification:    ID:   

Date of storing:    from 5/25/2007    to 5/25/2007

OK    Cancel

Tab    Menu

---

4	Activate the selected filter criteria with <i>[OK]</i> . The <i>[Filter]</i> option field is marked. The filter criteria are active.
5	Enter or select a number in the selection field for the dataset number. The selected dataset within the list of (filtered) measurement datasets is displayed.
6	If necessary, download the list of the (filtered) measurement dataset to the interface with <i>[Print]</i> .
7	Terminate the display of stored measurement datasets with <i>Terminate</i> .

#### 11.1.5 Erasing measurement datasets

1	Open the menu, <i>Memory / Manual memory or Automatic memory / Delete...</i> The <i>Delete file</i> dialog box pops up.
2	Select the file to be deleted and confirm with <i>[OK]</i> .
3	Confirm the safety query with <i>[OK]</i> . The file is deleted.

## 11.2 Calibration data

The current calibration record is automatically stored after each valid calibration procedure.

### 11.2.1 Displaying stored calibration data

The current calibration record for a meter and a sensor can be found in the menu, *Calibration / Calibration record...*

#### Displaying the current calibration record

1	Highlight a channel in the measured value display.
2	Select the measured parameter with <b>&lt;MODE&gt;</b> .
3	Open the <i>Calibration</i> menu with <i>Calibration record...</i> The current calibration record is displayed.
4	If required, output the calibration data to the interface with <i>[Print]</i> .



#### Note

The current calibration record can be quickly displayed by clicking on the CalClock with the right mouse button.

#### Displaying the calibration history

1	Open the <i>Calibration / Calibration history...</i> menu. The <i>Calibration memory</i> window with the calibration data for the selected sensor pops up.
2	If required, output the calibration data to the interface with <i>[Print]</i> .

### 11.2.2 Managing the calibration data

The calibration data is stored in the current calibration record (menu, *Calibration / Calibration record...*) and in the calibration history (menu, *Calibration / Calibration history...* and *Memory / Calibration memory*).

The current calibration record of ID sensors is stored in the sensor, of non ID sensors it is stored in the ProLab 4000.

The meter creates a separate calibration history for each ID sensor calibrated with the ProLab 4000.

For non ID sensors calibrated with the meter, a calibration history is created for each measured parameter (pH, ISE, Cond) where the current calibration data is appended.

Managing functions for all calibration data are available to the administrator only.

#### Viewing the calibration history

The administrator can view the calibration histories of all sensors and users.

1	Open the menu, <i>Memory / Calibration memory / Display...</i> The <i>Open file</i> dialog box pops up.
2	If necessary, select a different folder.
3	Select a file ("*.cal") and confirm with <i>[OK]</i> . The <i>Calibration memory</i> window with the calibration data pops up.
4	If necessary, output the calibration data to the interface with <i>[Print]</i> .

#### Erasing a calibration history

The administrator can delete the calibration histories of all sensors and users.

The current calibration data of each sensor is stored separately and is retained even if the calibration history is deleted.

1	Open the menu, <i>Memory / Calibration memory / Delete...</i> The <i>Delete file</i> dialog box pops up.
2	If necessary, select a different folder.
3	Select a file ("*.cal") and confirm with <i>[OK]</i> . A safely query pops up.
4	Confirm the deletion of the file with <i>[OK]</i> . The file is deleted.

### **11.3 Recorder data**

Information on the recording, storing, displaying and deleting of measured value curves is given on page 163 ff.

Files containing recorder data have the file extension ".rdt".

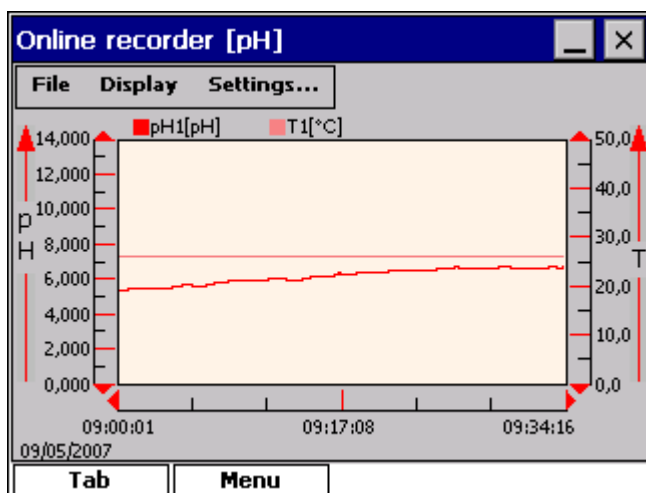
### **11.4 Configuration data**

Information on the recording, storing, displaying and deleting of configuration files is given on page 182 ff.

Files containing configuration data have the file extension ".ste".

## 12 Recorder

The recorder represents measured values graphically in a system of coordinates. The recorder can record a running measurement (online recorder) or the developing of a stored measurement (offline recorder).



The following editing functions are available for the recorder:

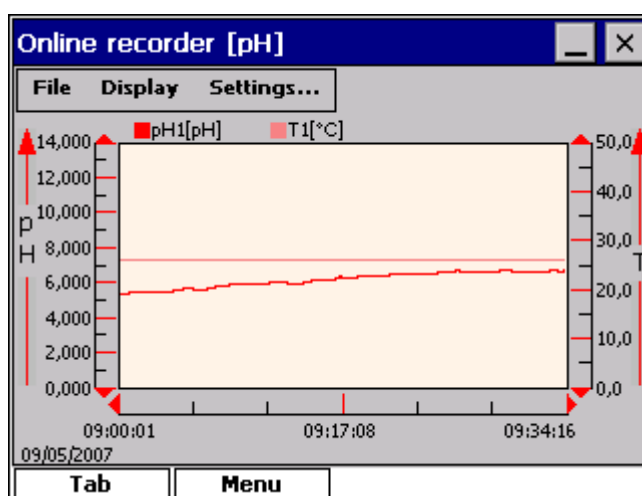
- Displaying or hiding the measured temperature (see page 165)
- Adjusting the colors and axis intercepts of the recorder (see page 168)
- Setting the limit values (see page 171)
- Zooming the displayed section (see page 173)
- Displaying a precise measured value at a specific location (see page 175)

## 12.1 Recording the measured value curve

The recorder records the course of the measured values curve and the course of the temperature curve.

### Starting the recorder

- |   |  |
|---|--|
| 1 | Highlight a channel in the measured value display, e.g. pH.  |
| 2 | Open the <i>Measuring / Recorder...</i> menu.<br>The <i>Online recorder</i> window pops up.<br>The current measurement data of the selected channel is recorded. |



### Note

While the recorder is recording measurement data of a channel, the functions for this channel that could interfere with data integrity are blocked.

If the recorders for two similar electrodes are activated, both measured value curves and both temperature value curves are displayed in one window.

During the recording, the measured value graphic is stored in the working memory only. When the recorder is terminated, a query appears for the storing of the measured value graphic.

## 12.2 Recording the curve of the measured temperature value

If the recorder was started without recording the temperature value, you can switch on the recording of the temperature value. The current setting for the recording of the temperature value is retained until the next start of the recorder.

1	Open the recorder menu, <i>Settings...</i> The recording of the temperature value is switched off or on (✓).
2	Select the menu item, <i>Temperature recording</i> . To change the setting for the temperature recording, it is required to restart the online recorder. A dialog box pops up prior to restarting where you can store the previous recorder data.
3	Discard the previous recorder data with <i>[Cancel]</i> . The recording is restarted with the current setting for the temperature value recording. or – Confirm the storing of the previous recorder data with <i>[OK]</i> . The <i>Save file</i> window opens. – Enter a new file name and confirm with <i>[OK]</i> . The previous recorder data is stored. The recording is restarted with the current setting for the temperature value recording.

### 12.3 Storing recorder data

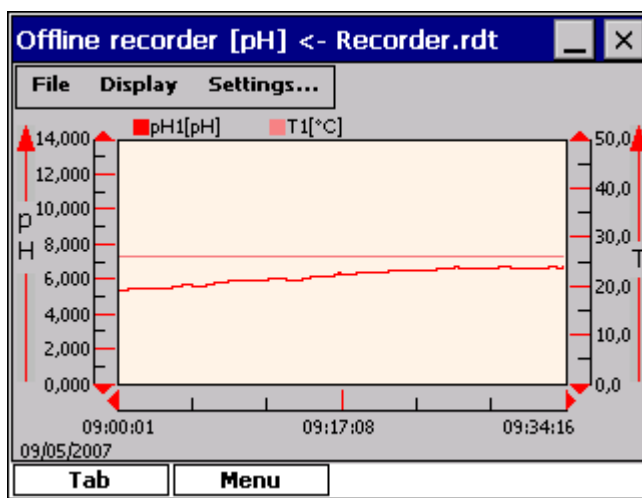
The recorder records the course of the measured values curve and the course of the temperature curve. You can store the previous course of the measured value recording in a file at any time.

1	Open the <i>File / Save as</i> menu. The <i>Save file</i> window pops up.
2	Enter a new file name and confirm with <i>[OK]</i> . The previous progression of the measured value graphic is stored in the file. With the online recorder, the progression of the measured value is stored in the working memory.
3	Further storing processes: Open the <i>File / Save</i> menu. The recorder data is stored in the file that was selected previously without any query.

## 12.4 Displaying stored recorder data

### Opening the offline recorder

- 1 Open the menu, *Memory / Recorder / Display...*  
The *Open file* dialog box pops up.
- 2 Select a file with recorder data and confirm with *[OK]*.  
The *Offline recorder* window pops up and displays the selected recorder data.

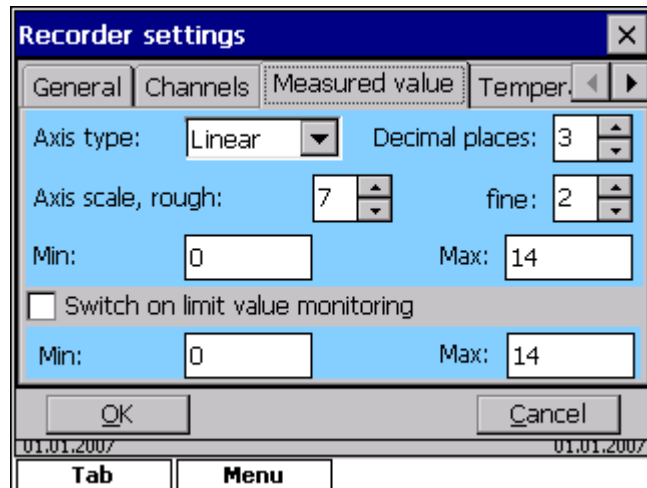


### Displaying a different recorder file

- 3 Open the *File / Open* menu.  
The *Open file* dialog box pops up.
- 4 Select a file and confirm with *[OK]*.  
The selected recorder data is displayed.

## 12.5 Settings for the recorder

In the *Recorder settings* dialog box, the appearance of your recorder is defined. The following settings can be done while the recording is running or after opening a completed recording.



- Colors for the recorder window (register, *General*)
  - Background color of the system of coordinates
  - Color of the legend of the system of coordinates
- Colors of the curves (register, *Channels*)
  - Color of measured value curve (*Measured value*)
  - Color of temperature value curve (*Temp.*)
- Scaling of the axis for the measured value (register, *Measured value*)
  - Axis type (linear / logarithmic)
  - Minimum and maximum value for the recorder
  - Activating the limit value function
  - Minimum and maximum limit value for the measured value
- Scaling of the axis for the temperature value (register, *Temperature*)
  - Minimum and maximum value for the recorder
  - Activating the limit value function
  - Minimum and maximum limit value for the temperature value
- Displayed intercept of the time axis (register, *Time*)
  - Unit of the x axis (*Displayed time period*)
- Recording interval (register, *Time*)

### 12.5.1 Defining the recording interval

The *Recording interval* defines at which intervals the measured values are recorded.

1	Open the recorder menu, <i>Settings...Settings...</i> The <i>Recorder settings</i> window pops up.
2	Select the <i>Time</i> register for the entry of the recording interval.
3	Select the interval.
4	Use <i>[OK]</i> to accept the new settings and close the dialog box, <i>Recorder settings</i> . The new settings are active. or Select another register to make further settings.

### 12.5.2 Specifying the axes of the system of coordinates

The appearance of the recorder is specified by specifying the axes of the system of coordinates:

- Time axis of the measured value recording:  
The time period entered in the field, *Displayed time period* is displayed including the last recorded measured value.
- Measured value and temperature value axis
  - *Axis type* (linear or logarithmic)
  - Resolution of the axis for measured values  
The number in the *Decimal places* field specifies with how many decimal places the measured value scale should be labeled.
  - Minimum and maximum measured value  
Here you define the part of the measured value and temperature you want to keep in view such as pH 0 to pH 14.
  - Scaling of the axes (*Axis scale, rough and fine*)  
In the *Axis scale, rough* field you specify how often the measured value scale should be divided between the minimum and maximum value.  
In the *fine* field you specify how often an axis intercept of the rough scaling should be divided.

You can view the entire progress of the recording regardless of the settings at any time (see page 173).

---

1	Open the recorder menu, <i>Settings...Settings...</i> The <i>Recorder settings</i> window pops up.
2	Select the <i>Measured value</i> register for the scaling of the measured value axis.
3	Make the settings for the axes. If necessary, define limit values (see page 171).
4	Select the <i>Temperature</i> register for the scaling of the temperature value axis.
5	Make the settings for the axes. If necessary, define limit values (see page 171).
6	Use <i>[OK]</i> to accept the new settings and close the dialog box, <i>Recorder settings</i> . The new settings are active. or Select another register to make further settings.

### 12.5.3 Defining and activating limit values

With the limit values you define the measured values at which the curve of the measurement developing is displayed gray if the measured are below or above the limits.

Thus measured values below or above the limits can easily be recognized.

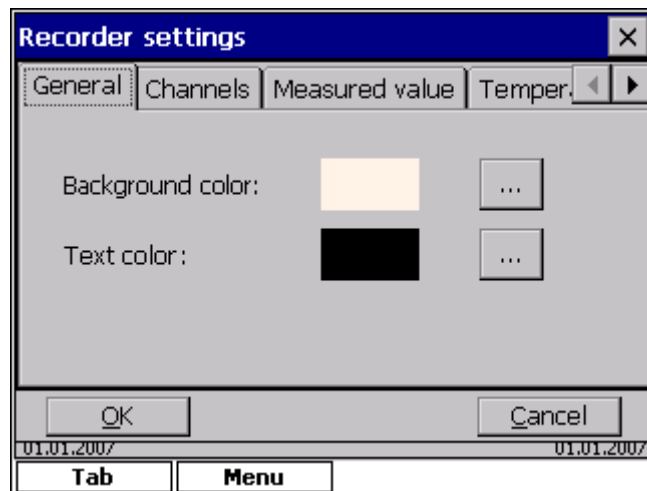
1	Open the recorder menu, <i>Settings...Settings....</i> The <i>Recorder settings</i> window pops up.
2	Select the <i>Measured value</i> register to define the limit values for the measured value.
3	Mark the selection field, <i>Switch on limit value monitoring</i> .
4	Enter the upper and lower limit value.
5	Select the <i>Temperature</i> register to define the limit values for the measured value.
6	Mark the selection field, <i>Switch on limit value monitoring</i> .
7	Enter the upper and lower limit value.
8	Use <i>[OK]</i> to accept the new settings and close the dialog box, <i>Recorder settings</i> . The new settings are active. or Select another register to make further settings.

### 12.5.4 Defining the colors for the recorder representation

The appearance of the recorder is determined with the following colors:

- Background color
- Text color for axes legend
- Color of the measured value curve
- Color of temperature value curve

1	Open the recorder menu, <i>Settings...Settings...</i> The <i>Recorder settings</i> window pops up.
2	Select the <i>General</i> register card for the setting of background color and text color.
3	Open the color palette for background color with [...].
4	Select a color and confirm with [OK].
5	Open the color palette for the text color with [...].
6	Select a color and confirm with [OK].



7	Select the <i>Channels</i> register for the setting of the curve colors.
8	If necessary, select a channel.
9	Open the color palette for the measured value ( <i>Measured value</i> ) with [...].
10	Select a color and confirm with [OK].
11	Open the color palette for the temperature value ( <i>Temp.</i> ) with [...].
12	Select a color and confirm with [OK].

- |    |  |
|----|--|
| 13 | Use <i>[OK]</i> to accept the new settings and close the dialog box, <i>Recorder settings</i> .<br>The new settings are active.<br>or<br>Select another register to make further settings. |
|----|--|

## 12.6 Changing the displayed axis intercept

The standard settings for the displayed axis intercepts are defined in the *Recorder settings* window for the time axis (register, *Time*), the measured value axis (register, *Measured value*) and the temperature axis (register, *Temperature*) (see page 169).

In the recorder window, you can change the displayed axis intercept and move back to the standard display at any time.

### Displaying the entire time axis

The *Total time axis* function provides an overview of the entire process since the recording of the measured value curve was started.

- |   |  |
|---|--|
| 1 | Open the <i>Display / Total time axis</i> menu.<br>The time axis from the start of the recording is displayed. |
|---|--|

### Displaying the time axis with specified time period

The *Reset zoom* function is used to reset the representation of the recorder to the standard settings specified in the *Recorder settings* window.

The recorder then shows the specified minimum and maximum of the measured value and temperature axis and the specified time period (see page 169).

- |   |  |
|---|--|
| 1 | Open the <i>Display / Reset zoom</i> menu.<br>The representation of the recorder is reset to the standard settings specified in the window, <i>Recorder settings</i> . |
|---|--|

### Displacing the axis intercept

As described below, the axis intercepts of the recorder can be displaced either in the direction of the time axis or in the direction of the measured value/temperature axis. By his the displayed axis intercept is displaced to the left/right or up/down but not scaled up.

This function is only available if the zoom function is not active.

- 1 Click on an arrow at the beginning or end of an axis with the mouse (time axis or measured value/temperature axis).  
The displayed axis intercept is displaced in the direction of the arrow.

### **Zooming an axis intercept**

The axis intercepts of the recorder can be zoomed as follows (time axis and measured value/temperature axis).

- 1 Draw a rectangle within the recorder with the mouse.  
The marked section is displayed bigger.

### **Undoing the zooming**

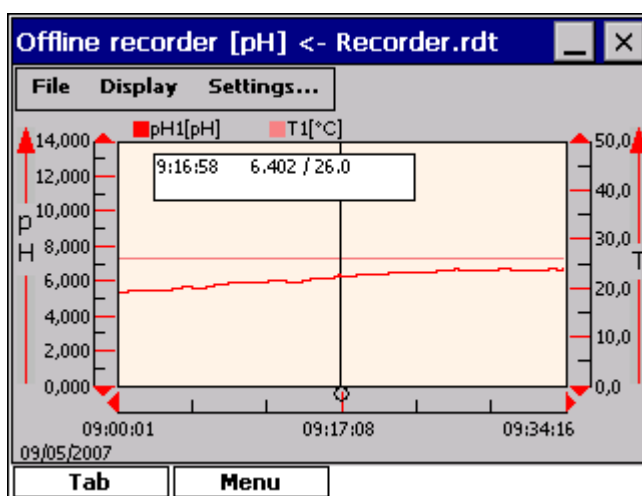
You can undo the last zoom step as follows.

- 1 Click on an axis with the mouse.  
The context menu pops up.
- 2 Open the menu item, *Undo zoom*.  
The last zoom step is undone.

## 12.7 Displaying exact measurement data at a point (cursor)

In the recorder window, you can display the exact measurement data numerically at a point of the measuring curve.

- 1 Open the menu item, *DisplayCursor*.  
A cursor is displayed.
- 2 Move the cursor to a position with the mouse.  
The respective numeric measurement data is displayed in a box.



## 12.8 Deleting stored recorder data

- 1 Open the menu, *Memory / Recorder / Delete....* The *Delete file* dialog box pops up.
- 2 Select a file (\*.rdt) and confirm with *[OK]*.  
A safety query pops up.
- 3 Confirm the safety query with *[OK]*.  
The file is deleted.



## 13 Transmitting data

### 13.1 Printing current measurement data

To which interface the measurement data should be output with **<PRINT>** is specified in the menu, *System / Data output...* (see page 60).

- |   |  |
|---|--|
| 1 | Output the current measurement data to the interface with <b>&lt;PRINT&gt;</b> . |
|---|--|

### 13.2 Transmitting data (to a PC or printer)

The meter has the following interfaces for PC/printer:

- RS232 interface (serial interface)  
e.g. to connect a PC/printer with the serial interface
- USB-B interface *USB Device*  
e.g. to connect a PC
- USB-A interface, *USB Host*  
e.g. to connect devices with USB connection (printer, keyboard, mouse, storage, card reader, barcode scanner, hub etc.)

The interfaces, RS232 (serial port) and USB-B (*USB Device*) are used to transmit data to a PC and update the meter software.

The USB-A (*USB Host*) also enables the transmission of data to an external USB printer.

#### 13.2.1 RS232 interface

- |   |  |
|---|--|
| 1 | Connect the interface to the PC with the Z390 (PC) cable or to the printer with the Z393 (ext. serial printer) cable.  |
| 2 | Set up similar transmission data on the PC/printer: <ul style="list-style-type: none"> <li>● Baud rate: selectable in the range 1200 ... 115200</li> <li>● Handshake: RTS/CTS + Xon/Xoff</li> <li>● Set on the PC only: <ul style="list-style-type: none"> <li>– Parity: none</li> <li>– Data bits: 8</li> <li>– Stop bits: 1</li> </ul> </li> </ul> |

**Note**

Pin assignment of the socket: See page 195.

### Installation of the USB driver on the PC

#### 13.2.2 USB-B interface (*USB Device*)

Connect the interface to the PC via the supplied Z875 USB cable.

System requirements of the PC for installation of the USB driver:

- PC with Pentium processor or higher with at least one free USB connection and CD-ROM drive
- Windows 2000, XP.

1	Insert the supplied installation CD in the CD drive of your PC.
2	<p>Connect the meter to the USB-B input (<i>USB Device</i>) of the PC via the USB cable.</p> <p>Windows automatically installs the driver for the meter. Follow the Windows installation instructions as necessary.</p> <p>The meter is listed as a virtual COM interface among the connections in the Windows instrument manager.</p>
3	<p>Set up similar transmission data on the PC/printer:</p> <ul style="list-style-type: none"> <li>● Baud rate: selectable in the range 1200 ... 115200</li> <li>● Handshake: RTS/CTS + Xon/Xoff</li> <li>● Set on the PC only:               <ul style="list-style-type: none"> <li>– Parity: none</li> <li>– Data bits: 8</li> <li>– Stop bits: 1</li> </ul> </li> </ul>

### 13.2.3 USB-A interface (*USB Host*)

Connect the USB-A interface (*USB Host*) of the ProLab 4000 to the printer.

- |   |   |
|---|---|
| 1 | Connect the USB printer to the <i>USB Host</i> interface. |
|---|---|

### 13.2.4 Options for data transmission

Data can be transmitted to a PC or external printer via the interfaces, RS232, USB-B (*USB Device*) and USB-A (*USB Host*).

The following table shows which data is transmitted to the interface in which way:

Data	Control	Operation / description
Current measured values of the connected sensor	Manual	<ul style="list-style-type: none"> <li>● With <b>&lt;PRINT&gt;</b>.</li> <li>● Simultaneously with every manual storage process with <b>&lt;STO&gt;</b> (see page 153).</li> </ul>
	automatic, at intervals	<ul style="list-style-type: none"> <li>● Simultaneously with every automatic storage process (see page 153).</li> </ul>
Stored measured values	Manual	<ul style="list-style-type: none"> <li>● Displayed dataset: with <b>&lt;PRINT&gt;</b> after recall from data storage.</li> <li>● All datasets correspond to the filter criteria with the <i>[Print]</i> function in the memory display</li> </ul>
Calibration records	Manual	<ul style="list-style-type: none"> <li>● Displayed calibration record: with <b>&lt;PRINT&gt;</b> after recall from data memory.</li> </ul>
	Automatically	<ul style="list-style-type: none"> <li>● For the respective sensor at the end of a calibration procedure.</li> </ul>



#### Note

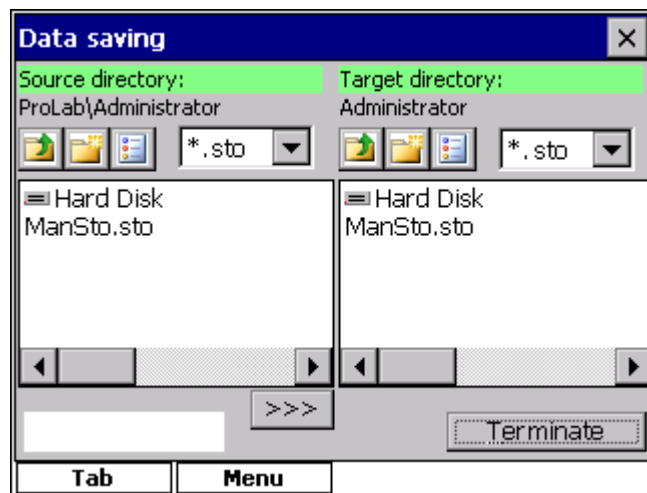
The following rule applies: Except for the menus, the display content is generally downloaded to the interface with **<PRINT>** (displayed measured values, measurement datasets, calibration records).

### 13.3 Data backup

#### 13.3.1 Data backup by the administrator

To back up important data against being lost or to relocate big files from the instrument, the administrator can plug an external USB medium to the ProLab 4000 in order to save data on it.

- 1 Connect a USB memory device to the USB-A *USB Host* interface.
- 2 Open the *File / Data saving...* menu.  
A double dialog box opens.



- 3 Select a file extension in the list of file types, e.g. \*.sto.  
All files in this directory that have the selected extension are displayed.
- 4 In the source directory, select the source to be copied, a directory (CalHistory, or a user directory) or a file.
- 5 In the target directory, select the target, such as a directory in an external storage medium (hard disk).
- 6 If necessary, create and select a new folder in the target directory.
- 7 With [**>>>**] start the copy procedure.
- 8 If necessary, back up further files or directories.
- 9 Terminate the data backup with **<ESC>**.

### 13.3.2 Viewing backed up data

The external USB medium is displayed within the directory of each user. Thus the data can be read at any time after connecting the USB medium.

Example: Viewing backed up measurement data

1	Connect a USB memory device to the USB-A <i>USB Host</i> interface.
2	Open the menu, <i>Memory / Manual memory</i> or <i>Automatic memory / Display...</i> The <i>Open file</i> dialog box pops up.
3	Select a file from the external medium and confirm with <i>[OK]</i> . A data record of the selected file is displayed.

## 14 Configurations

As the administrator, you can create and assign a configuration to each user (see page 52). The settings for each measured parameter are defined in a configuration file. If a configuration file is assigned to a user, the measurement setting for the user are fixed and the user rights limited.

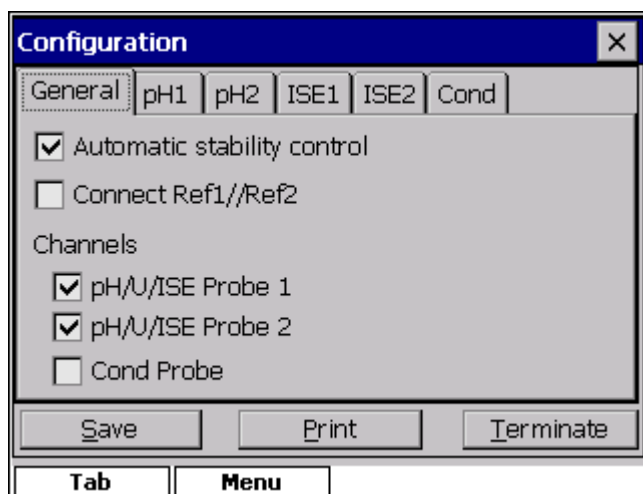
All users whose user rights were not limited by the user can create their own configuration files for different measurement tasks. This can be useful if measurement tasks require different basic settings.

After a user login without any stored configuration, the meter always starts with the settings last used (not with the configuration last called up).

## 14.1 Viewing a configuration

A configuration viewer is available so the current configuration settings can be viewed. It gives an overview of the current measurement settings.

- 1 Open the menu, *File / View configuration...*  
The *Configuration* window appears.  
The current configuration is displayed.



### Note

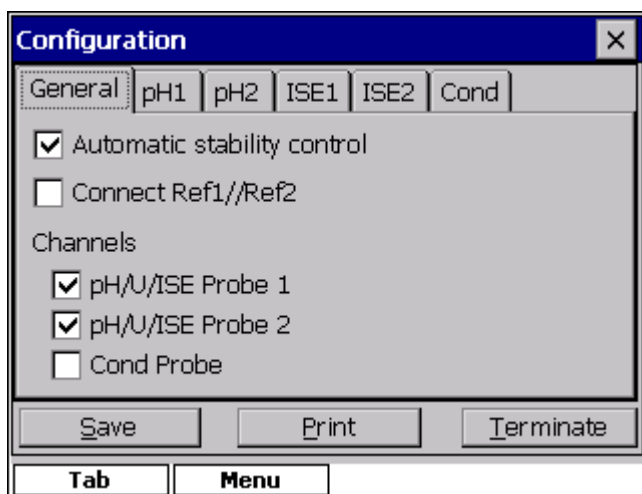
A user whose user rights were restricted by the administrator cannot change these settings.

- 2 If required, output the settings to the interface with *[Print]*.
- 3 Close the *Configuration* window with *[Terminate]*.

## 14.2 Creating a new configuration

When creating a configuration, the current settings of the meter for each measured parameter are taken over in the *Configuration* window first. Then the settings can be adjusted and stored as an extra configuration file.

- 1 Open the menu, *File / New configuration...*  
The *Configuration* window appears.



- 2 Define the options for allowed measurements for all measured parameters.
- 3 Using *[Save]*, open the *Save file* dialog.
- 4 Enter a new file name and confirm with *[OK]*.  
The configuration is stored.
- 5 If required, output the settings to the interface with *[Print]*.
- 6 If necessary, store further configurations.
- 7 Close the *Configuration* window with *[Terminate]*.



### Note

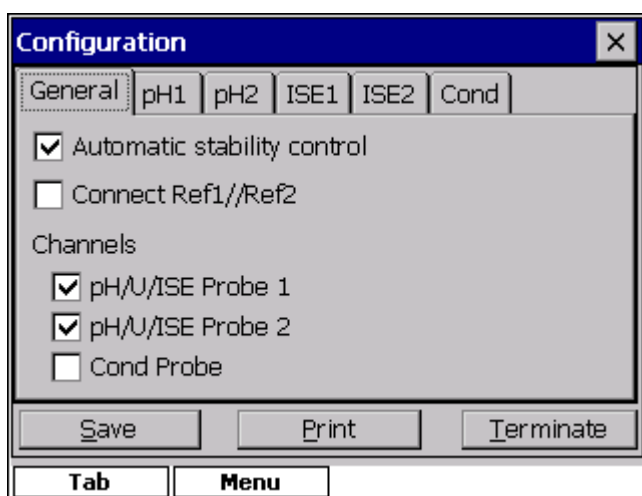
To activate the settings of a configuration, the configuration has to be loaded (see page 185).

### 14.3 Loading a configuration

All users who can create a configuration can also load it.

When loading a configuration, all settings stored in the configuration file can be loaded.

- 1 Open the *File* menu with *Select configuration....*  
The *Open file* dialog box pops up.
- 2 Select a configuration file ("\*.ste") and confirm with *[OK]*.  
The *Configuration* window pops up.



- 3 The configuration for all measured parameters can be viewed but not changed.
- 4 If required, output the settings to the interface with *[Print]*.
- 5 Load the configuration with *[OK]*.  
The settings stored in the configuration are active.
- 6 Close the *Configuration* window with *[Terminate]*.

#### 14.4 Deleting a configuration

All users who can create a configuration can also delete it in their directory.

1	Open the <i>File</i> menu with <i>Delete configuration....</i> The <i>Delete file</i> dialog box pops up.
2	Select the file to be deleted and confirm with <i>[OK]</i> .
3	Confirm the safety query with <i>[OK]</i> . The file is deleted.

## 15 Maintenance, cleaning, disposal

### 15.1 Maintenance

The only maintenance activity required is replacing the batteries.



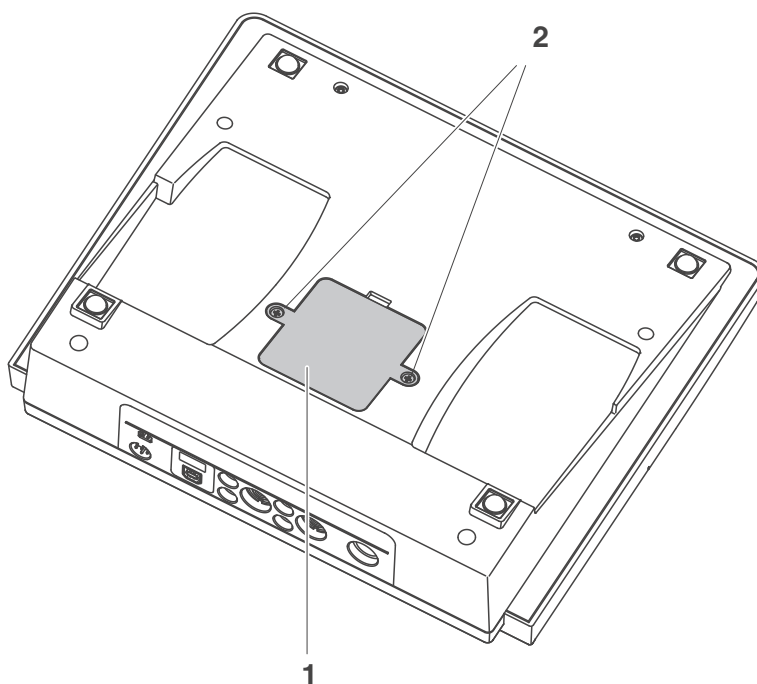
#### Note

For maintenance of the measuring cells and electrodes refer to the relevant operating manuals.

#### Replacing the batteries

If the meter stays connected to the power supply while the batteries are being replaced, or if they are replaced within approx. one minute, the date and time will be retained in the meter.

- |   |   |
|---|---|
| 1 | Using a screw driver, unscrew the screws (2) of the lid of the battery compartment. |
|---|---|



- |   |   |
|---|---|
| 2 | Open the battery compartment (1) on the underside of the meter.       |
| 3 | Remove the four batteries from the battery compartment.               |
| 4 | Place four new batteries (type Micro AAA) in the battery compartment. |
| 5 | Close the battery compartment (1).                                    |

- |   |   |
|---|---|
| 6 | Using a screw driver, tighten the screws (2) of the lid of the battery compartment. |
| 7 | Switch the meter on with <On/Off>.  |

**Note**

If the date and time are lost, the setting of the date and time is displayed automatically after switching on.  
Set the date and time (see page 59)

**CAUTION**

**Make sure that the poles of the batteries are the right way round. The ± signs on the batteries must correspond to the ± signs in the battery compartment.**

**Only use leakproof alkaline manganese batteries.**

**15.2 Cleaning**

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

**CAUTION**

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

**15.3 Disposal****Note**

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

It is illegal to dispose of the instrument in household refuse.

## 16 What to do if...

### 16.1 pH and ORP measurement

#### Error message *Err1*

Cause	Remedy
pH electrode:	
– Measured value outside the measuring range	– Use a suitable electrode
– Air bubble in front of the diaphragm	– Remove air bubble
– Air in the diaphragm	– Extract air or moisten junction
– Cable broken	– Replace the electrode
– Gel electrolyte dried out	– Replace the electrode

#### Error message *Err2*

Cause	Remedy
– No electrode connected	– Connect the electrode
– Setting time during calibration too long	– Adjust temperature if necessary – Recalibrate

#### Error message *Err4*

Cause	Remedy
– Temperature not stable during calibration.	– Adjust temperature if necessary – Recalibrate

#### Error message, *Error*

Cause	Remedy
pH electrode:	
– The values determined for zero point and slope of the electrode are outside the allowed limits.	– Recalibrate
– Diaphragm contaminated	– Clean diaphragm

Cause	Remedy
– Electrode broken	– Replace the electrode
Buffer solutions:	
– Incorrect buffer solutions	– Select the suitable buffer set for the buffers used or – Replace the buffer solutions
– Buffer solutions too old	– Use only once. Note the shelf life
– Buffer solutions depleted	– Replace the buffer solutions

**No stable measured value**

Cause	Remedy
<i>pH electrode:</i>	
– Diaphragm contaminated	– Clean diaphragm
– Membrane contaminated	– Clean membrane
<i>Test sample:</i>	
– pH value not stable	– Measure with air excluded if necessary
– Temperature not stable	– Adjust temperature if necessary
<i>Electrode + test sample:</i>	
– Conductivity too low	– Use a suitable electrode
– Temperature too high	– Use a suitable electrode
– Organic liquids	– Use a suitable electrode

**Obviously incorrect measured values**

Cause	Remedy
<i>pH electrode:</i>	
– Not connected	– Connect the electrode
– Cable broken	– Replace the electrode
– pH electrode unsuitable	– Use a suitable electrode
– Temperature difference between buffer and test sample too high	– Adjust temperature of buffer or sample solutions

	Cause	Remedy
	– Measurement procedure not suitable	– Follow special procedure
<b>CalClock on red background</b>	Cause	Remedy
	– Calibration interval expired	– Recalibrate the measuring system

## 16.2 Ion selective measurement

<b>Error message <i>Err1</i></b>	Cause	Remedy
	– Measuring range exceeded	– Dilute test sample
<b>Obviously incorrect measured values</b>	Cause	Remedy
	– Electrode not connected	– Connect the electrode
	– Cable broken	– Replace the electrode
<b>Error message, Error (invalid calibration)</b>	Cause	Remedy
	<i>ISE electrode:</i>	
	– Moisture in the plug	– Dry plug
	– Electrode obsolete	– Replace the electrode
	– Electrode unsuitable for the range to be measured	– Use a suitable electrode
	– Socket damp	– Dry socket
	<i>Calibration procedure:</i>	
	– Wrong sequence of standards for three point calibration	– Select correct sequence
	– Calibration standards do not have the correct temperature (max. $\pm 2$ °C temperature difference)	– Adjust the temperature of the calibration standards

**Warning [TempErr]**

Cause	Remedy
– Temperature difference between measurement and calibration greater than 2 K.	– Adjust the temperature of the test sample

**Warning [ISEErr]**

Cause	Remedy
– Electrode voltage outside calibrated range	– Recalibrate

**16.3 Conductivity measurement****Conductivity measuring cell was not recognized**

Cause	Remedy
– Measuring cell not connected	– Connect measuring cell
– Cable broken	– Replace measuring cell

**Error message, Error (invalid calibration)**

Cause	Remedy
– Measuring cell contaminated	– Clean cell and replace it if necessary
– Unsuitable control standard	– Use control standard, 0.01 mol/l KCl

**CalClock with red frame**

Cause	Remedy
– Calibration interval expired	– Recalibrate the measuring system

**Cond temp?**

Cause	Remedy
– Test sample does not have the correct temperature (max. $\pm 2$ °C temperature difference from calibration temperature)	– Adjust the temperature of the test sample

## 16.4 General errors

**Meter does not react to  
keystroke**

**Cause**

- Operating condition undefined or EMC load unallowed

**Remedy**

- Processor reset:  
Press the **<On/Off>** and **<SC>** key simultaneously.

**Time is lost**

**Cause**

- Buffer batteries empty

**Remedy**

- Exchange buffer batteries (see page 187)



## 17 Technical Data

### 17.1 General data

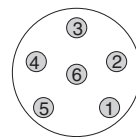
<b>Dimensions</b>	approx. 240 x 280 x 70 mm	
<b>Weight</b>	approx. 2.5 kg (without power pack)	
<b>Mechanical structure</b>	Type of protection	IP 54
<b>Electrical safety</b>	Protective class	III
<b>Test certificates</b>	cETLus, CE	
<b>Ambient conditions</b>	Storage	- 25 °C ... + 65 °C
	Operation	+ 5 °C ... + 45 °C
	Climatic class	2
<b>Power supply</b>	Power pack	FRIWO FW7555M/09, 15.1432.500-00 Friwo Part. No. 1883259 Input: 100 ... 240 V ~ / 50 ... 60 Hz / 400 mA Output: 9 V = / 1.5 A Connection max. overvoltage category II Primary plugs contained in the scope of delivery: Euro, US, UK and Australian.
	Batteries (to buffer the system clock in the case of a power failure)	4 x 1.5 V alkali-manganese batteries, Type AAA
<b>Sensor input</b>	pH/U/ISE probe 1 + 2	
	Input resistance	> 5 E12 Ohm
	Input current	< 1 E-12 A

**RS232 serial interface**

Connection of the PC cable (Z390) or printer cable (Z393)

Baud rate	adjustable: 1200, 2400, 4800, 9600, 19200 Baud
Type	RS232, data download
Data bits	8
Stop bits	2
Parity	None
Handshake	RTS/CTS
Cable length	Max. 15m

Socket assignment



RS 232

- 1 RTS
- 2 RxD
- 3 TxD
- 4 -
- 5 SG
- 6 CTS

**USB-B interface (USB Device)**

Automatic switch-over when a USB cable is connected

Type	RS232 - USB interface converter
Cable length	max. 3 m

**USB-A interface (USB Host)**

Type	USB 1.1
Cable length	max. 3 m

**Guidelines and norms used**

EMC	EC guideline 2004/108/EC
	<p><u>Interference emission:</u>                  EN 61326-1                  EN 61000-3-2                  EN 61000-3-3                  FCC Class A</p>
	<p><u>Interference immunity:</u>                  EN 61326-1                  Performance feature C for ESD according to IEC61000-4-2</p>

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Instrument safety	EC guideline 2006/95/EC EN 61010-1 class A ANSI/UL 61010-1 CAN/CSA-C22.2 No. 61010-1
Radio data transmission	EC guideline 1999/5/EC EN 300 330-2 EN 50364 EN 60950-1
Climatic class	VDI/VDE 3540
IP protection class	EN 60529

## 17.2 Measuring ranges, resolution, accuracy

### 17.2.1 Temperature

Measuring ranges, resolution	Variable	Measuring range	Resolution
	T [°C]	- 35.0 ... + 150.0	0.1

Accuracy ( $\pm 1$ digit)	Variable	Accuracy	Temperature of the test sample
	T [°C]	$\pm 0.1$	- 35.0 ... + 150.0

Manual temperature input	Variable	Range	Increment
	T <sub>manual</sub> [°C]	-35 ... + 150	1

### 17.2.2 pH/ORP

Measuring ranges, resolution	Variable	Measuring range	Resolution
	pH	- 2.000 ... + 20.000	0.001
		- 2.00 ... + 20.00	0.01
		- 2.0 ... + 20.0	0.1
	U [mV]	- 2200.0 ... + 2200.0	0.1
		- 2200 ... + 2200	1

Accuracy ( $\pm 1$ digit)	Variable	Accuracy	Temperature of the test sample
	<i>pH</i>	$\pm 0.002$ $\pm 0.01$ $\pm 0.1$	+ 15 °C ... + 35 °C
	<i>U [mV] / range</i>		
	- 2200.0 ... + 2200.0	$\pm 0.1$	+ 15 °C ... + 35 °C
	- 2200 ... + 2200	$\pm 1$	+ 15 °C ... + 35 °C

## 17.2.3 ISE

Measuring ranges, resolution	Variable	Measuring range	Resolution
ISE [mg/l, %, ppm, mg/kg, $\mu\text{mol/l}$ ]		1.0 E-40 ... 9.9 E-4	1 E-39 ... 1 E-5
		0.001 ... 9.999	0.001
		10.00 ... 99.99	0.01
		100.0 ... 999.9	0.1
		1000 ... 999999	1
		1.0 E6 ... 9.9 E39	1 E1 ... 1 E38

Manual temperature input	Variable	Range	Increment
	$T_{\text{manual}}$ [°C]	- 35 ... + 150	1

## 17.2.4 Conductivity

Measuring ranges, resolution	Variable	Measuring range	Resolution
$\chi$ [ $\mu\text{S/cm}$ ]		0.000 ... 1.999*	0.001
		0.00 ... 19.99**	0.01
		0.0 ... 199.9	0.1
		200 ... 1999	1
$\chi$ [mS/cm]		2.00 ... 19.99	0.01
		20.0 ... 199.9	0.1
		200 ... 1999	1
Resistivity [Ohm*cm]		0.00 ... 9.99	0.01
		10.0 ... 99.9	0.1
		100 ... 999	1
Specific resistance [kOhm*cm]		1.00 ... 9.99	0.01
		10.0 ... 99.9	0.1
		100 ... 999	1
Resistivity [MOhm*cm]		1.00 ... 9.99	0.01
		10.0 ... 99.9	0.1
		100 ... 999	1
SAL		0.0 ... 70.0 according to the IOT table	0.1
TDS [mg/l]		0 ... 2000 (factor can be set in the range 0.40 ... 1.00)	1

\* only possible with cells of the cell constant,  $0.010 \text{ cm}^{-1}$

\*\* only possible with cells of the cell constant,  $0.010 \text{ cm}^{-1}$  or  $0.090 \dots 0.110 \text{ cm}^{-1}$

Cell constants	Cell constant C	Values
	Can be calibrated in the ranges	0.450 ... 0.500 cm <sup>-1</sup> 0.585 ... 0.715 0.800 ... 1.200 cm <sup>-1</sup>
	Adjustable	0.010 cm <sup>-1</sup> (fixed) 0.090 ... 0.110 cm <sup>-1</sup> 0.250 ... 25.000 cm <sup>-1</sup>

Reference temperature	Reference temperature	Values
	Adjustable	20 °C (Tr20) 25 °C (Tr25)

Accuracy (± 1 digit)	Variable	Accuracy	Temperature of the test sample
<b>χ / Temperature compensation</b>			
	<i>None (Off)</i>	± 0.5 %	
	<i>Nonlinear (nLF)</i>	± 0.5 %	0 °C ... + 35 °C according to EN 27 888
		± 0.5 %	+ 35 °C ... + 50 °C Extended nLF function according to SI Analytics GmbH measurements
	<i>Linear (lin)</i>	± 0.5 %	+ 10 °C ... + 75 °C
<b>SAL / range</b>			
	<i>0.0 ... 42.0</i>	± 0.1	+ 5 °C ... + 25 °C
		± 0.2	+ 25 °C ... + 30 °C
<b>TDS [mg/l]</b>			
		± 1	

## 18 Lists

This chapter provides additional information and orientation aids.

### **Abbreviations**

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

### **Status display indicators**

### **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.

### **Trademarks used**

The list comprises the trademarks used in the present document and their owners.

### **Index**

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

**Abbreviations**

$\kappa$	Conductivity value (international $\gamma$ )
°C	Temperature unit, degrees Celsius
°F	Temperature unit, degrees Fahrenheit
C	Cell constant [ $\text{cm}^{-1}$ ] (internat. k)
D.O.	Dissolved oxygen
Lin	Linear temperature compensation
LoBat	Batteries almost empty (Low battery)
mV	Voltage unit
mV/pH	Unit of the electrode slope (internat. mV)
nLF	Nonlinear temperature compensation
pH	pH value
S	Slope (internat. k)
SAL	Salinity
SELV	Safety Extra Low Voltage
TDS	Total Dissolved Solids
U	Voltage

### Status display indicators

[SC]	Measured value (Hold) or Measurement with stability control
[ARng]	Automatic range selection (AutoRange)
[TP]	Temperature sensor is being used
CondTP	when measuring pH using multiparameter meters only: Integrated temperature sensor of a conductivity measuring cell is being used
[nLF]	Conductivity measurement only: Temperature compensation "nLF"
[Lin]	Conductivity measurement only: Temperature compensation "TC lin"
[TC off]	Conductivity measurement only: No temperature compensation "TC off"
[Tref20]	Conductivity measurement only: $T_{\text{Ref}} = 20\text{ °C}$ is selected as the reference temperature
[Tref25]	Conductivity measurement only: $T_{\text{Ref}} = 25\text{ °C}$ is selected as the reference temperature
[ISEErr]	For calibration with ion sensitive electrodes only: Electrode voltage outside the calibrated range (see page 191)

## 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.
- AutoRange** Name of the automatic selection of the measuring range.
- 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.
- Channel** A channel is an indication on the display that corresponds to a physical connection at the meter.  
The connections for similar sensor types are numbered on the meter (*pH/U/ISE Probe 1*, *pH/U/ISE Probe 2*). To secure the assignment of connection and channel on the display, the channel is numbered on the display.
- 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.
- 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 (voltage)  $U$  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.
- Junction** 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.
- Measured parameter** The measured parameter is the physical dimension determined by measuring, e. g. pH or conductivity.
- 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).

---

<b>Molality</b>	Molality is the quantity (in Mol) of a dissolved substance in 1000 g solvent.
<b>Offset potential</b>	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 zero point is part of the offset potential.
<b>ORP voltage</b>	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).
<b>pH value</b>	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.
<b>Potentiometry</b>	Name of a measuring technique. The signal (depending on the measured parameter) of the electrode is the electrical potential. The electrical current remains constant.
<b>Reference temperature</b>	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.
<b>Reset</b>	Restoring the original condition of all settings of a measuring system.
<b>Resistance</b>	Short name for the electrolytic resistivity. It corresponds to the reciprocal value of the electrical conductivity.
<b>Resolution</b>	Smallest difference between two measured values that can be displayed by a measuring instrument.
<b>Salinity</b>	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.
<b>Salt content</b>	General designation for the quantity of salt dissolved in water.
<b>Slope</b>	The slope of a linear calibration function.
<b>Stability control</b>	Name for a function to check the stability of the measured value.
<b>Standard solution</b>	The standard solution is a solution where the measured value is known by definition. It is used to calibrate a measuring system.
<b>TDS</b>	Total dissolved solids
<b>Temperature coefficient</b>	Value of the slope of a linear temperature function.

- Temperature compensation** Name of a function that considers the temperature influence on the measurement and converts it accordingly. Depending on the measured parameter to be determined, the temperature compensation functions in different ways. For 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.
- Temperature function** Name of a mathematical function expressing the temperature behavior of a test sample, a sensor or part of a sensor.
- Test sample** Designation of the test 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.
- Zero point** 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 (pH = 7).

**Trademarks used**

<b>Trademark</b>	<b>Owner of the trademark</b>
Merck	Merck KGaA
SCHOTT	Schott Glas AG
Mettler Toledo	Mettler Toledo
Fisher	Fisher Scientific Company
Fluka	Fluka AG
Radiometer	Radiometer
Baker	Mallinckrodt Baker, Inc.
Metrohm	Metrohm AG
Beckman	Beckman Instruments, Inc.
Hamilton	Hamilton Company Corporation
Precisa	Precisa Instruments AG
Reagecon	Reagecon Diagnostics Limited
Riedel-de Haen	Honeywell International Inc.
Windows	Microsoft Corporation



## Index

**A**

Authorized use .....21

**B**

Battery compartment .....187

Blank value addition .....128

**C**

Calibration

ISE .....103

Conductivity .....149

pH .....74

Calibration evaluation

ISE .....105

Conductivity .....150

pH .....78

Calibration interval .....88

Calibration points

ISE .....103

pH .....76

Calibration record

Stored calibration records, display ..

160, .....175

Cell constant .....149

Cleaning .....188

Connecting sensors .....15

**D**

Data output .....163, 177

Default settings

Measured parameter .....65

System settings .....66

Delete

Measurement datasets .....159

Display .....14

Display illumination .....14

**F**

Firmware update .....211

**I**

Initial commissioning .....24

Initialize .....65

Ion concentration .....97

ISE standard solutions .....103

**J**

Jack field ..... 15

**K**

Key functions ..... 12

Keys ..... 12

**L**

Lists ..... 201

**M**

Measurement accuracy ..... 88

Measuring

ISE ..... 98

Conductivity ..... 132

ORP voltage ..... 91, 93

pH ..... 71

Measuring method ..... 113

Blank value addition ..... 128

Sample addition ..... 122

Sample subtraction ..... 125

Standard addition ..... 114

Standard subtraction ..... 119

Measuring mode

ISE ..... 97

Cond ..... 131

pH ..... 69

Measuring ranges

Conductivity ..... 199

Menus (navigation) ..... 42

**O**

Obligations of the purchaser ..... 22

Operational safety ..... 22

**P**

pH ..... 69

pH buffer sets ..... 74

Precautions ..... 21

Principle operation ..... 33

Print ..... 179

**R**

Recorder ..... 163, 177

Reset ..... 65  
RS232 interface ..... 178, 179  
RS232 socket assignment ..... 196

## S

Safe operation ..... 22  
Safety ..... 21  
Sample addition ..... 122  
Sample subtraction ..... 125  
Scope of delivery ..... 23  
Sensor window ..... 14  
Single-point calibration  
    pH ..... 81, 82, 83, 85, 86, 109  
Slope  
    ISE ..... 103  
    pH ..... 74, 149  
Stability control  
    Manual  
        ISE ..... 99  
        Conductivity ..... 133  
        ORP voltage ..... 91, 94  
        pH ..... 71  
Standard addition ..... 114  
Standard addition with blank value correction  
128  
Standard subtraction ..... 119  
Status line ..... 14  
Stored measurement datasets, display ....  
158  
Storing functions ..... 153  
System configuration  
    Recall ..... 184, 185

## T

Temperature compensation ..... 137  
Temperature measurement ..... 62  
    ISE ..... 97  
    Conductivity ..... 131  
    pH ..... 69, 89  
Temperature sensor  
    pH ..... 70, 90, 98  
Temperature unit ..... 61  
Three-point calibration  
    ISE ..... 109  
    pH ..... 82  
Transmitting data ..... 177  
Transmitting measured values ..... 177  
Two-point calibration

ISE ..... 108  
pH ..... 81, 83, 85

## Z

Zero point of the pH electrode ..... 74, 149

## Appendix

### A.19 Firmware update

#### General information

With the "Update\_ProLab3000\_4000" program and a PC you can update the firmware of the ProLab 4000 to the newest version. Available firmware updates can be found on the Internet.

Connect the meter to a PC for the update.

For the update via the USB-B interface (*USB Device*), the following is required:

- a free USB interface (virtual COM port) on your PC
- the driver for the USB interface of the PC (installation of the USB driver from the installation CD-ROM)
- the USB cable  
(Z875, included in the scope of delivery of the ProLab 4000).

For the update via the RS232 interface, the following is required:

- a free RS232 interface on your PC
- the RS232 cable, Z390.

#### Preparing the ProLab 4000 for the update

8	Disconnect the ProLab 4000 from the power supply.
9	Disconnect the interface cable (USB, RS232) from the ProLab 4000.
10	Reconnect the power supply. The self-test, meter designation, software version and subsequently the <i>Standby</i> display appear.



- |    |  |
|----|--|
| 11 | Connect the ProLab 4000 to a USB interface (virtual COM port) of the PC with the aid of the USB interface cable.<br>or<br>Connect the ProLab 4000 to a serial interface (COM port) of the PC with the aid of the Z390 interface cable. |
|----|--|

**Program installation**

- |   |   |
|---|---|
| 1 | With the installation program, "Install_Update_ProLab3000_4000_Vx_yy_English.exe", install the firmware update program on a PC. |
|---|---|

**Program start**

- |   |   |
|---|---|
| 2 | Start the "Update_ProLab3000_4000" program from the Windows start menu. |
| 3 | If necessary, change the language in the language menu.                 |

**Firmware update**

- |   |   |
|---|---|
| 4 | Start the updating procedure in the firmware update program with <i>[OK]</i> .  |
| 5 | Follow the instructions of the firmware update program. During the programming process, a corresponding message and a progress bar is displayed. The programming process takes up to 15 minutes. A terminatory message is displayed after a successful programming process. The firmware update is completed. |
| 6 | Disconnect the ProLab 4000 from the PC. The ProLab 4000 is ready for operation.   |

After switching the meter off and on you can check whether the meter has taken over the new software version.

## A.20 Menus

### A.20.1 Main menu

**File** File

- | New configuration...
- | Select configuration...
- | View configuration...
- | Delete configuration...
- | Terminate

**Memory** Memory

- | Manual memory
  - | New...
  - | Select...
  - | Display...
  - | Delete...
- | Automatic memory
  - | New...
  - | Display...
  - | Delete...
- | ISE method memory
  - | New...
  - | Select...
  - | Display...
  - | Delete...
- | Calibration memory
  - | Display...
  - | Delete...
- | Recorder
  - | Display...
  - | Delete...

<b>System</b>	System <ul style="list-style-type: none"><li>- Data output...<ul style="list-style-type: none"><li>- Baud</li><li>- Output format (ASCII, CSV)</li><li>- Header</li></ul></li><li>- Autom. printout...</li><li>- Reset</li><li>- Measuring<ul style="list-style-type: none"><li>- Autom. stability control</li><li>- Temperature unit</li><li>- Connect Ref1/Ref2</li></ul></li><li>- Signal On</li><li>- Country and language...<ul style="list-style-type: none"><li>- Country</li><li>- Language</li></ul></li><li>- Date and time...</li><li>- Color code...</li><li>- Activate lock</li></ul>
<b>Window</b>	Window <ul style="list-style-type: none"><li>- Channels...</li><li>- Maximize recorder</li></ul>
<b>User</b>	User <ul style="list-style-type: none"><li>- Administration...</li><li>- Change password...</li></ul>
<b>Help</b>	Help <ul style="list-style-type: none"><li>- Help topics</li><li>- Meter info...</li><li>- Sensor info...</li><li>- System info...</li></ul>

### A.20.2 pH sensor menu

#### **Measuring**

##### Measuring

- pH resolution
  - High
  - Medium
  - Low
- Alternative TP
- Setting of man. temp...
- Reset pH
- Recorder...

#### **Calibration**

##### - Calibration

- pH calibration type
  - AutoCal
  - Buffer sets
  - VariCal
  - Slope in (mV/pH / %)
  - Zero point in (mV / pH)
- Calibration interval...
- Calibration record...
- Calibration history...

**A.20.3 U sensor menu*****Measuring***

## Measuring

- | High resolution
- | Alternative TP
- | Setting of man. temp...
- | Determine reference...
- | Recorder...

**A.20.4 dU sensor menu*****Measuring***

## Measuring

- | High resolution
- | Alternative TP
- | Setting of man. temp...
- | Referenz
  - | anderer U-Kanal
  - | Referenzwert
  - | Determine reference...
- | Recorder...

### A.20.5 ISE sensor menu

#### **Measuring**

#### Measuring

- ISE settings
  - Units
  - Ion type
  - Blank value correction
  - Reference measurement
  - Input reference value...
  - Stability control
    - High
    - Medium
    - Low
- ISE methods
  - Standard addition...
  - Double standard addition...
  - Standard subtraction...
  - Sample addition...
  - Sample subtraction...
  - Blank value addition...
- Alternative TP
- Setting of man. temp...

#### **Calibration**

#### Calibration

- Calibration record...
- Calibration history...

### A.20.6 Cond sensor menu

#### **Measuring**

##### Measuring

- ├ Cell constant
  - ├ Calibrated cell constant
  - ├ Adjustable cell constant...
  - ├ Adjustable LF 313T...
  - ├ LF 213T
- ├ Temperature coefficient
  - ├ TC nLF
  - ├ TC Lin...
  - ├ TC off
  - ├ *TC nLin1.....TC nLin4...*
- ├ Reference temperature
  - ├ Tref 25
  - ├ Tref 20
  - ├ Tref Var
- ├ TDS factor setting...
- ├ Alternative TP
- ├ Setting of man. temp...
- ├ Reset Cond
- ├ Recorder

#### **Calibration**

##### Calibration

- ├ Calibration interval...
- ├ Calibration record...
- ├ Calibration history...
- ├ TC-Kalibrierung
  - ├ *TC nLin1.....TC nLin4...*

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