Operating manual

SCHOTT®
Instruments

Lab 870

Laboratory pH meter
with automatic sensor recognition

ba75555e04 11/2009

Accuracy when going to press

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

Warranty

We guarantee the instrument described for 3 years from the date of purchase.
The instrument warranty covers manufacturing faults that are discovered within the warranty period.
The warranty does not cover components that are replaced during maintenance work, e. g. batteries.

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

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

CE conformity
Radio data transmission

SI Analytics GmbH hereby declares that the Lab 870 meter is in compliance with the essential requirements and the other relevant provisions of Directive 1999/5/EC.
The EC declaration of conformity can be requested from SI Analytics GmbH.

Copyright

KONFORMITÄTSERKLÄRUNG
DECLARATION OF CONFORMITY
DÉCLARATION DE CONFORMITÉ

Wir erklären in alleiniger Verantwortung, dass das Produkt

pH-Meter
Lab 870

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

We declare under our sole responsibility that the product

pH meter
Lab 870

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

Nous déclarons sous notre seule responsabilité que le produit

pH-mètre
Lab 870

auquel se réfère cette déclaration est conforme aux indications du chapitre

Technische Daten
pH-Meter Lab 870
30. Oktober 2009

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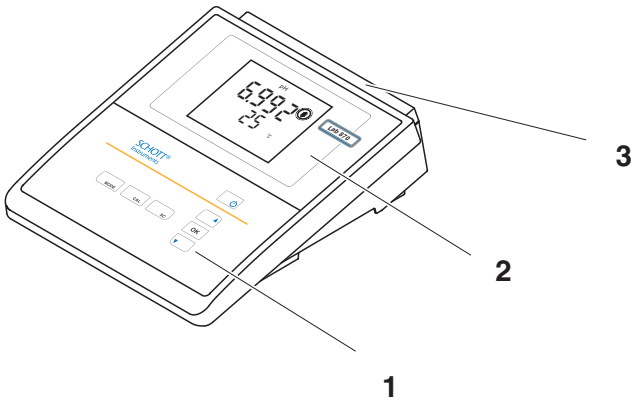
1 Overview

The compact Lab 870 precision pH meter enables you to perform pH measurements rapidly and reliably. The Lab 870 provides the maximum degree of operating comfort, reliability and measuring certainty for all applications.
The proven calibration procedures and special stability control function (SC) support your work with the pH meter.



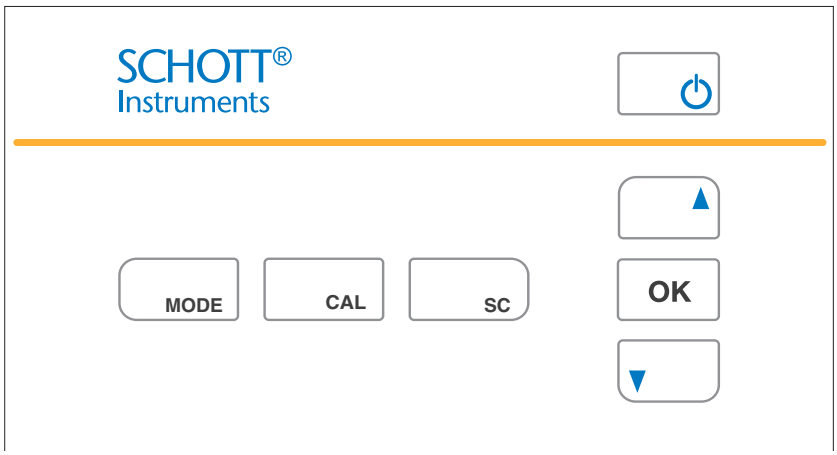
1	Keypad
2	Display
3	Socket field

Note
The meter is also available as part of individual Sets of equipment. You will find information on this and other accessories in the SI Analytics GmbH laboratory catalog or via the Internet.

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

- Application reports
- pH primers
- Safety datasheets.

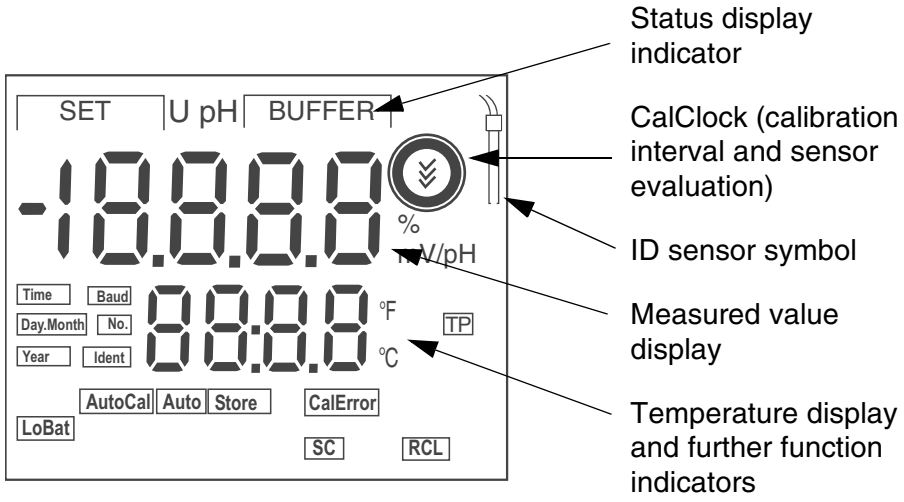
1.1 Keypad



In this operating manual, keys are indicated by brackets <..> .
The key symbol (e.g. **<OK>**) indicates a keystroke in this operating manual.

	**<On/Off>:** **<On/Off__>:**	Switch meter on / off Reset calibration values
	**<MODE>**: **<MODE__>**:	Select measured parameter Open setting menu for calibration and measurement
	**<CAL>**: **<CAL__>**:	Call up calibration procedure Display calibration data
	**<SC>**: **<SC__>:**	Activate / deactivate stability control Set interval for data transmission
	**<▲>**:	Increment values, scroll
	**<▼>**:	Decrement values, scroll
	**<OK>**: **<OK__>**:	Confirm entries Open setting menu for system settings

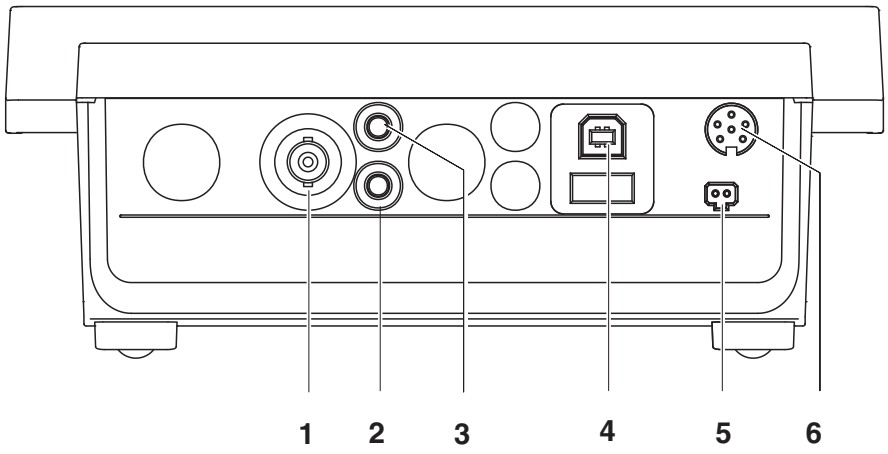
1.2 Display



Function display indicators

[SET]	During calibration: number of the buffer set
[BUFFER]	During calibration: number of the buffer
[AutoCal]	Calibration with automatic buffer recognition
[CalError]	An error occurred during calibration
[LoBat]	With battery operation: batteries almost empty
[SC]	Stability control is active
[TP]	Temperature measurement active

1.3 Socket field



Connectors:

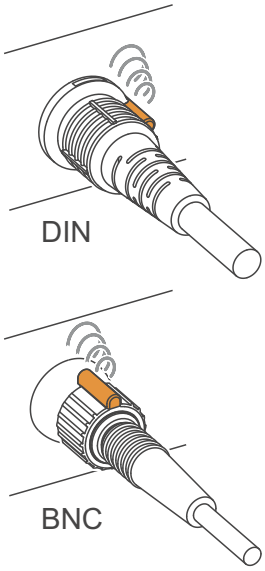
1	pH electrode
2	Reference electrode
3	Temperature sensor
4	USB interface
5	Power pack
6	RS 232 interface

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 GmbH sensors - fulfill these conditions.

1.4 Automatic sensor recognition

The automatic sensor recognition function enables

- operation of a sensor with different meters without recalibration
- operation of different sensors with a meter without recalibration
- to assign measurement data to a sensor
  - measurement datasets are always downloaded to the interface along with the sensor type and sensor series number
- to assign calibration data to a sensor
  - calibration data is always downloaded to the interface along with the sensor type and sensor series number



To be able to use the automatic sensor recognition function, you need a meter that supports the automatic sensor recognition (e.g. Lab 870) and a sensor (ID sensor) that is suitable for sensor recognition.

In ID sensors, sensor data is stored that clearly identifies the sensor. The sensor data is automatically transmitted to the meter by radio and used for sensor identification there.

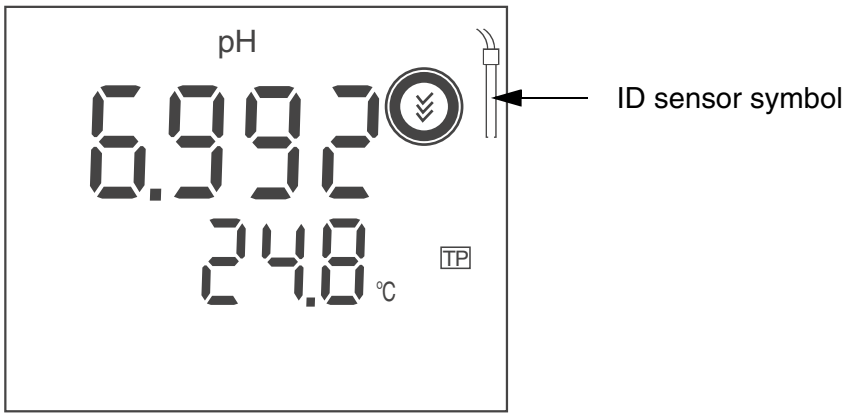
Note
You can also operate non-ID sensors with the Lab 870 meter. In this case, however, you will not be able to use the advantages of the sensor recognition function.

ID sensors

SI Analytics GmbH ID sensors support the automatic sensor recognition. "ID" is added to the designation of these sensors, e.g. electrode BlueLine 14 pH ID.

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

ID sensors connected to the Lab 870 meter are identified by the ID sensor symbol on the display of the meter.



Sensor data from ID sensors

ID sensors transmit the following sensor data

- Sensor type
- Sensor series number
- Calibration data
  - Calibration date
  - Calibration characteristics
  - Calibration interval

The calibration data is updated in the ID sensor after each calibration procedure. The ID sensor symbol flashes while this is being done.

Note
The sensor must not be disconnected while the ID sensor symbol is flashing, as 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 is read out by the meter and stored in the meter.

2 Safety

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

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

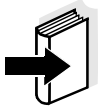
Safety instructions in this operating manual are indicated by the warning symbol (triangle) in the left column. The signal word (e.g. "Caution") indicates the level of danger:

WARNING
indicates instructions that must be followed precisely in order to avoid possibly great dangers to personnel.

CAUTION
indicates instructions that must be followed precisely in order to avoid the possibility of slight injuries or damage to the instrument or the environment.

Further notes

Note
indicates notes that draw your attention to special features.



Note
indicates cross-references to other documents, e.g. operating manuals.

2.1 Authorized use

This meter is authorized exclusively for pH and ORP measurements in the laboratory.
The technical specifications as given in chapter 7 TECHNICAL DATA (page 57) 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 constructed and tested in compliance with the IEC 1010 safety regulations for electronic measuring instruments.
It left the factory in a safe and secure technical condition.

Function and operational safety

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

The smooth functioning and operational safety of the meter can only be guaranteed under the environmental conditions that are specified in chapter 7 TECHNICAL DATA (page 57).

If the instrument was transported from a cold environment to a warm environment, the formation of condensate can lead to the faulty functioning of the instrument. In this event, wait until the temperature of the instrument reaches room temperature before putting the instrument back into operation.

CAUTION
The meter is only allowed to be opened by personnel authorized by SI Analytics GmbH.

Safe operation

If safe operation is no longer possible, the instrument must be taken out of service and secured against inadvertent operation!
Safe operation is no longer possible if the meter:

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

If you are in any doubt, please contact the supplier of the instrument.

Obligations of the purchaser

The purchaser of this meter must ensure that the following laws and guidelines are observed when using dangerous substances:

- EEC directives for protective labor legislation
- National protective labor legislation
- Safety regulations
- Safety datasheets of the chemical manufacturers.

3 Commissioning

3.1 Scope of delivery

- Lab 870 laboratory meter
- Power pack
- 4 batteries 1.5 V Mignon type AA
- USB cable with A plug and B plug
- Transparent cover
- Operating manual
- CD-ROM with USB driver

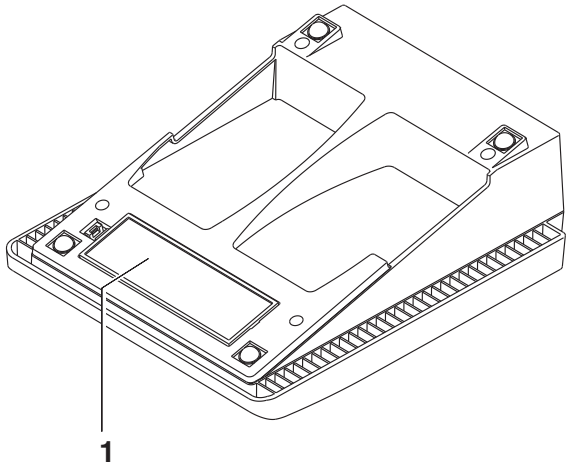
3.2 Initial commissioning

Perform the following activities:

- Insert batteries
- Switch on the meter
- Set the date and time
- Connect the power pack (for line power operation only).

Insert batteries

1	Open the battery compartment (1) on the underside of the meter.
2	Place four batteries (type Mignon AA) in the battery compartment.
3	Close the battery compartment (1). The date (day) flashes in the display.
4	Set the date and time according to page 42.



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.

Switching on the meter

1	Switch on the meter with **<On/Off>**. A display test is briefly displayed.

Setting the date and time

2	See page 42.

Connecting the power pack

You can either operate the measuring instrument with batteries or with the plug-in power supply. The plug-in power supply supplies the measuring instrument with low voltage (12 VDC). This saves the batteries.

CAUTION
The line voltage at the operating site must lie within the input voltage range of the original power pack (see page 57).

CAUTION
Use original power packs only (see page 57).

3	Insert the plug into the socket of the pH meter.
4	Connect the original power pack to an easily accessible power outlet.

Note
You can carry out measurements without the power pack.

4 Operation

4.1 Switching on the meter

1	Place the meter on a flat surface and protect it from intense light and heat.
2	Press the **<On/Off>** key. A display test is briefly displayed. Subsequently, the meter switches to the measuring mode (measured value display).

Note
The meter has an energy saving feature to avoid unnecessary battery depletion during battery operation.
The energy saving feature switches off the meter if no key was pressed during the specified interval (setting the switch-off interval, see page 42).
The energy saving feature is not active:

- if the meter is supplied via the power pack or the USB interface
- if a PC is connected (with communication cable to RS232 interface)
- if the printer cable is connected (for external printers).

4.2 General operating principles

This section contains basic information on the operation of the Lab 870.

4.2.1 Operating modes

The instrument has the following operating modes:

- Measurement
  The display indicates the measurement data in the measured value display
- Calibration
  The display guides you thru a calibration procedure with calibration information
- Transmitting data
  The meter transmits measuring data and calibration records to a serial interface automatically or manually.
- Configuration
  The system menu or a sensor menu with submenus, settings and functions is displayed

4.2.2 Operation

Keys

The meter is operated via keys. The keys can have different functions with long or short keystrokes.

Functions

Generally, with a short keystroke a function is carried out. A long keystroke opens a setting menu.

In a setting menu, settings are selected with the **<▲><▼>** keys. A setting is confirmed with **<OK>**. With confirming, the setting is finished and the next setting is displayed.

Representation

In this operating manual, keys are indicated by brackets <..> . The key symbol (e.g. **<OK>**) generally indicates a short keystroke (under 2 sec) in this operating manual. A long keystroke (approx. 2 sec) is indicated by the underscore behind the key symbol (e.g. **<OK__>**).

4.3 Measuring

Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect an electrode to the meter.
2	Adjust the temperature of the buffer solutions or test solutions, or measure the current temperature, if you measure without a temperature sensor.
3	Calibrate or check the meter with the electrode.
4	Select the measured parameter with **<MODE>**.

Note
Incorrect calibration of pH electrodes leads to incorrect measured values. Calibrate regularly before measuring.

CAUTION
When connecting an earthed PC/printer, measurements cannot be performed in earthed media as incorrect values would result. The RS232 and USB interfaces are not galvanically isolated.

Temperature sensor

You can measure with or without a temperature sensor. If a temperature sensor is connected, it is indicated on the display by TP.

Note
The pH meter automatically recognizes the type of the temperature sensor used. Therefore, you can connect electrodes with an NTC30 or Pt1000.

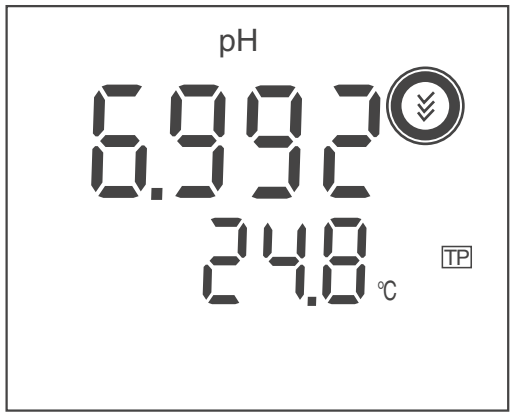
The temperature measurement is absolutely essential for a reproducible pH measurement. If the measurement is made without a temperature sensor, proceed as follows:

1	Measure the current temperature using a thermometer.
2	Set the temperature value with **<▲><▼>**.

Note
When calibrating without temperature sensor, also set the current temperature of each buffer solution manually (see **<▲><▼>**).

4.3.1 Measuring the pH value

1	Perform the preparatory activities according to page 23.
2	Immerse the pH electrode in the test sample.
3	Using **<MODE>**, scroll as necessary until the measured parameter *pH* is displayed.



Stability control SC (drift control)

The stability control function (drift control) checks the stability of the measurement signal. The stability has a considerable effect on the reproducibility of the measured value.

For identical measurement conditions, the following criteria apply:

Drift within 15 sec < 0.02 pH units.

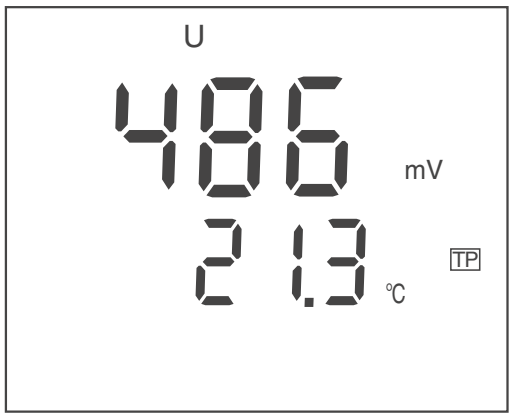
1	If necessary, call up the measured variable pH with **<MODE>**.
2	With **<SC>**, activate the stability control function. The *SC* function display indicator appears. The current measured value is frozen (hold function).
3	Start measurement with stability control with **<OK>**. SC flashes until a stable measured value is reached. This measured value is downloaded to the interface.
4	If necessary, start the next measurement with stability control with **<OK>**.
5	To terminate the stability control function: Press the **<MODE>** or **<SC>** key.

Note
The current measurement with stability control can be terminated at any time (accepting the current value) by pressing **<OK>**.

4.3.2 Measuring the ORP

The meter can, in conjunction with an ORP electrode, measure the ORP (mV) of a solution.

1	Perform the preparatory activities according to page 23.
2	Immerse the ORP electrode in the test sample.
3	If necessary, call up the measured parameter U with **<MODE>**.
4	Wait for a stable measured value.



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

4.4 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.
For non-ID sensors, the calibration data is stored in the meter. For ID sensors, the calibration data is stored in the sensor.

When do you have to calibrate?

- After connecting another electrode
- If the CalClock has expired and flashes

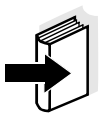
Buffer sets for calibration

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 calibration.

No.	Buffer set*	pH values	at
1	SI Analytics GmbH DIN buffers according to DIN 19266/NBS	1.679 4.006 6.865 9.180 12.454	25 °C
2	SI Analytics GmbH Technical buffers according to DIN 19267	2.000 4.010 7.000 10.011	25 °C
3	Merck1*	4.000 7.000 9.000	20°C
4	Merck2 *	1.000 6.000 8.000 13.000	20°C
5	Merck3 *	4.660 6.880 9.220	20°C
6	DIN 19267 *	1.090 4.650 6.790 9.230	25 °C

No.	Buffer set*	pH values	at
7	Mettler Toledo USA *	1.679 4.003 7.002 10.013	25 °C
8	Mettler Toledo TEC *	1.995 4.005 7.002 9.208	25 °C
9	Fisher *	2.007 4.002 7.004 10.002	25 °C
10	Fluka BS *	4.006 6.984 8.957	25 °C
11	Radiometer *	1.678 4.005 7.000 9.180	25 °C
12	Baker *	4.006 6.991 10.008	25 °C
13	Metrohm *	3.996 7.003 8.999	25 °C
14	Beckman *	4.005 7.005 10.013	25 °C
15	Hamilton Duracal *	4.005 7.002 10.013	25 °C
16	Precisa *	3.996 7.003 8.999	25 °C

* Brand names or trade names are trademarks of their respective owners protected by law (see page 65).



Note
The buffer set is selected in the menu for measurement settings (see page 44).
A list of the stored buffer sets can be downloaded to the interface (*Set 1 ... 16*) with **<CAL__>** while selecting the buffer set in the menu for measurement settings.

Calibration points

Calibration can be performed using one, two or three buffer solutions in any order (single-point, two-point or three-point calibration). The meter determines the following values and calculates the calibration line as follows:

	Determined values	**Displayed calibration data**
1-point	ASY	● Zero point = *ASY* ● Slope = Nernst slope (-59.2 mV/pH at 25 °C)
2-point	ASY SLO	● Zero point = *ASY* ● Slope = *SLO*
3-point	ASY SLO	● Zero point = *ASY* ● Slope = *SLO* The calibration line is calculated by linear regression.

Note
You can display the slope in the units, mV/pH or %.
You can display the zero point in the units, mV or pH.

AutoCal

is adapted to the permanently programmed buffer solutions as a fully automatic single-, two- or three-point calibration. The buffer solutions are automatically recognized by the meter.

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) by pressing **<OK>**.

Calibration record

When finishing a calibration, the new calibration values are first displayed as an informative message and stored.
For ID sensors, the calibration data is stored in the sensor (see page 11)

Displaying the calibration data

You can display the data of the last calibration (see page 35). Subsequently, you can transmit the displayed calibration data to the interface, e. g. to a printer or PC, with the **<CAL__>** key.

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

Sample record:

```
16.09.2005 08:53:54
Lab 870  02320025

Calibration pH
Cal time:    16.09.2005 08:22:14
Cal interval:    14 d
AutoCal
Buffer 1   2.000
Buffer 2   4.010
Buffer 3   7.000
Buffer 4   10.011
b1  -177.0 mV    25.0 °C
b2   177.0 mV    25.0 °C
b3     0.0 mV    25.0 °C
Slope        :    -58.99 mV/pH
Asymmetry    :      0.4 mV
Sensor       :    +++
```

If an ID sensor is used, the calibration record additionally names the sensor type and sensor series number (see page 11).

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 as the CalClock and in the calibration record.

CalClock	Calibration record	Zero point [mV]	Slope [mV/pH]
	+++	-15 ... +15	-60.5 ... -58
	++	-20 ... +20	-58 ... -57
	+	-25 ... +25	-61 ... -60.5 or -57 ... -56
	-	-30 ... +30	-62 ... -61 or -56 ... -50

CalClock	Calibration record	Zero point [mV]	Slope [mV/pH]
Clean the electrode according to the sensor operating manual			
CalError	*CalError*	< -30 or > 30	... -62 or ... -50
Eliminate the error according to page 53			

Preparatory activities

1	Switch on the meter with **<On/Off>**.
2	Connect a pH electrode to the meter.
3	Keep the buffer solutions ready.
4	Adjust the temperature of the solutions and measure the current temperature if the measurement is made without temperature sensor.
5	Set the buffer set to be used for calibration as necessary.

4.4.1 Calibration interval (*Int.C*)

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.

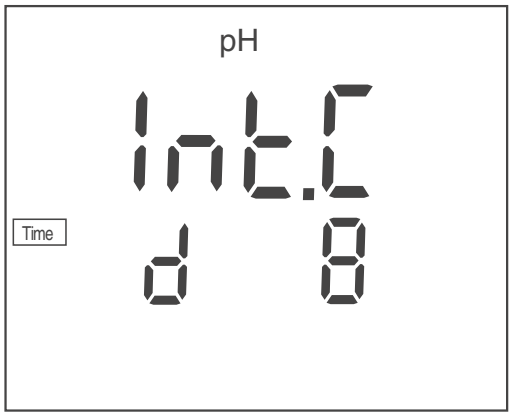
After the specified calibration interval (*Int.C*) has expired, the outer ring of the CalClock flashes. It is still possible to measure.

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

Setting the calibration interval

The calibration interval (*Int.C*) is set to 7 days (d7) in the factory. You can change the interval (1 ... 999 days):

1	Open the menu for measurement settings with **<MODE__>**.
2	Confirm all settings with **<OK>** until *Int.C* is displayed.



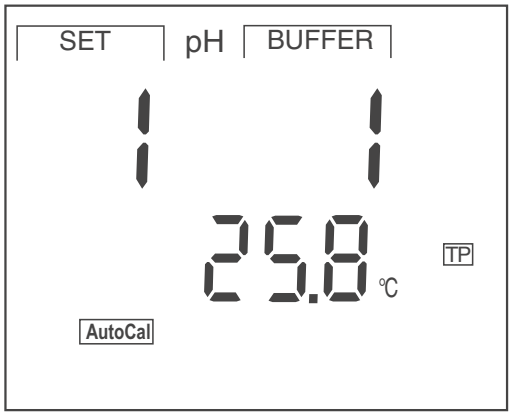
3	Set the calibration interval with **<▲><▼>**.
4	Confirm the setting with **<OK>**.

4.4.2 Automatic calibration (AutoCal)

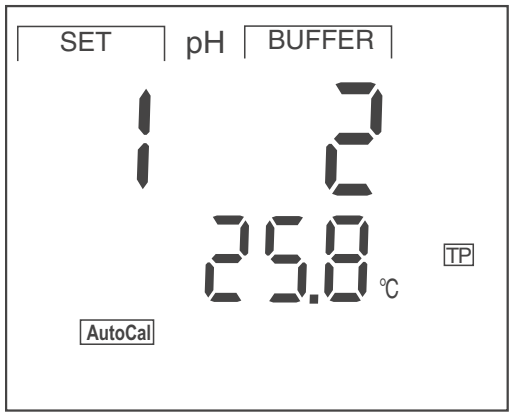
For this procedure, use one, two or three buffer solutions of the selected buffer set in any order.

Note
The steps 2, 6 and 10 are not necessary if you use a temperature sensor.

1	Start the calibration with **<CAL>**. The number of the specified buffer set is displayed (SET 1 ... 16). For ID sensors, the number of the buffer set used last is displayed. The first buffer (BUFFER 1) of the buffer set (SET_x) is requested.



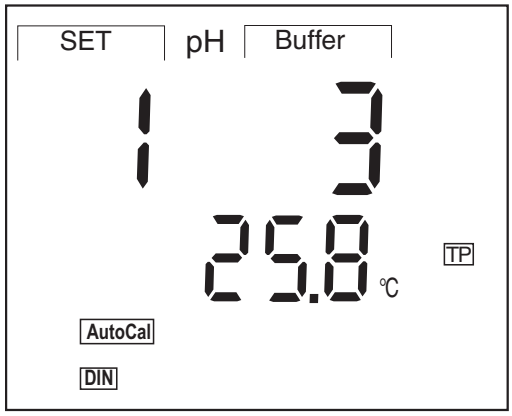
2	If necessary, set the temperature of the buffer solution with **<▲><▼>**.
3	Immerse the pH electrode in the first buffer solution.
4	Start the measurement with **<OK>**. The *SC* display indicator flashes. Depending on the setting, the display shows the nominal pH value for the recognized buffer or the electrode voltage (mV). As soon as a stable value is recognized, the next buffer (BUFFER 2) is requested.



Note
Here you can cancel the calibration procedure with **<MODE>**. This corresponds to a **single-point calibration**. The value of the zero point (Asy) is displayed for 10 seconds, then the value of the slope (Slo) is displayed for 10 seconds. After this the meter switches to the measuring mode.

Continue with two-point calibration

5	Thoroughly rinse the electrode with distilled water.
6	If necessary, set the temperature of the second buffer solution with **<▲><▼>**.
7	Immerse the pH electrode in the second buffer solution.
8	Start the measurement with **<OK>**. The *SC* display indicator flashes. Depending on the setting, the display shows the nominal pH value for the recognized buffer or the electrode voltage (mV). As soon as a stable value is recognized, the next buffer (BUFFER 3) is requested.

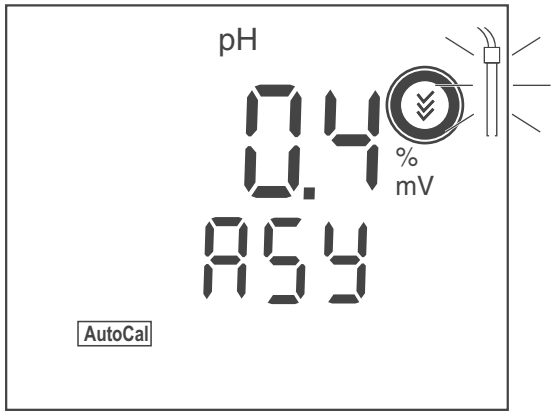


Note
Here you can cancel the calibration procedure with **<MODE>**. This corresponds to a **two-point calibration**. The value of the zero point (Asy) is displayed for 10 seconds, then the value of the slope (Slo) is displayed for 10 seconds. After this the meter switches to the measuring mode.

The ID sensor symbol flashes while the calibration data is being stored in the sensor. The sensor must not be disconnected while the ID sensor symbol is flashing, as otherwise the calibration data will not be completely transmitted. The sensor will then have no valid calibration.

Continue with three-point calibration

9	Thoroughly rinse the electrode with distilled water.
10	If necessary, set the temperature of the third buffer solution with **<▲><▼>**.
11	Immerse the pH electrode in the third buffer solution.
12	Press the **<OK>** key. The *SC* display indicator flashes. Depending on the setting, the display shows the nominal pH value for the recognized buffer or the electrode voltage (mV). As soon as a stable value is recognized, the value of the zero point (ASY) is displayed for 10 seconds, then the value of the slope (SLO) is displayed for 10 seconds. After this the meter switches to the measuring mode. The ID sensor symbol flashes while the calibration data is being stored in the sensor.



Note
The sensor must not be disconnected while the ID sensor symbol is flashing, as otherwise the calibration data will not be completely transmitted. The sensor will then have no valid calibration.

Note
While the zero point (*ASY*) is being displayed, you can change the unit of the zero point with <▲><▼> .

While the slope (*SLO*) is being displayed, you can change the unit of the slope with <▲><▼> .
The % display refers to the Nernst slope of 59.2 mV/pH at 25° C (100 x determined slope/Nernst slope).

The unit of zero point and slope can be permanently changed in the measurement settings (see page 44).

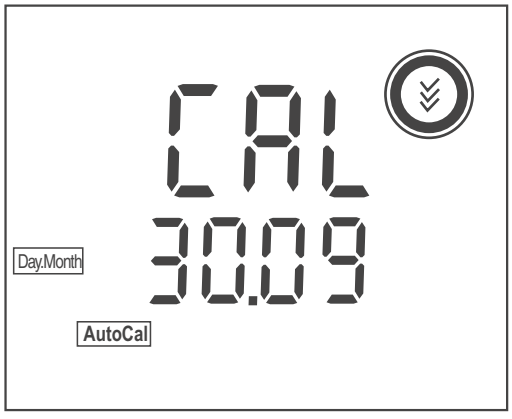
4.4.3 Downloading calibration data

You can download calibration data:

- to the display
  - via the memory menu
  - via the calibration menu
- to the interface (see page 38)

Download to display via memory menu

1	Open the memory menu with **<RCL>**.
2	If necessary, scroll with **<RCL>** until *CAL diSP* is displayed.
3	Press **<OK>** to display the calibration data. The following data is displayed consecutively for 10 seconds each: date, zero point, slope.



While the calibration data is being displayed, you can:

- press **<OK>** to display further calibration data (date, zero point, slope)

- press **<▲><▼>** to switch over the unit of the zero point (*Asy*) (while the zero point is being displayed)
- press **<▲><▼>** to switch over the unit of the slope (*Slo*) (while the slope is being displayed)

Download to display via calibration menu

1	Press **<CAL__>** to display the calibration data. The following data is displayed consecutively for 10 seconds each: date, zero point, slope.

While the calibration data is being displayed, you can:

- press **<OK>** to display further calibration data (date, zero point, slope)
- press **<▲><▼>** to switch over the unit of the zero point (*Asy*) (while the zero point is being displayed)
- press **<▲><▼>** to switch over the unit of the slope (*Slo*) (while the slope is being displayed)

4.5 Transmitting data

The meter has two interfaces:

- RS232 interface (serial port)
- USB interface (device)

Via both interfaces, you can transmit data to a PC and update the meter software.

The meter is supplied with power via the USB interface.

The RS232 interface enables to transmit data to an external printer.

Note
The relevant interface cable has to be connected if you want to download data to an interface (USB or RS232).
It is not possible to download data to both interfaces (USB and RS232) at the same time. After connecting a meter to the USB socket the RS232 interface is inactive. The RS232 interface is active if no meter is connected to the USB interface.

CAUTION
The interfaces are not galvanically separated.
When connecting an earthed PC/printer, measurements cannot be performed in earthed media as incorrect values would result.

4.5.1 Options for data transmission

Via the USB interface you can transmit data to a PC. Via the RS 232 interface, you can transmit data to a PC or an external printer.

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

Data	Control	Operation / description
Current measured values	Manual	● With **<OK>**.
	Automatic, at intervals	● With **<SC__>**. Then you can set the transmission interval (*Int.2*) (page 39).
	Automatic	● After each measurement with stability control.
Calibration records	Manual	● Without display indication (see page 39). ● During the display indication with **<CAL__>** (see page 35).
	Automatic	● On completion of a calibration procedure.

4.5.2 Automatically downloading measurement datasets at intervals

In order to automatically download to the interface measured values at certain time intervals, set the download interval (*Int.2*).

Setting the download interval

The default setting for the download interval (Int *2*) is OFF.
To switch the function on, set an interval (5 s, 10 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 20 min, 30 min, 60 min):

1	Press **<SC__>** to open the setting of the *Int.2* interval.
2	If necessary, set an interval with **<▲><▼>**.
3	Close the setting with **<OK>**. The download to the interface takes place at the specified interval.

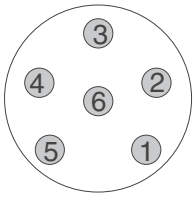
4.5.3 Downloading calibration data

1	Open the memory menu with **<RCL>**.
2	If necessary, scroll with **<RCL>** until *CAL Prt* is displayed.
3	Press **<OK>** to download the calibration data to the interface.

4.5.4 RS232 interface

1	Connect the interface to the PC or printer via the cable Z390 (PC) or Z393 (ext. printer).
2	If necessary, disconnect a connected USB cable from the meter.
3	Set up the following transmission data at the PC/printer: – Baud rate: selectable from 1200, 2400, 4800, 9600, – Handshake: RTS/CTS + Xon/Xoff – PC only: – Parity: none – Data bits: 8 – Stop bits: 2

Socket assignment (RS232)



RS 232

1 *
2 RxD
3 TxD
4 *
5 SGnd
6 CTS

* not used

4.5.5 USB interface (device)

Connect the interface to the PC via the supplied Z875 USB cable. The data output automatically switches to *USB*. The RS232 interface is deactivated.

Installation of the USB driver on the PC

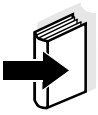
System requirements of the PC for installation of the USB driver:

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

1	Insert the supplied installation CD in the CD drive of your PC.
2	Install the USB driver on the PC. Follow the Windows installation instructions as necessary.
3	The meter is listed as a virtual COM interface among the connections in the Windows instrument manager.

4.5.6 Operation with MultiLab pilot

With the aid of the MultiLab pilot software, you can record and evaluate measuring data with a PC. The data is transmitted after the meter is connected to the RS232 serial interface or USB interface of a PC.



Note
More detailed information can be found in the MultiLab pilot software operating manual.

4.6 Settings

You can adapt the meter to your individual requirements. The settings are done in the following menus:

- System settings (**<OK__>**)
  - Baud rate (*Baud*)
  - Switch-off interval (*t.Off*)
  - Date (*Day.Month*)
  - Date (Year)
  - Time (*Time*)
- Settings for calibration and measurement (**<MODE__>**)
  - Number of the buffer set for pH calibration (*Set 1 ... 16*)
  - Display of the buffer during calibration (pH nominal value or measured voltage value in mV)
  - Unit of the value for the slope (*mV/pH* or *%*)
  - Unit of the value for the zero point (*mV*, *pH*)
  - Resolution (*Hi*, *Lo*)
  - Temperature unit (*°C* / *°F*)
  - Calibration interval (*Int.C* [0 ... 999])
- Setting for data download (**<SC__>**)
  - Data download interval (*Int.2*)

Note
You can exit the setting menu at any time by pressing **<MODE>**. Settings already modified and confirmed with **<OK>** are stored.

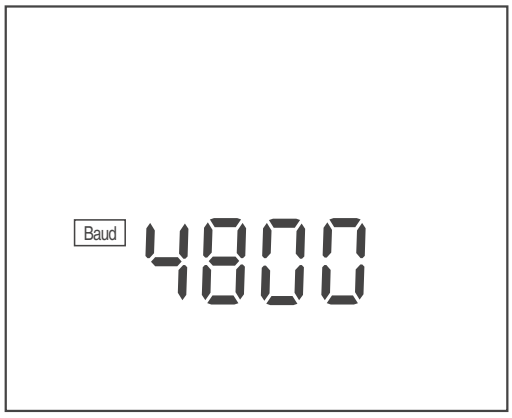
4.6.1 System settings

The default setting is printed in bold.

Baud rate (*Baud*)	1200, 2400, **4800**, 9600
Switch-off interval (*t.Off*)	10, 20, 30, 40, 50 min, **1**, 2, 3, 4, 5, 10, 15, 20, 24 h
Date (*Day.Month*)	Any
Date (Year)	Any
Time (*Time*)	Any

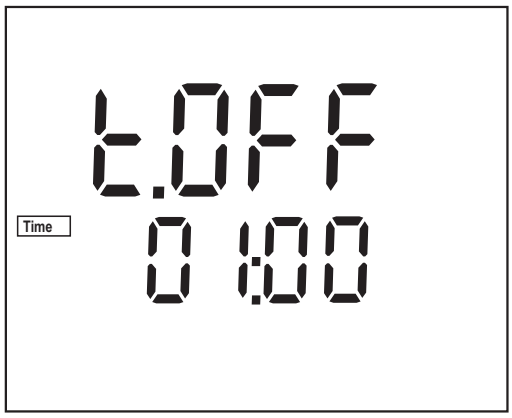
1	Open the menu for system settings with **<OK__>**. The first system setting is displayed.

Baud rate (*Baud*)



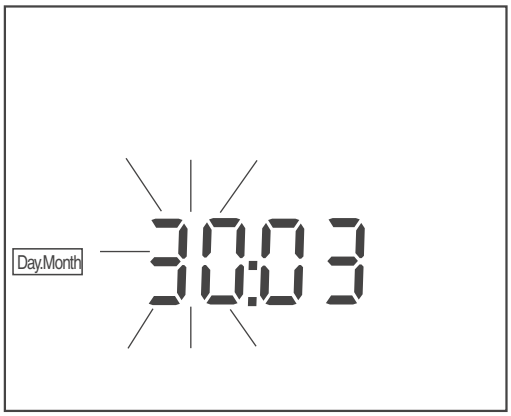
2	Set the required baud rate with **<▲><▼>** .
3	Confirm with **<OK>**. *t.OFF,* the setting of the switch-off interval is displayed.

Switch-off interval (*t.OFF*)



4	Set the switch-off interval with <▲><▼>.
5	Confirm with **<OK>**. *Day.Month*, the setting of the date is displayed. The day display flashes.

Date and time



6	Set the date of the current day with <▲><▼> .
7	Confirm with **<OK>**. The month display flashes.
8	Set the current month with <▲><▼> .
9	Confirm with **<OK>**. *Year*, the setting of the year is displayed.
10	Set the year with <▲><▼> .
11	Confirm with **<OK>**. The setting of the time is displayed. The hour display flashes.
12	Set the current hour with <▲><▼> .
13	Confirm with **<OK>**. The minute display flashes.
14	Set the current minute with <▲><▼> .
15	Confirm with **<OK>**. The system settings are completed. The meter switches to the measuring mode.

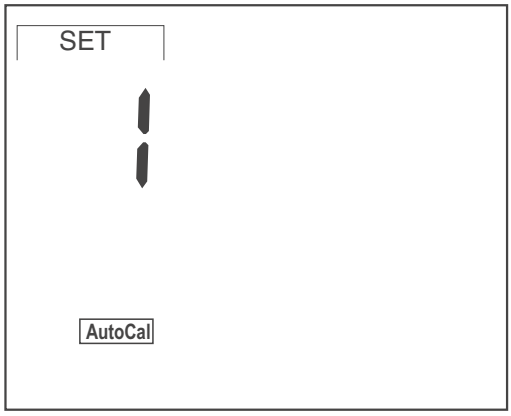
4.6.2 Measurement settings

These settings apply to calibration and measurement (the default setting is printed in bold).

Number of the buffer set for pH calibration (*SET*)	***1** ... 16*
Display during calibration (*BUFFER*)	***pH*** (buffer nominal value), *U* (electrode voltage)
Unit of the value for the slope (*SLO*)	***%**, mV/pH*
Unit of the value for the zero point (*ASY*)	***pH**, mV*
Resolution (*rES*)	***HI** (0.001), Lo (0.01)*
Temperature unit (*Unit*)	°**C**, °F
Calibration interval (*Int.C*)	*0 ... **7** ... 999 d*

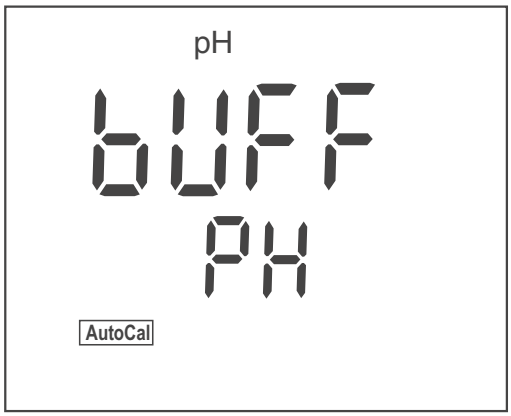
Buffer set for pH calibration (*SET*)

1	Open the menu for measurement settings with **<MODE__>**. *Set 1 ... 16,* the specified buffer set is displayed.



2	Using **<▲><▼>**, select a buffer set *Set 1 ... 16*.
3	Confirm with **<OK>**. *bUFF,* the setting of the display during calibration is displayed.

Display during calibration (*bUFF*)

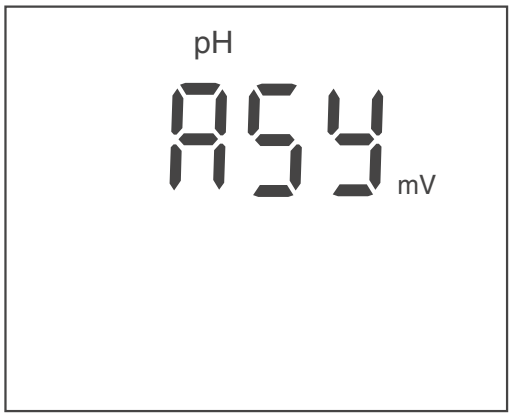


4	Using <▲><▼>, select the display during calibration *pH* or *U*.
5	Confirm with **<OK>**. *SLO*, the unit of the value for the slope (*mV/pH* or *%*) is displayed.

Unit of the value for the slope (*SLO*)

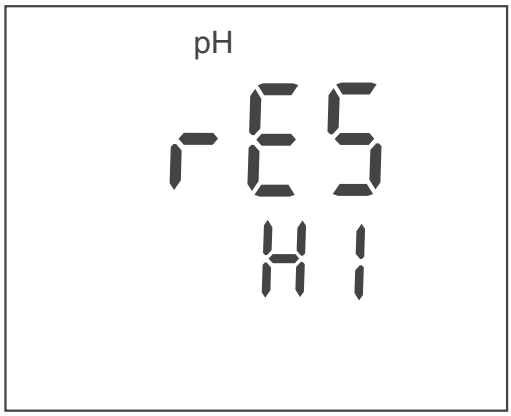
6	Using <▲><▼>, select the unit for the slope.
7	Confirm with **<OK>**. *ASY*, the unit of the value for the zero point (*mV* or *pH*) is displayed.

Unit of the value for the zero point (*ASY*)



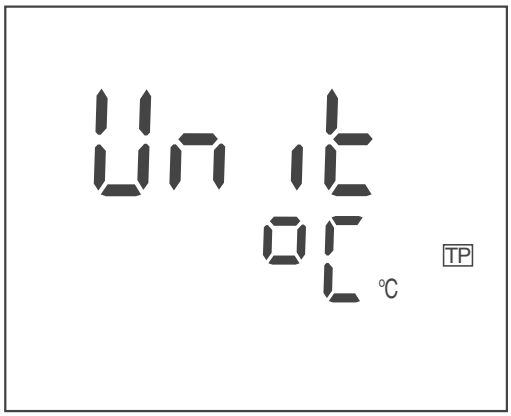
8	Using <▲><▼>, select the unit for the zero point.
9	Confirm with **<OK>**. *rES*, the setting of the resolution is displayed.

Resolution (*rES*)



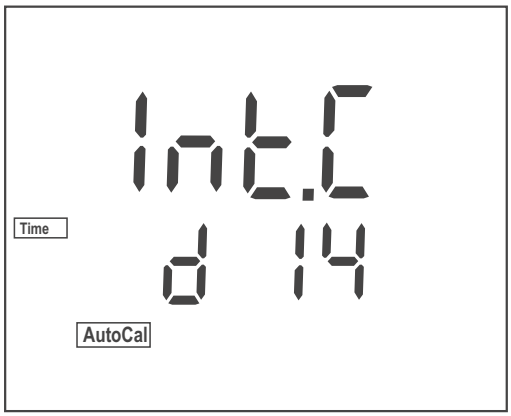
10	Using <▲><▼>, toggle between *Hi* (0.001)and *Lo* (0.01).
11	Confirm with **<OK>**. *Unit*, the setting of the unit of the temperature value is displayed.

Temperature unit (*Unit*)



12	Using <▲><▼>, toggle between *°C* and *°F*.
13	Confirm with **<OK>**. *Int.C*, the setting of the calibration interval is displayed.

Calibration interval (*Int.C*)



14	Set the interval with <▲><▼>.
15	Confirm with **<OK>**. The measurement settings are completed. The meter switches to the measuring mode.

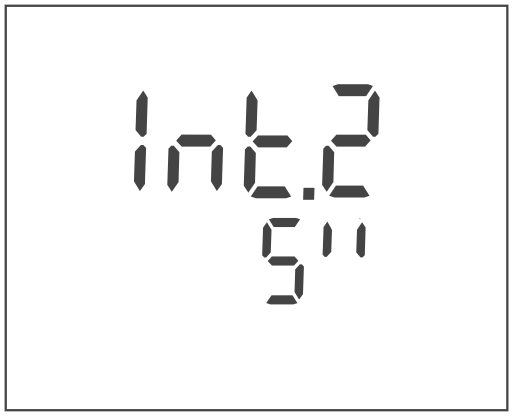
4.6.3 Interval for automatic data transmission

The interval for automatic data transmission serves to transmit the current measurement dataset to the interface at the specified interval.

Data transmission interval (*Int.2*)	**OFF**, 5 s, 10 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 20 min, 30 min, 60 min

1	Press **<SC__>** to open the setting for the transmission interval. *Int.2*, the setting of the transmission interval is displayed.

Data transmission interval



2	Press **<▲><▼>** to select an interval.
3	Confirm with **<OK>**. The setting of the interval for the data transmission to the interface is completed. The meter switches to the measuring mode.

4.7 Reset

4.7.1 Resetting calibration values

This function resets the calibration values to the default condition. All other meter settings are retained.

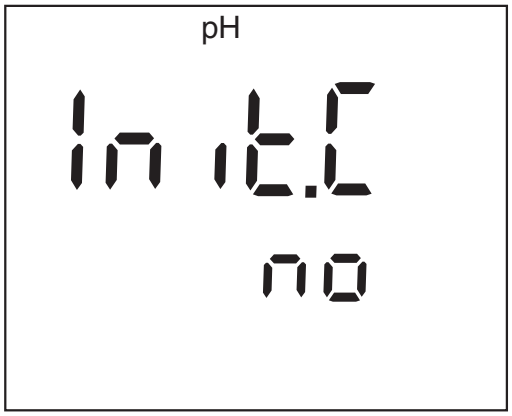
Calibration values in the default condition

Zero point	pH 7.000 (0 mV)
Slope	100 % (-59.2 mV/pH)

Note
The measuring system is not calibrated after a reset. Before measuring recalibrate the meter.

Resetting calibration values

1	Press **<On/Off__>** to open the menu for the reset of the calibration data. *Init.C* is displayed.



2	Press **<▲><▼>** to display *no* or *YES*. *YES*: Reset the calibration values. *no*: Retain the calibration values.
3	Confirm with **<OK>**. The menu is finished. The meter switches to the measuring mode.

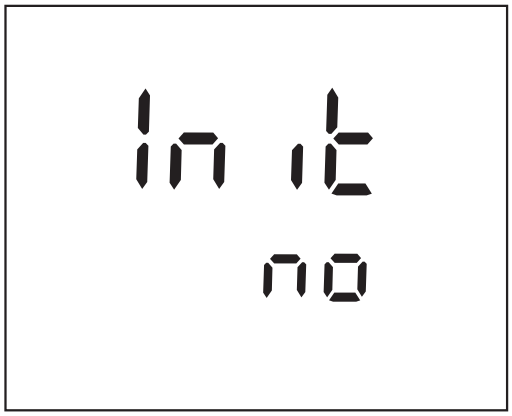
4.7.2 Resetting all meter settings

This function resets to the default condition all meter settings including the calibration values. The corresponding values are given on the following pages:

Calibration values	page 49
System settings	page 42
Measurement settings	page 44

Resetting the meter settings

1	Switch on the meter with **<On/Off>**. The display test appears briefly on the display.
2	During the display test, press **<MODE>** to open the menu for the reset of the meter settings. *Init* is displayed.



3	Press **<▲><▼>** to display *no* or *YES*. *YES*: Reset the meter settings. *no*: Retain the meter settings.
4	Confirm with **<OK>**. The menu is finished. The meter switches to the measuring mode.

Note
The measuring system is not calibrated after a reset. Before measuring recalibrate the meter.

5 Maintenance, cleaning, disposal

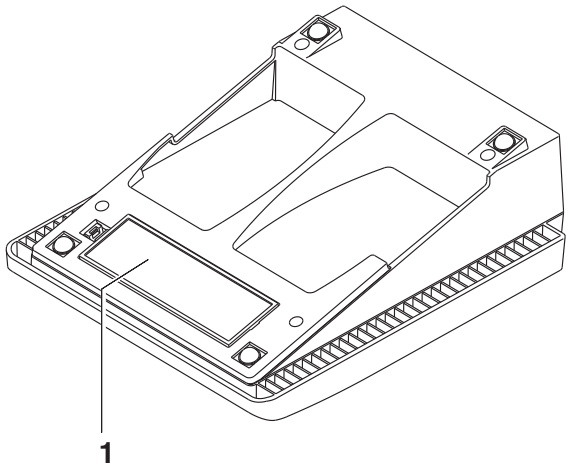
5.1 Maintenance

The only maintenance activity required is replacing the batteries.

Note
For maintenance of the electrodes refer to the relevant operating manuals.

5.1.1 Replacing the batteries

1	Open the battery compartment (1) on the underside of the meter.
2	Remove the four batteries from the battery compartment.
3	Place four new batteries (type Mignon AA) in the battery compartment.
4	Close the battery compartment (1). The date (day) flashes in the display.
5	Set the date and time according to page 42.



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.

5.2 Cleaning

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

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

5.3 Packing

This meter is sent out in a protective transport packing.
We recommend: Keep the packing material. The original packing protects the instrument against damage during transport.

5.4 Disposal

Batteries

This note refers to the battery regulation that applies in the Federal Republic of Germany. We would ask end-consumers in other countries to follow their local statutory provisions.

Note
This instrument contains batteries. Batteries that have been removed must only be disposed of at the recycling facility set up for this purpose or via the retail outlet.
It is illegal to dispose of them in household refuse.

6 What to do if...

Error message *Err1*

Cause	Remedy
pH electrode:	
– Measured value outside the measuring range	– Use a suitable electrode
– Air bubble in front of the junction	– Remove air bubble
– Air in the junction	– 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 *CalError*

Cause	Remedy
pH electrode:	
– The values determined for zero point and slope of the electrode are outside the allowed limits.	– Recalibrate
– Junction contaminated	– Clean junction
– Electrode broken	– Replace the electrode
Buffer solutions:	

Cause	Remedy
– Incorrect buffer solutions	– Change calibration procedure
– Buffer solutions too old	– Use only once. Note the shelf life
– Buffer solutions depleted	– Change solutions

No stable measured value

Cause	Remedy
pH electrode:	
– Junction contaminated	– Clean junction
– Membrane contaminated	– Clean membrane

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

Electrode + test sample:	
– Conductivity too low	– Use a suitable electrode
– Temperature too high	
– Organic liquids	

CalClock flashes

Cause	Remedy
– Calibration interval expired	– Recalibrate the measuring system

Display, *LoBat*

Cause	Remedy
– Batteries almost empty	– Replace the batteries (see page 51)

Display *to*

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

Obviously incorrect measured values

Cause	Remedy
pH electrode:	
– pH electrode unsuitable	– Use a suitable electrode
– Temperature difference between buffer and test sample too high	– Adjust temperature of buffer or sample solutions
– Measurement procedure not suitable	– Follow special procedure

Instrument does not react to keystroke

Cause	Remedy
– Operating condition undefined or EMC load unallowed	– Processor reset: Press and hold the **<SC>** key and switch the meter on

You want to know which software version is in the instrument

Cause	Remedy
– E. g., a question by the service department	– Switch on the meter. During the display test, display the software version with **<OK>**.

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7 Technical data

7.1 General data

Dimensions approx. 240 x 190 x 80 mm

Weight approx. 1.0 kg (without power pack, without stand)

Mechanical structure Type of protection IP 43

Electrical safety Protective class III

Test certificates cETLus

Ambient conditions

Storage	- 25 °C ... + 65 °C
Operation	0 °C ... + 55 °C
Climatic class	2

Power supply

Batteries	4 x 1.5 V alkali-manganese batteries, Type AA
Operational life	Approx. 500 operating hours
Power pack (charging device)	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.

Serial interface

Automatic switch-over when a cable Z 875, Z 391 is connected.

Baud rate	adjustable: 1200, 2400, 4800, 9600 Baud
Type	RS232, bidirectional
Data bits	8
Stop bits	2
Parity	None
Handshake	RTS/CTS+Xon/Xoff

USB interface

Automatic switch-over when a USB cable is connected.

Type	USB 1.1 (device)
Cable length	max. 3 m

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Guidelines and norms used

EMC	EC guideline 2004/108/EC EN 61326-1 Class B FCC Class A
Instrument safety	EC guideline 2006/95/EC EN 61010-1 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	EN 60529

FCC Class A Equipment Statement

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

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

7.2 Measuring ranges, resolution, accuracy

Measuring ranges, resolution

Variable	Measuring range	Resolution
pH	- 2.000 ... + 19.999 - 2.00 ... + 19.99	0.001 0.01
U [mV]	- 999.9 ... + 999.9 - 2000 ... + 2000	0.1 1
T [°C]	- 5.0 ... + 120.0	0.1
T [°F]	+ 23.0 ... + 248.0	0.1

Manual temperature input

Variable	Range	Increment
T_{manual} [°C]	- 25 ... + 125	1
T_{manual} [°F]	- 13 ... + 257	1

Accuracy (± 1 digit)

Variable	Accuracy	Temperature of the test sample
pH / range *		
- 2.000 ... + 19.999	± 0.005	+ 15 °C ... + 35 °C
- 2.00 ... + 19.99	± 0.01	+ 15 °C ... + 35 °C
***U [mV]** / range*		
- 999.9 ... + 999.9	± 0.3	+ 15 °C ... + 35 °C
- 2000 ... + 2000	± 1	+ 15 °C ... + 35 °C
***T [°C]** / temperature sensor*		
NTC 30	± 0.1	
PT 1000	± 0.3	

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

Note
The accuracy values specified here apply exclusively to the meter. The accuracy of the electrodes and buffer solutions has to be taken into account additionally.

Translation of the legally binding German version Stand October 30, 2009

8 Lists

This chapter provides additional information and orientation aids.

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

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

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

°C	Temperature unit °Celsius
°F	Temperature unit, °Fahrenheit
ASY	Zero point (asymmetry)
AutoCal	Automatic calibration using a selected buffer set
Cal	Calibration
CalError	Error message (see WHAT TO DO IF...)
Err1	Overflow Display range exceeded
Err2, Err4	Error message (see WHAT TO DO IF...)
InI	Initialization Resets individual basic functions to the status they had on delivery
LoBat	Low Battery (batteries almost empty)
mV	Voltage unit
mV/pH	Unit of the electrode slope
pH	pH value
S	Slope value
SC	Stability control (drift control)
SELV	Safety Extra Low Voltage
SEr	Serial interface Download of the data memory to the RS 232
SLO	Slope (slope on calibration)
TP	Temperature Probe Temperature measurement active

Glossary

Asymmetry see zero point

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

AutoRange Name of the automatic selection of the measuring range.

Junction The junction is a porous body in the housing wall of reference electrodes or electrolyte bridges. It arranges the electrical contact between two solutions and makes the electrolyte exchange more difficult. The expression, junction, is also used for ground or junction-less transitions.

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.

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).

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.

Measured variable The measured parameter is the physical dimension determined by measuring, e. g. pH, conductivity or DO concentration.

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.

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).

Molality Molality is the quantity (in Mol) of a dissolved substance in 1000 g solvent.

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.

pH value The pH is a measure of the acidic or basic effect of an aqueous solution. It corresponds to the negative decadic logarithm of the molal hydrogen ions activity divided by the unit of the molality. The practical pH value is the value of a pH measurement.

Potentiometry	Name of a measuring technique. The signal (depending on the measured parameter) of the electrode is the electrical potential. The electrical current remains constant.
ORP voltage	The ORP is caused by oxidizing or reducing substances dissolved in water if these substances become effective on an electrode surface (e. g. a gold or platinum surface).
Reset	Restoring the original condition of all settings of a measuring system.
Stability control	Function to control the measured value stability.
Standard solution	The standard solution is a solution where the measured value is known by definition. It is used to calibrate a measuring system.
Slope	The slope of a linear calibration function.

Trademarks used

Trademark	Owner of the trademark
Merck	Merck KGaA
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
Windows	Microsoft Corporation

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Appendix: Firmware update

General information

With the Update_Labxxx_MxxxP program and a PC you can update the firmware of the Lab 870 to the newest version.

- a free USB interface (virtual COM port) on your PC
- the driver for the USB interface (installation see page 40)
- the Z875 USB cable (included in the scope of delivery of the Lab 870).

For the update via the RS232 interface, the following is required:

- a free RS232 interface on your PC
- the RS232 cable, Z390.

Program installation

With the installation program, "Install_Update_Labxxx_MxxxP_Vx_yy_English.exe", install the firmware update program on your PC.

Program start

Start the "Update_Labxxx_MxxxP" program from the Windows start menu.

You can change the language via the language menu.

Firmware update

Proceed as follows:

1	Connect the Lab 870 to a USB interface (virtual COM port) of the PC with the aid of the USB interface cable Z875. or Connect the Lab 870 to a serial interface (COM port) of the PC with the aid of the interface cable Z390.
2	Make sure the Lab 870 is switched on.
3	To start the update process click the OK button. The program automatically recognizes the used interface.
4	To go on, follow the instructions of the program. During the programming process, a corresponding message and a progress bar (in %) appear. The programming process takes approx. two minutes. A terminatory message is displayed after a successful programming process. The firmware update is now completed.
5	Disconnect the meter from the PC. The instrument is ready for operation.

After switching the meter off and on you can check whether the meter has taken over the new software version (see page 55).

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